Universidade do Porto
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Doctoral Programme in Informatics Engineering

PhD Research Proposal

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Title thesis

Adaptive Learning Environments with Knowledge Representation and Social Interaction

Research Topics

Web based learning environments and interfaces, instructional design, knowledge communities ,social networks,tagging, argumentative maps.

Research Questions

1.- People can use computers in collaborative learning environments, while constructing knowledge.

a) How web systems might improve the computer's usability in learning processes?

b) How do students interact with the learning community to develop knowledge?

2.- How can a system that organizes structures and navigates through web content, reinforces the collaborative learning?

Abstract

This report partially fulfils the definitive registration on the doctoral programme in informatics engineering at Engineering Faculty of Porto University, Portugal. The main topics of this research study are Web learning environments with collaborative support and semantic social networks.

In concrete, the main issue is design a learning system that structures knowledge with visual representation and navigation. To implement it I will use AJAX and PHP. However, before designing and implementing it I must study the learning theories to support the system architecture, as well as the human and social dimensions which learning requires.

Therefore, this report, divided in three parts, firstly deals with the motivation factors, namely: the phenomena description, the learning paradigm, the participation, the evolvement and empowerment. Also presents the thesis statement. After that, it describes the state of the art in a learning and technology perspective. Finally, it describes the PhD research proposal, the work plan and the proposed learning tool.

The product to be developed is twofold, it will use (1) trees of knowledge which are directly related to how knowledge is structured, visualized, distributed, stored and shared; will apply (2) the theory of connectivism, which asserts the learning of knowledge in a distributive manner, based on a network of connections formed from experience and interactions with a knowing community. After being constructed, a class of high school students will validate the proposed tool.

By combining trees of knowledge with semantic social networks, we are in fact trying to perform a true collaborative learning environment, where students and teachers will actively interact towards wisdom.

Keywords:

E-learning, Conectivism, Semantic Social Networks, Computer Supported Collaborative Learning, Web-based environments.

ACM Classification Keywords:

H.5.3 [Group and Organization Interfaces]

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1. Introduction

The World Wide Web has definitively changed the way people interact with information and it has not stopped yet. We are assisting to the massification of internet and at the same time new usages appear. (O'Reilly 2005) mentioned that with the web 2.0 the future is here, we have just to distribute it. Moreover, the youngsters, the net generation, look at the web with close proximities perspective. In contrast, adults, who have some paradigm barriers, have difficulties to see the scope involved. However, I am sure the web can be an interesting meeting point for all people, despite their age, social or cultural background. In fact, there are several interesting web sites where grandparents and grandchildren work together. Therefore my goal is to develop an e-learning system, providing web services, but with simplicity enough to intermediate on a cyclic social construction of knowledge between individuals and communities.

The proposed learning environment should therefore have the web as a platform and get advantage of the learner's web familiarity, providing tools to maximise the learning effort in community cooperation, having some guiders, namely the teacher, acting as a coach.

This is a difficult task because learning is a complex activity, which relates many fields, such as education, psychology, sociology and technical approaches. However, the proposed work is more concerned with technology usage. In fact, the main propose of this study is, based on connectivism learning theory, to develop a simple and yet powerful web learning tool for collaborating students. I intend to build an online environment that affords new learning opportunities for users and later on validate it in a high school context to see its effectiveness on the teenager student's side and on the teacher's side.

Why develop another web tool for learning? The number of sites and tools available never stops growing and undoubtedly, some of them are very interesting to use. Nevertheless, I want to put in practice my own learning approach based on my own experience as a teacher.

This approach explores learning environments with use and reuse of learning resources, based on the user's interactions. The learners will have an active role on the learning process, rather than a passive one. They will collect data around a specific topic and will structure the data in a tree form. Later on, they can compare and merge it with other user's collections, usually their own class members. The idea is also to use an argumentation stage, where all users could participate and get involved. Therefore, the learning system will have two possibilities: collect and discuss. Of course, this system is intended to be used in a class scenario, but the users will be able to use it in any learning scenario with or without face-to-face involvement.

