Ecosystem Concept and Models to support E-Learning 2.0

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Abstract:

Member of our modern society are faced with fast and ever-changing political, social, economical, technological and environmental situations. Consequently, it is expected that members of the society keep pace with these mutable situations, and be able to adapt their skills and expertise. Thus, modern ICT-based learning approaches are required and E-Learning 2.0 is a promising and interesting approach in this context. Although there is an increasing interest in the E-learning 2.0 topic, there is a lack of concrete and sufficient models. In this paper we explore how the notion of ecosystems and existing ecosystem-based models for learning are applicable for E-learning 2.0 approaches.

1 Introduction

It is well documented that our modern society is characterized by rapid developing and ever-changing political, social, economical, technological and environmental situations. Consequently, our society of the 21st century makes great demands on its members in virtually every part of their lives. Members of the society must now keep pace with these mutable situations, adapt their skills and expertise with agility, collaborate and compete to provide value to society.

As a result of this, educational approaches have changed over the last century from remedial repetitive learning to today's learning with an understanding to become more independent in the learning process [1]. Learning is no longer concentrated mainly in the first stages of human life through formal education and specific training in business but becomes a day-by-day routine over human's life cycle. This situation requires new forms and channels in the learning process [2]. Moreover, modern learning approaches must take into account social and cultural aspects as well as the individual's profile including task and role-based aspects, interests, knowledge state, short-term learning objectives and long-term career goals. Not only processing and acquiring knowledge is a key to a modern learning approach, but also content creation, collaboration and community-based practice for knowledge and skills development are important success factors [3] [4]. Learning must be seen as integrated activities which take place over the entire life cycle of the individuals in virtually any part of life, such as educational organizations, business and leisure time. The learning environment must be flexible enough to enable students accessing all relevant resources. [5] [6] Furthermore, learning is not restricted to one learner or a stable pre-defined group. The network of learning agents and sources dynamically changes according to situations and context; it may include individuals, intelligent agents (based on artificial intelligence), communities and organizations such as education institutions, R&D institutions, business and industry, digital libraries, and web resources [2].

Educational approaches have also been influenced by the use of technology over the last decades, such as motion pictures, radio, television, computers and other emerging information and communication technologies (ICT) [7]. Children who grew up with technologies such as Playstations, Wii, iPods, iTunes, iPhone, etc; and mobile technologies are more than likely to apply ICT in virtually any situation. This new generation, termed as digital natives, net generation or generation Y (Gen Y), uses technology as a tool everywhere, and at anytime for any purpose. They are experienced multi-taskers using several media simultaneously for communication, learning and entertainment [8]. Based on already existing Web technologies a "new" Web for easier participation and collaboration has emerged and become popular under the term Web 2.0, a term coined by Tim O'Reilly [9]. Web 2.0 is more a concept than a new technology which addresses aspects of (1) Web technologies as a platform, (2) specific types of services and applications built on top of Web 2.0 technologies, and (3) specific kind of development approach [10].

Influenced by the situation outlined so far, ICT-based learning environments have analogously matured from content-centred, centralized and more static learning systems of the e-learning 1.0 era to enhanced approaches which have become popular as *e-learning 2.0* by Stephen Downes [11]. Unlike the content-centred approach, e-Learning 2.0 is seen as a people-centric approach [12]. Although there is no widely accepted definition of e-Learning 2.0, characteristics includes blurring roles of teachers and students, the collaborative nature of learning, transfer of pre-existing knowledge to recipients (the students), strong focus on content sharing, syndication, reuse and re-purposing, adaptation as well as personalization [12] [13]. Stephen Downes summarized these characteristics in a very abstract from as a platform which is built on knowledge exchange in a learning network [14].