My past research has started by analyzing the existing difficulty in the internet for search, organization and relation of diverse topics of a determined knowledge area, where no aggregation exists. After that, I headed towards the understanding of what are the ingredients in a learning web system in order to have an active role in school. Surprisingly the web 2.0 provides interesting engineering solutions, as well as some possible answers to the fact that e-learning systems did not manage to change the learning paradigm. (Downes 2006) references a second version of e-learning systems, where all actors of learning, namely teachers and students will actively get involved, reaching critical thinking.

After having done some initial research on these matters, I proposed, on January 2006, an e-learning web architecture (Silva and Restivo 2006a), appealing to the use of web semantics in learning contexts. Also a poster, with this approach was presented on April 2006 (Silva and Restivo 2006b), where some ideas were clarified. However, a major contribution to the present work was possible after the attendance of a particular workshop. It was about pedagogical perspectives with argumentation visualization techniques for collaborative environments. My core idea has then changed. First, the idea was to use ontologies as a formal representation of knowledge with the possibility of dynamically integrating distinct ontologies from different users (same knowledge domain) and visualizing this integrated knowledge as a single dynamic pedagogical ontology. Now the ideas of social networks applied to knowledge construction and argumentation usage highlight my path. In order to merge all these ideas I wrote and presented a study on September 2006 (Silva and Restivo 2006c).

Now, my research is heading towards two seminal ideas: the formal representation of knowledge and collaborative environments with social networks. For the first, a simple architecture might be appropriate for organizing data, such as learning contents, and define the relationships between data. Ontologies might have an interesting usage for that and for interoperability issues, but with a simple semantic approach (tagging, for instance) we can well structure the information. Of course, knowledge is not only simple facts, but also the relationship between them and that must be taken into account when designing the learning system architecture.

One of the big research questions is related to how a system organize, structure and enable navigation through web content and (re)used. The collaborative environments with social networks enhanced by knowledge acquisition and, in particular, the theory of connectivism can contribute with the answer solution.

(Downes 2006) gives reference to the newly empowered learner, the member of the net generation, who will give more focus to learning systems based on conversation, interaction, sharing, creation and participation. He regards learning not as a separate activity, but rather as embedded in meaningful activities such as games or workflows. The new e-learning 2.0 systems go in this direction because they comprise resources and services organized in order to offer learning opportunities in a network environment.

On my research, there have been other references too. I must refer the (Kaleidoscope SIG of European CSCL), Special Interest Group in Computer Supported Collaborative Learning, which supports learning activities and considers scripts usage for facilitating

social or cognitive processes in collaborative learning environments. And also (Kaleidoscope VDS and ICO course on CSIL), Virtual Doctoral School on Computer Supported Inquiry Learning, which involves PhD students in an active engaged and constructive learning process. In fact, I realised with CSIL students enable the investigation of a domain only by building questions in a collaborative environment. They actually learn about it and build complex inquiry skills. Several learning systems have been developed, such as the EU-project (WISE 2006), (Co-Lab), (Inquiry Island) and (Cool Modes) to prove this claim.

I must also refer a previous research initiative within the (NoE Kaleidoscope) about argumentation, introduced in a Virtual Doctoral Course, (VDS on argumentation in science education).

In the next section, there are some key factors for my e-learning thesis, where students will have an effective tool for socially construct knowledge interrelations, rather than an e-learning solution with only readable content management.

In order to understand the strands and stay tuned with recent research done by the international community, a continuous state-of the-art has started to be written, which is presented on chapter three. It focuses two distinct areas: Learning and technology, where both have very close relations, as I pinpoint in subsection five of state-of-art. I also refer some tools, web technologies and interesting projects, some very popular, as we can state on (Google Zeitgeist) search statistics, while others definitively will soon be known.

After that, section four describes the project approach, the tests and validation methods with the tool to be developed in a real situation. Of course, this software will be free for others to use and it will always be a beta version.

By shaping the way learners interact with each other, the tool will expectably be an effective learning system.

2. Motivation

My research proposal starts with the premises that students learn effectively if they have substantial control over the way in which they organize or control their pace; and learning is a socially constructed activity among student's peers and teacher coaching. Several motivation factors will have an important role; however, after shortly describing the learning phenomena and paradigm, I will describe three of which I consider most important. At the end, I present the thesis statement of my work.

2.1 Phenomena description

When students engage in learning community processes, they create, appropriate, share and construct knowledge within a specific group. With co-working, students can break some barriers and minimise the learning difficulties. Therefore, social evolvement reinforces learning.