We believe that the e-Learning 2.0 attributes and characteristics could be a key for moving towards modern ICT-based learning approaches. Although the increasing interest in the e-learning 2.0 topic in diverse blogs and conferences, there is a lack of concrete and sufficient concepts, models and architectures. Such complex situations in learning settings requires appropriate attention in the most important dimensions, namely (1) the learning content, (2) the learning process, (3) the learning community, (4) the organizational aspects, and (5) the technological aspects. In particular the high complexity of the environmental conditions, the need for collaboration and competition, and therefore the high dynamic of changing relations between members of the learning community, sources and services must be appropriately considered. These characteristics of modern learning settings, comparable with the situation in biotic ecosystems, have motivated us to start research for a holistic ecosystem-based model for learning and e-learning [15].

In this paper we explore how the notion of ecosystems and how existing ecosystem-based models for learning and e-learning are applicable to E-learning 2.0 concept. This paper is organized as follows: An introduction into the ecosystem conception and application domains are briefly outlined in Section 2 and followed by ecosystem-based theoretical models for learning and e-learning in Section 3. Finally, in Section 4 the applicability of these models for E-learning 2.0 approaches and future work will be discussed.

2 The concept of Ecosystem and Application Domains

The basic concept of ecosystem was first introduced by a British ecologist A.G. Tansley. Tansley [16] defined an ecosystem in 1935 as a *"community or assemblage and its associated physical environment in a specific place."* However, Tansley's initial definition does not

explicitly mentioned interrelation and interaction. The term 'system', borrowed from the physics domain by Tansley, implicitly highlights the interaction between the living and non-living components. Today the definition according to the Encyclopedia Britannica defined an ecosystem as a "*complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space.*"

As a fundamental example, a natural ecosystem is a biological community of interacting organisms and their physical environment [17]. The interactions between the living and non-living components within an ecosystem may include a high level of complexity and it may also include a nested hierarchical structure. In addition, the ecosystem can be of any size as long as a symbiotic relationship and interactions exist between organism and the physical environment [18].

Using the power of the generic definition of ecosystem is its applicability to any system, and incorporating the interactions between living and non-living components of an ecosystem. To be more specific, a model indicating the adaptation of ecosystem is required for a particular application domain. Some of the features of a concrete model are defined by external aspects, and other features emerge from within the system. In order to describe a particular instance of a model, the following characteristics have to be specified: (1) the living and non-living components as well as proper level of aggregation, (2) the temporal extent and the temporal and spatial scale, (3) the physical boundaries of the system, (4) the description of type and extent of relations and interaction between identified components, and (5) constraints on system behaviors [18].

Given these insights, it is obvious that the model of the ecosystem strongly emphasizes a holistic approach highlighting the significance of each component, their behaviours, relationship and interactions, as well as the environmental borders in order to create a new system or examine an existing system, or form an effective and successful system. Pickett and Cadenasso assert in 2002 that ecosystems can be widely applied to humans and human-generated processes and structures [18].

It is this fundamental ecological concept covered by the ecosystem and its applicability to various application domains as well as the exciting and interesting holistic approach that led us to transform the idea of the ecosystem in the learning domain. The following section explores the applicability of the ecosystem approach for e-learning 2.0.

3 Ecosystem-based Models applicable for E-Learning 2.0

In 2004 Frielick [19] proposes an ecosystemic approach for teaching and learning which goes beyond the constructivistic approach and moves towards the enactivistic approach. The idea is based on the notion of ecological epistemology where the individual mind is just a part of a larger interconnected web of mental processes. Based on that the key idea is that the teaching and learning process is *"ecosystemic process of transforming information into knowledge, in which teacher, subject and student relationships are embedded or situated in a context where complex interacting influences shape the quality of learning outcomes."* Consequently, the ecological model outlined in Fig. 1 focuses on the learning and teaching activities on different levels (on the inter- and intra-personal level, or on department and on institutional level). It also addresses the different tasks in the learning process (course design, teaching mode, assessment and evaluation) and takes into account teaching objectives, pedagogical strategies, learning methods and learners' preferences.