However, schools are a place where active learning, with collective knowledge construction in favour of individual learning, not always take place. In addition, students can have an independent role in the classroom using their teachers as coaches, not deliverers of knowledge. In these cases the learning paradigm remains. Paradoxically, those eager for change often resist their teacher's attempts to transfer responsibility for learning in new ways. One approach to change this strand is teachers providing scaffolding to students in order to increase student's autonomy. Another one is to enable students to work together and solve their divergences with mutual interaction. When students really have the chance to practice, making responsible decisions as a group and feel autonomy, they take a major step towards adulthood in a democratic society.

In fact, with critical dialogues and the evaluation of various points of view students learn how to disagree productively, how to reach consensus on general principles or guidelines, and how one person's freedom to choose is limited by obligations to the group. This habit takes on new dimensions, as students begin to play a more active role in their own governance.

As students begin to take ownership of their learning, both in the classroom and in governance, they look for support to others in the same position. With student involvement in learning activities, with control over their own learning and with teachers to coach and guide, is half way towards the success of learning acquiring. Furthermore, students will see their self-respect increasing, because they will know their value by themselves. They will be able to make smart decisions, use good judgment, and use their mind as well.

By knowing what others think and how to use the mind and how to learn from social interaction, students will undoubtedly learn more and with more fun.

However, the teacher cannot stop being vigilant. With inquiry activities and assessments, the teacher will monitor student's development, not as a supervisor, but rather as a coach. The students will become involved citizens, self-directed achievers and collaborative contributors.

Of course, the individual is crucial for the success of empowering learning along with willing and motivation. Also the organizational learning units/systems, namely schools, interrelate the authority, the competence and the resources required for learning activities. Nevertheless, I am more concerned with the social dynamics among student peer's facilitators and teacher coaching rather than other organizational school issues.

2.2 Learning paradigm

What does a paradigm mean and what is its importance in learning? Well, a paradigm is a model, a perspective, a value system, a frame of reference, a filter, or a worldview that guides one's actions. It has the power to influence our perception.

New paradigms are appearing into our society, due to the abrupt changes in information systems and the emergent spin-of web technologies, namely web 2.0.

Therefore learning itself must modify, adapt and incorporate these push-ups. However, it is not enough to create a new paradigm. If the education community does not see its potential and misses the window of opportunity, it would be in paradigm paralysis. This might happen just because of their mindset, which prevents from perceiving the entire significance. It is possible to see a new technology and completely miss its true significance. This is because our paradigm is only either ready or equipped to deal with our current perspectives (Ted McCain and Ian Jukes 2000).

However, while web platform has evolved into a 'read-write' web (O'Reilly 2005), learning is changing into e-learning 2.0, where content is used rather than read (Downes 2006).

The model of e-learning, where content is produced by publishers, organized, structured into courses and consumed by students, has migrated to an online learning content-authoring platform, where learning is created rather than read. It is more likely to be produced by students than author's courseware. In addition, the structural content is more likely to resemble a language or a conversation rather than a book or a manual.

The model is a radical departure from what e-learning had looked like for a while. However, do you remember your first experience with the Internet? Was it or not a new paradigm you welcomly embraced? By relying on the present web paradigm, we are blind to the true power of the new web 2.0 systems. This is a critical mistake and new learning mechanisms should not be compromised by the actual paradigm. Because of their oversight, the entire success of learning in future can come out compromised.

A growing community of educators and developers has been gathering around a model of online learning - Personal Learning Environment or PLE (Scott's Workblog 2006), which would give the learner greater control over their learning experience by managing their resources, the work they have produced, or the activities they participate in. They would constitute their own personal learning environment, which they could use to interact with institutional systems to access content, assessment, libraries for instance.

Another interesting model is based on Virtual Labs Environments, (Co-Lab), acting as a content repository, with cognitive tools associated and also with chat. It brings together, in an integrated way, collaborative and domain modelling, where guidance for learners is available.

The key to success lies on how we perceive and apply the new technologies. It is time for education to catch up by delivering new skills for students and new roles for teachers in this search for wisdom.