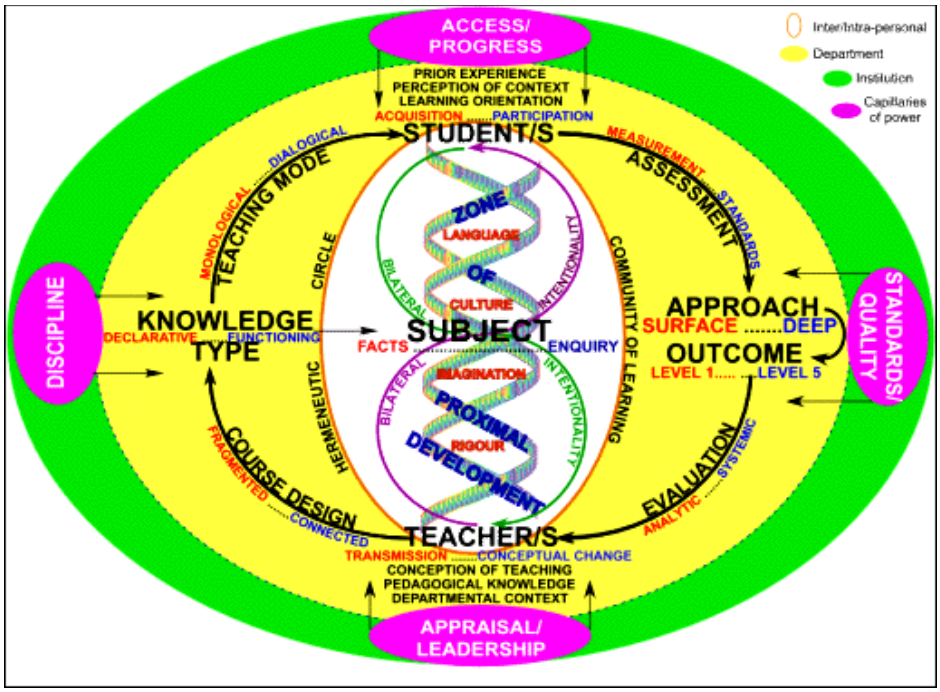

Fig. 1: Ecological model of learning and teaching from [19]

The ecological model of learning and teaching as shown above is a complex web of interaction. Learning and the development of knowledge and understanding emerge from the complex interactions between the different parts as information travels around the physical and mental pathways that constitute the total ecology of mind or mental system. According to Frielick in [19], e-learning can at best assist learners to a level of competence. In order to gain expertise or deep learning in the ecological model as illustrated above, can only be gained in the real presence and engagement with a master or expert.

Another framework is that of Sedita published in 2003 [20] who aims to understand the dynamics of the learning process of modern learning settings. The motivation for this framework was the interest on knowledge transfer and learning in companies. In particular the innovation process based on this knowledge flow was seen as an ecology process. Although the notion of ecology process has been used no theoretical background has been provided in this initial paper. Pilotti and Sedita extend this work by explicitly broaden their views of learning ecology [2].

Pilotti and Sedita in [2] identified requirements which addressed multiple dimensions of modern learning processes. This might include different forms of learning on individual and group level, the need for interacting in evolutionary contexts, dynamically linking individuals to other individuals and content, and the need for education in intra-firms, inter-firms and trans-national educational systems. Although these broad requirements have been identified, the framework is only very focused on four aspects of a learning ecology (see Fig. 2) being (1) type of learning, (2) agents involved, (3) types of education, and (4) channels of education.