2.3 Participation

Learning environments are changing from a presentation to a participation paradigm. However, what is participation all about? While interactivity is a property of the technology, participation is a property of culture. So what are participatory cultures? Today many teens create media content or share content they produce. They are actively involved in participatory cultures.

A participatory culture is a culture with relatively low barriers to artistic expression and civic engagement, strong support in creating and sharing one's creations, and some type of informal mentorship whereby the knowledge acquired by the most experienced is then passed along to novices. Not every member must contribute, but they all feel some degree of social connection with one another. All members are free to contribute when ready and what they contribute will be appropriately valued.

In fact while to adults, the Internet primarily means the World Wide Web, to children it means email, chat, games and here they are already content producers. These communication and entertainment-focused activities enable children to engage in multi-tasking, becoming proficient at navigation and manoeuvre to win, judging their participation and that of others. In terms of personal development, identity, expression and their social consequences, participation, social capital, civic culture are the activities that serve to network today's younger generation (Livingstone 2003).

Participatory culture is emerging as the culture that absorbs and responds to the explosion of new media technologies that make it possible for average consumers to archive, annotate, appropriate, and re-circulate media content in powerful new ways. A focus on expanding access to new technologies carries us only so far if we do not also foster the skills and cultural knowledge necessary to deploy those tools toward our own ends.

Forms of participatory culture include:

> **Affiliations** -memberships, formal and informal, online communities centred around various forms of media, such as: Friendster, Facebook, message boards, metagaming, game clans, or MySpace.
>
> **Expressions** -producing new creative forms, such as: digital sampling, skinning and modding, fan videomaking, fan fiction writing, zines, mash-ups.
>
> **Collaborative Problem-solving** - working together in teams, formal and informal, to complete tasks and develop new knowledge, such as through Wikipedia, alternative reality gaming, spoiling.
>
> **Circulations** - Shaping the flow of media such as: podcasting, blogging.

A growing body of scholarship suggests potential benefits of these forms of participatory culture, including opportunities to peer-to-peer learning, a changed attitude toward intellectual property, the diversification of cultural expression, and a more empowered conception of citizenship. Access to this participatory culture functions as a new form of hidden curriculum, shaping which youth will succeed and which will be left behind as

they enter school. Some have argued that children and youth acquire these key skills and competencies on their own by interacting with popular culture. Three concerns, however, suggest the need for policy and pedagogical interventions:

> **The Participation Gap** - the unequal access to the opportunities, experiences, skills, and knowledge that youth will need for full participation in the world of tomorrow.
>
> **The Transparency Problem** - the challenges young people face in learning to see clearly the ways that media shape perceptions of the world.
>
> **The Ethics Challenge** - traditional forms of professional training and socialization involved in the young people education are breaking down. These youngsters are increasingly having public roles as media makers and community participants.

Educators must work together to ensure that every young person has access to the skills and experiences needed to become a full participant, can articulate their understanding of how media shapes perceptions, and has been socialized into the emerging ethical standards that should shape their practices as media makers and participants in online communities. Schools as institutions have been slow to react to the emergence of this new participatory culture; the greatest opportunity for change is in after school programs and informal learning communities. These must devote more attention to fostering the new media literacy: a set of cultural competencies and social skills that young people need in the new media landscape. Participatory culture shifts the focus of literacy from one of individual expression to community involvement. The new literacy involves social skills developed through collaboration and networking.

The new skills include:

> **Play** - the capacity to experiment with one's surroundings as a form of problem solving;
>
> **Performance** - the ability to adopt alternative identities for the purpose of improvisation and discovery;
>
> **Simulation** - the ability to interpret and construct dynamic models of real-world processes;
>
> **Appropriation** - the ability to meaningfully sample and remix media content;
>
> **Multitasking** - the ability to scan one's environment and shift focus as needed to highlight details;
>
> **Distributed Cognition** - the ability to interact meaningfully with tools that expand mental capacities;
>
> **Collective Intelligence** -the ability to pool knowledge and compare notes with others toward a common goal;
>
> **Judgment** - the ability to evaluate the reliability and credibility of different information sources;

Transmedia Navigation - the ability to follow the flow of stories and information across multiple modalities;

Networking – the ability to search for, synthesize, and disseminate information;

Negotiation – the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping or following alternative norms.

Students acquire the skills they need to become full participants in our society (Jenkins, Clinton et al. 2006).

2.4 Involvement

Active involvement is a key issue on the learning processes and on the knowledge generation. It refers to the amount of physical and psychological energy that the student devotes to the academic experience. Furthermore, involvement occurs along a continuum; that is, different students manifest different degrees of involvement in a given object, and the same student manifests different degrees of involvement in different objects at different times. It has both quantitative and qualitative features. The extent of a student's involvement in academic work, for instance, can be measured quantitatively (how many hours the student spends studying) and qualitatively (whether the student reviews and comprehends reading assignments or simply stares at the textbook and daydreams) (Astin 1999).

The teachers cannot force active involvement. They cannot impose their approach on students whose perceptions of reality run contrary to theirs. However, they must feel obligated to share their views with such learners to promote awareness of alternative ways of thinking, communicating and acting in school. However, they must not be naive. Many pupils are and will remain passive and dependent upon when taught. Others will certainly resist any learner-centred method. A few will become defiant, or defiantly indifferent.

For dependent students, learning is, and will continue to be, teacher-centred. Either they will treat teachers as experts, who know what the student needs to do, or they will passively slide through the educational system, responding mainly to teachers who "force" them to learn. They do not like the uncertainty associated with choices; they feel insecure in a context not rewarded by compliance; they feel anxious if communication is not mainly one-way.

Nevertheless, if there is an active involvement of young people in activities and decisions that are interesting, they might act differently. If there is no defined road but rather some exploration activities, they will look at it. In addition, the social involvement is crucial. If a colleague has enrolled, he or she will go next. Recent studies based on inquiry learning, (S. Manlove, A.W. Lazonder et al. 2006), revealed that essential questions designed to provoke collaborative inquiry by students and teachers on proposed topics and/or themes, really change the students involvement.

Students with some freedom to choose which activities they want to investigate and pursue essential questions are a nice commitment between the two types of learners (active, passive). Furthermore, assessments connected to the activities pushing the inquiry deeper and requiring students to reflect critically and demonstrate understanding show interesting changes on student's attitudes towards the levels of commitment.

2.5 Empowerment

Empowerment implies a culture of continuous innovation in learning. It relates the amount of control that students believe themselves to have over their studies; the extent to which they are involved in decision-making and their levels of confidence at school. Through empowerment, students are able to manage and adapt, to change and contribute to generate changes in their lives and environments.

However, students must have a high "intrinsic task motivation" or perceive themselves to be empowered for them to succeed.

There are four possibilities:

One: *Meaning* done to the work carried out by the person. Effective teacher supervision can enhance it more.

Two: *Competence* associated with the student's work role. Feedback teacher on performance or encouraging the work performance enhances the feelings of competence.

Three: *Impact on* the student's work might have in the future.

Four: *Self-determination* the student has to accomplish the learning objectives. He or she can decide on the order and pace of work.

Furthermore external context and students reactions to reality, play an important role in their empowerment. Students must have an active rather than a passive orientation to school. Being active students, they will respond favourably to learning opportunities and are subject to a greater variety of experiences through which to question and re-shape existing thought processes (Thomas K. and Velthouse B. 1990).

2.6 Thesis Statement

This research is deeply concerned in understanding how people can use computers in collaborative learning environments, bringing people together, while constructing knowledge. In addition, the question of how web systems might change the computer's usability in learning processes is very important. Nevertheless, the underlying question is: how do students interact with the learning community to develop knowledge? The complex brain activity can find a link to social networks in web systems and trigger the learning action. It would be possible for students and teachers to interact in learning

environments and dynamically participate in the learning process. These systems should add some value to traditional systems, instead of simply mapping them, as a single copy without anything different.

The importance of complementing real class dynamics with web supported learning environments is my hypothesis. Will we reach any benefit by using both systems? Will the active participation of students increase in an environment that has some levels of freedom in exploring the matters to learn? Or will they disperse more, not building bridges between subjects and not profiting with co-working, which will result in a waste of time? These are my starting point issues I hopefully can have an answer at the end of my PhD research.