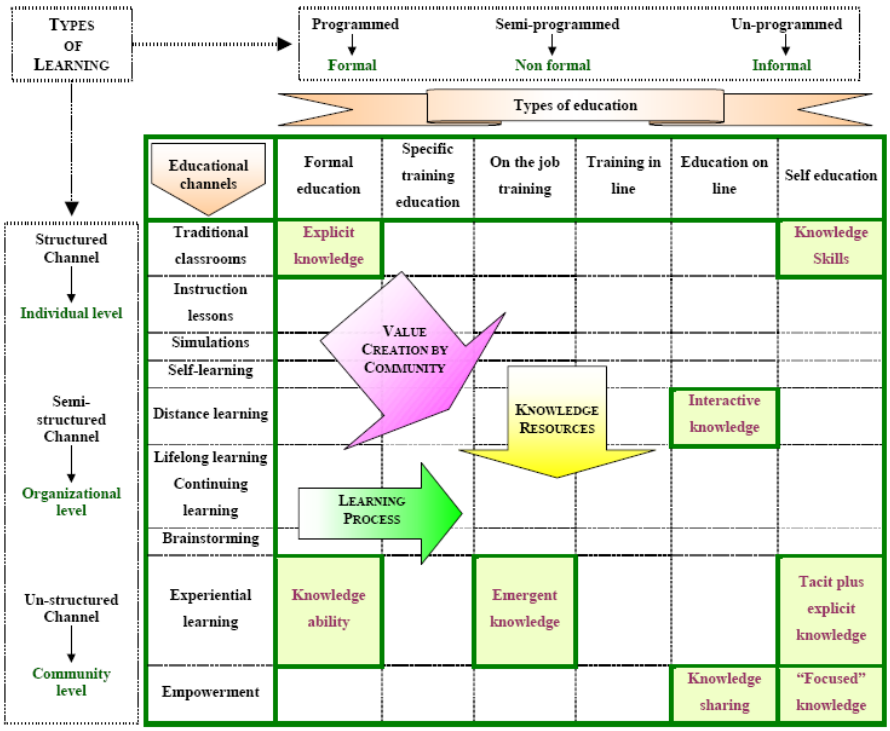

Fig.2: Extended framework depicting the relationships between types of learning between knowledge transfer and channels of education from [2].

Collier, Piccariello and Robson focus in 2004 [21]on another important aspect for learning 2.0 approaches. They provide a model for digital rights management for modern educational settings where a huge amount of learning content from diverse sources, partly collaboratively created, need to be handled. The authors argue that the management of intellectual property rights cannot feasible managed by ad hoc or proprietary methods. Thus they proposed a digital rights management ecosystem model as depicted in Fig. 3. It outlines a set of groups, applications and services involved in the process as well as intelligent property right aspects are linked to them.

The model includes six components: (1) *rights management environment* describes the logical borders and determines the context. This environment is defined by law, policy, practice, market mechanism, organizations, roles, and community expectations. (2) *Actors* subsume people and organizations to whom are rights applied. The key actors include authors, publishes, librarians, repository manager, faculty and students. (3) *Content life cycle* includes the processes of creation, distribution, acquisition and use of content. Digital rights management is seen as integrative part in these processes in content management. (4) *Tools and applications* address software which support the content life cycle, and consequently is also affected by the rights management. It comprises authoring tools, content repositories, learning management and delivery systems, and personal computing environments. (5) The rights management processes themselves are organized in the model into four parts: defining rights, distributing and acquiring rights, enforcing rights and tracking usage. Finally, (6) *standards and services* are seen in the model as the component which provides the technological context of digital rights management. It is typically strongly linked to other infrastructure of organizations.