3. State of Art

This literature review is organised in six parts. Firstly, I will refer some learning theories (constructivism, cognitive apprenticeship and connectivism*)*, environments and argument mapping. Then I will focus on some learning tools, such as forums, quick polls and surveys, e-portfolios, blogs, wikis and podcasts. Next, I will present some technological aspects, namely the semantic web and web 2.0. In particular, I will give emphasis to web feeds, Ajax with Php as well as social software. The purposes of these studies are to give a sustained background to my future doctoral proposal of developing a collaborative software-learning tool. That is why I give particular attention to structuring information, one of my thesis key issues. Finally, I will compare e-learning 2.0 with web 2.0.

3.1 Learning theories

The creation of instructional environments involves learning theories on their architecture and technological tools for their construction. However, for now, the main importance lays on learning theories and not on technological solutions.

The learning theories of Behaviorism, cognitivism, and constructivism although used as theory background, do not reflect the technology impact on learning.

In the last twenty years, technology has drastically changed how we can communicate, how we learn and innumerous other aspects of our lives. In addition, the knowledge life in many fields is shortening, due mainly to its exponential growth. Also today, formal education is still relevant, but students' informal learning is very important and influences a lot. This occurs in a variety of ways – through communities of practice, personal networks, and through completion of work-related tasks.

When (Driscoll 2000) defines learning as a persisting change in human performance or performance potential, which must come about as a result of the learner's experience and interaction with the world, he encompasses many of the attributes commonly associated with behaviorism, cognitivism, and constructivism.

We might compare these three theories with the epistemological traditions in relation to learning: Objectivism, Pragmatism, and Interpretivism.

> Objectivism is similar to behaviourism, it states that reality is external and objective, and that knowledge is gained through experiences.
>
> Pragmatism is similar to cognitivism and states that reality is interpreted, and knowledge is negotiated through experience and thinking.
>
> Interpretivism is similar to constructivism and states that reality is internal, and knowledge is constructed.

However, all these learning theories state that learning occurs inside a person. Even social constructivist views, which hold that learning is a socially enacted process, promote the principality of the individual in learning. These theories do not address learning that occurs outside people.

These learning theories are concerned with the actual process of learning, not with the value of what is to be learnt. In a networked world, the very manner of information that we acquire is worth exploring. An entirely new approach is needed and it includes technology and connection with new learning activities, making learning theories move towards into a digital age.

As an answer to these same issues (Siemens 2005) presented connectivism, which unify chaos, networks theory and complexity, yielding a new theoretical framework for explaining not only individual but also social and organizational learning processes. This learning theory goes beyond the constructivism itself and even the latest modifications of social constructivism for including social interactions without avoiding the same inside-out limitations of the original theory.

The starting point of this concept is that the knowledge exists by itself. Individuals must not build it. They are supposed to achieve knowledge by connecting the nodes where it is located. These nodes can be fields, ideas, communities that specialize and gain recognition for their expertise.

The learner is supposed to make links or bridges, which allow short connections between information. Interesting, though, is realising that people with similar interests and knowledge aggregate themselves in small networks. The chaos starts to give way to organization units. The conectivism theory argues that through the disperse meaning; the learner's must recognize the patterns, which appear to be beneath it. Therefore, meaning-making and forming connections between specialized communities are important activities. This capacity to form connections between sources of information, and thereby

create useful information patterns can have echo in many fields, such us economics, mathematics or computer science.

The author refers some connectivism key principles, expressed as follows:

- Learning and knowledge rests in diversity of opinions.

- Learning is a process of connecting specialized nodes or information sources.

- Learning may reside in non-human appliances.

- Capacity to know more is more critical than what is currently known.

- Nurturing and maintaining connections is needed to facilitate continual learning.

- Ability to see connections between fields, ideas, and concepts is a core skill.

- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.

- Decision-making is by itself a learning process. Choosing what you can learn and what the meaning of incoming information is can have different approaches, depending on how you see reality. In addition, while there is a right answer now, it may be wrong tomorrow due to alterations in the information available, affecting the decision.

Therefore, connectivism claims that due to a fast changing information, the understanding also changes at the same rate. New information continually acquired draw distinctions between important and unimportant information. Even the ability to recognize when new information alters the landscape based on decisions made yesterday is also critical.

Social network analysis is an additional element in understanding learning models in a digital era. (Kleiner 2002) explains not just how to recognize the collective cognitive capability of an organization, but how to cultivate and increase it. Within social networks, hubs are well-connected people who are able to foster and maintain knowledge flow. Their interdependence results in effective knowledge flow, enabling the personal understanding of the state of overall activities.

Surprisingly, Siemens claims that the starting point of connectivism is the individual. Personal knowledge is comprised of a network that feeds into organizations and institutions that in turn feed back into the network, and then continue to provide learning to individual. This cycle of knowledge development (personal-network-organization) allows learners to remain current in their field through the connections they have formed.

(Brown 2002) research can reinforce this theory when he claims that the internet leverages the small efforts of many with the large efforts of few. The central premise is that connections created with unusual nodes support and intensify existing large effort activities. The author provided a project experiment, which links senior citizens with elementary school students in a mentor program. The children listen to these grandparents better than they do their own parents. The small efforts of the many- the seniors – complement the large efforts of the few – the teachers. This amplification of learning, knowledge and understanding through the extension of a personal network is the epitome of connectivism.

Going a step further with collaborative learning environment where social interactions emerge and also with structuring information, some fundamental features start to take shape. Some of them must be part of a system requisite. We can start with the classification presented by (Hein 1995).

- Learning is an *active process* that requires the learner being engaged with the world.
- There are always *two different levels* in the learning process: while *constructing meaning*, we also *construct systems of meaning*.
- *Language* has a central role in learning.
- Learning is a *social activity*: our learning is intimately associated with our connection with other human beings, our teachers, our peers, our family as well as casual acquaintances.
- Learning is *contextual*: we do not learn isolated facts and theories in some abstract ethereal land of the mind separate from the rest of our lives; we learn in relationship to what we know, what we believe, to our prejudices and to our fears.
- One *needs knowledge to learn*: it is not possible to assimilate new knowledge without having some structure developed from previous knowledge to build on. The more we know, the more we can learn.
- *Motivation* is a key component in learning. Unless we know "the reasons why", we may not be very involved in using the knowledge that may be instilled in us, even by the most severe and direct teaching.

Furthermore e-learning presented by (Drucker 2000) as a new *ubiquitous* learning process has two fundamental benefits: the eliminations of the barriers of time and distance and the personalization of the user's experience.

E-Learning is integrated into the value chain activity, that is, it integrates content in context, delivering the timeliest form of knowledge. Nevertheless, some barriers still exist and e-learning *per si* isn't the answer to all.

A dynamic learning system can complement a traditional class method. Some authors call it B-learning, as for blended learning, where both systems interact. One key issue is the

learner's goals and motivations, which will determine the degree of interaction and engagement. Nevertheless, these issues relate the teacher, the tool availability for teaching and the right environment to accomplish the knowledge apprenticeship.

Nowadays different web-based systems have grown with the aim of supporting the learning activity. Among them, the most common are the so-called CMS (courseware management systems), online environments that provide a wide set of functions for a virtual classroom, such as the sharing of learning material to read, programming examples to analyze, quizzes to take, tools for communications like chat-rooms or email services and others.

These systems, as (Weber and Brusilovsky 2001) argues, owe their popularity to their versatility. In fact, research in AIED (Artificial Intelligence in Education) has produced systems that can provide better support to the learners, but that remain fragmented in respect to the educational activity considered as a whole. The author is referring mainly to ITS (intelligent tutoring systems) and AH (adaptive hypermedia), well known technologies which draw their force from the construction of a learner model and the definition of specific teaching behaviours depending on this model.

The potential of moving these types of systems into the web-based environment is appealing, and can be justified at least by two reasons. The first one is related to users, who would be many more compared to those of a traditional standalone application, therefore a personalization of the service would become fundamental. The second one is leaving more autonomy to the learner, better teacher assistance and collaboration between peer students.

Another field of research is CL (collaborative learning). A clear and useful description of this scenario is given by (Dillenbourg 1999). Some aspects worth mentioning are:

a) The number of people involved in the process,

b) The way people learn in collaboration,

c) The kind of collaboration instituted among the different actors,

This must be taken into consideration when describing a CL scenario.

In addition, we are trying to make a shift from traditional academic education, where Computer-based learning (CBT) is seen as a self-paced and user-friendly interface. CBT attempts to automate education and replace the instructor with some pre-recorded educational content. Although CBT provides a richer and more personalized user experience with multimedia technologies and asynchronous interaction, its contents and methods are for a general audience.