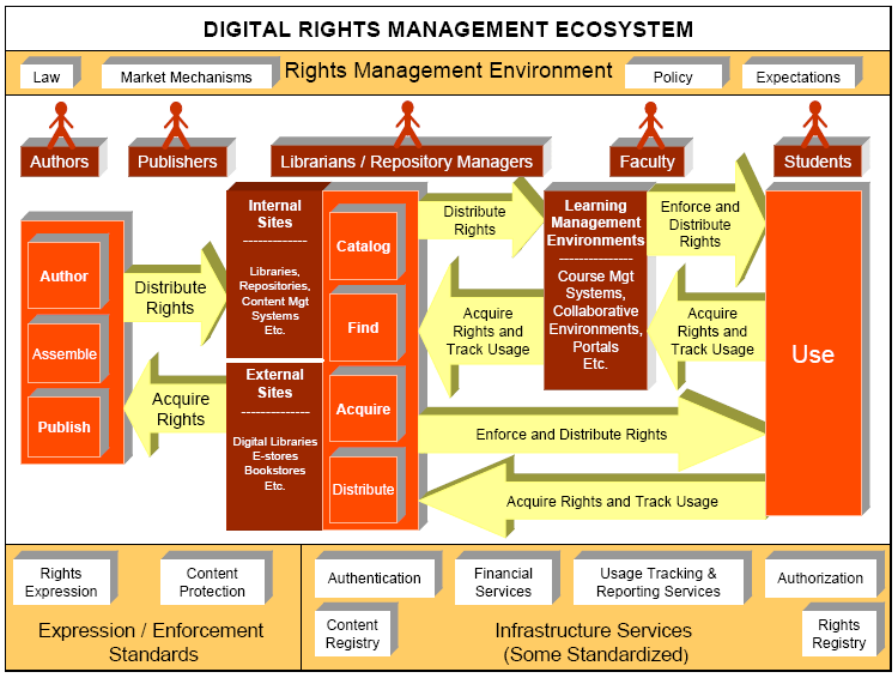

Fig 3: Digital Rights Management Ecosystem for educational community from [21]

This particular model is developed to be used to identify the concrete rights management aspects of a given ecosystem. The procedures include identifying the actual situation of the ecosystem in the aforementioned six components and based on that, identify the functionality gaps need to be filled.

Another approach for modern learning settings has been introduces by Chang and Gütl in 2007 which captures stakeholders as well as artifacts and resources [15]. This approach is based on the original notion of ecosystem as outlined in the previous section. In a generalized view an ecosystem is classified by living and non-living components and all their interrelationships in specified physical boundaries. Transforming that to the learning domain, Chang and Gütl proposed the definition of ***learning ecosystem (LES).*** LES consists of the stakeholders incorporating the whole chain of the learning process and the learning utilities, the learning environment, within specific boundaries, which the authors call learning environmental borders.

Given the abstract definition stated above, a first generic model for learning situations is outlined as follows, see also Fig. 4. As the biotic or living units in the ecosystem the *learning communities and other stakeholders* such as teachers, tutors, content providers, instructional designers and pedagogical experts, form the living parts of the learning ecosystem. The *learning utilities* comparable to the abiotic or non-living units (or the *learning environment* comparable to the physical environment) represent the non-living parts, which include the learning media (content and pedagogical aspects), technology, and tools applied in traditional teaching methods. The *learning environmental boundaries,* an analogy to the specified physical boundaries of the ecosystem defines the physical and logical borders of the learning system. That is one of the system's characteristics, which are in common specified as the *learning ecosystem conditions*. These conditions are determined by external and internal influences, such as evolution of knowledge, educational goals, learning tasks, cultural and sociological aspects, and expectations by society, private industry and business organizations, the government, public service and not-for-profit organizations.

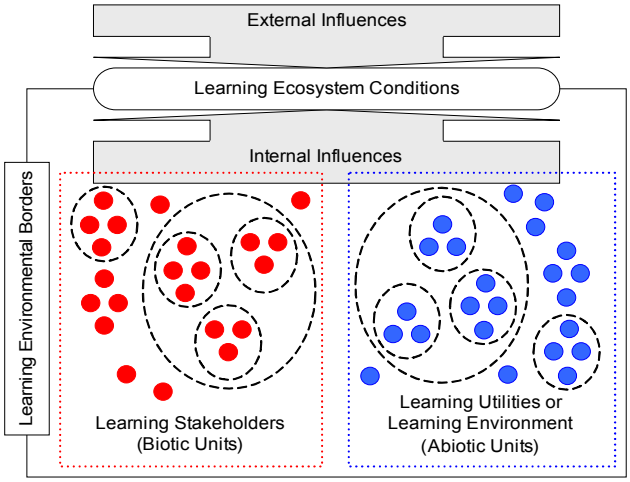

Fig.4: *Simplified representation for the learning ecosystem (LES) from [15].*

The main interests in the learning domain are relationships and interactions related to the information flow as well as knowledge transfer and transformation. In light of this, some conclusions are identified. Like a biological ecosystem, in a learning ecosystem, individuals can form groups spontaneously and can interact with each other or with learning utilities at the individual or group level. They also can perform, change or adapt specific behaviors in order to contribute to or perturb to the success of the learning ecosystem. Changes in the learning ecosystem conditions influence the "behavior" of the system and its components. To be successful and to be valuable for the system, each individual and group must adapt to the environmental conditions to find their niches. In order to fit them all together, proper learning utilities must also be available.

The authors also emphasize that the generic view of the learning ecosystem can be applied to any learning situation, such as traditional face-to-face teaching in classrooms or e-learning in business environments. This is to assert that in any learning situation biotic and abiotic components or cluster of components, their relationships and interactions together with the ecosystem's conditions have to be considered. Furthermore, the biotic and abiotic components as well as the learning environmental borders and the other conditions of the learning ecosystem are in principle dynamic. This generic view helps to get a better picture about a specific learning situation, and allows educators and practitioners to achieve a more holistic approach for the development of more effective learning.

By restricting the system's conditions of the proposed learning ecosystem to the e-learning domain it can be constricted to an ***e-learning ecosystem (ELES)***. This allows educators and practitioners to identify and examine (a) the specifics of the learning communities and other stakeholders, (b) the more specific learning utilities, and (c) the more restricted learning ecosystem conditions.

4 Conclusions and Future Work

In this paper we have shown that learning must be seen as integrated activities which take place over the entire life cycle of the individuals in virtually any part of life. Learning is not restricted to one learner or a stable pre-defined group. The network of learning agents and sources dynamically changes according to situations and context; it may include individuals, computer-based agents, communities and organizations. Furthermore, not only processing and acquiring knowledge is a key to a modern learning approach, but also content creation,

collaboration and community-based practice for knowledge and skills development are important success factors. Consequently, the learning environment must be flexible enough to support the above mentioned situation.

In addition, we have outlined that ICT-based learning environments have analogously matured from content-centered, centralized and more static learning systems of the e-learning 1.0 era to enhanced, people-centric approaches which have become popular as e-learning 2.0. Characteristics includes blurring roles of teachers and students, the collaborative nature of learning, transfer of pre-existing knowledge to recipients, strong focus on content sharing, syndication, reuse and re-purposing, adaptation as well as personalization. The most important dimensions of an e-learning 2.0 environment which need to be considered are (1) the learning content, (2) the learning process, (3) the learning community, (4) the organizational aspects, and (5) the technological aspects. Although e-learning is becoming increasingly popular, to our knowledge no sufficient concepts, models and architectures for researching and developing e–learning 2.0 applications are available so far.

Furthermore, we have explored and shown that the notion of ecosystem which is based on a fundamental ecological concept is applicable to describe and model techno-social systems in various application domains. The idea of the ecosystem is also an exciting and interesting holistic approach which can be applied in the learning domain. A selection of ecosystem-based models for learning situations and application has shown that each of the models covers partly the above mentioned dimension of the learning environment but none of the models addresses sufficiently all dimensions.

In order to better support research, development and evaluation of e-learning 2.0 applications and environments, we will work on a framework which combines and extends existing ecosystem-based models and will provide guidelines which of the aspects will be covered by specific models and how to apply them.

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