In CSCL (Computer Supported Collaborative Learning) systems, one of the focuses must be on the use of technology as a mediation tool for collaborative methods of instruction.

Collaborative learning can be categorized depending on the locus of use (intra, inter or extra classroom), on how the use is coordinated synchronously in time, e.g. chat programs, or asynchronously, e.g. email), or on the instructional role they are designed to serve (to situate a learning process, or to support problem solving).

Thus, as (Lipponen 2002) says, CSCL is focused on "how collaborative learning supported by technology can enhance peer interaction and work in groups, and how collaboration and technology facilitate sharing and distributing of knowledge and expertise among community members".

Another attempt to cast the new web-based instruction into a theoretical framework is presented by (Young 2004). After pointing out how little research is present in order to understand "the unique ways in which the web might promote, impede or fundamentally affect the way in which we learn and the development of related skills", the author defines the new medium as a *"cognitive tool"*. That device supports one's cognitive powers and receives its cultural significance and meaning by the community of users. This means that while helping learning and thinking from a web-based activity, it is determining the web's 'normal' usage routines, which subsequently affect the way it is further developed.

This dialectic between learner and tool is described using three theoretical positions:

- *Situated cognition*, emphasizes authentic activity as the most fertile learning setting,
- *Distributed cognition theory* posits that one does not possess knowledge as such, rather "knowledge evolves from a complex relationship between the tools, rules, values, artefacts and individuals making up a particular environment",
- *Activity theory* studies cognition as the result of the learner's goal-oriented activities, the various tools used in these processes, the communities involved in the environment and the rules they have established. These theories act as conceptual maps to understand the everyday use of the web and to draw effective instructional routes based on the growing new technologies.

The work of Young, therefore, does not intend to be a conclusive assertion on the nature of web-based activities, but it opens diverse directions of research and stresses the importance of a theoretical reflection in order to drive and understand the practice.

In addition, in the field of e-learning theory, it is worth noting other research done in the following directions:

- The definition of some ethical guidelines for computer supported education (Aiken and Epstein 2000), based on the fundamental dimensions of human beings. For example, systems should avoid information overload (intellectual dimension), they should encourage and not demoralize the user, while supporting the developments of positive character traits (ethical dimension), or should not attempt to replace the teacher (social dimension).
- The definition of a "blended learning" paradigm (Motschnig-Pitrik and Mallich 2004), in which the advantages of traditional lecturing are conjugated with the repeatability of e-Learning software. A complete and deeper form of learning is in fact reachable only if the 'human factor' is maintained within the educational process: in such a scenario, the burden of delivering

significant parts of intellectual knowledge is allocated to the computer, while the teacher acts as a facilitator and a bearer of the human values to be transmitted to the student.

- The assessment of e-learning strategies applied to student's performances. If learning can be described (within the framework of cognitive Load theory) as a passage of information from working memory to long-term memory, there are techniques to evaluate the frequency and success of this process and therefore estimate the design of a learning environment (Heo and Chow 2005).

Recently in the e-learning discussions, (Downes 2005) argues that personal descriptions, as found in social networks, and resource descriptions, as found in the semantic web, should be merged to form a single network, the semantic social network. Also (Marchiori 2006) claims there are in learning systems cost relations between technological and social aspects. To enable computers to play a key role in collaboration environments, one must combine computers with people.

Therefore, learning systems should have:

- *More interaction* like the Digg swarm (Diggs Lab),
- *More connection* between social space and data space, associated with the semantic web usage.
- *Go social* with social software where by spreading the load we multiply the benefit,
- *Go visual* creating interactive systems enticing the user like in (MMORPGS 2006) environments,
- Maintain the *social cost low* by using poor semantics and reasoning, like old keywords approach, rather than precise semantics and exact reasoning from semantic web.

With that, e-learning has the potential to become more personal, social and flexible with new web services, empowering students in a truly learning environment.

Some good examples can be found such as (Tagworld) for meeting people; (Flickr) for sharing photos, discovering, bookmarking, and promoting news; (Technorati) for tracking blogs; (Wink) for making tutorials; or (Eurekster) system for vertical community web search.

Nowadays there are various webbing tools, which are present next to a table classified according to the user's interaction. The first level only enables access to data and information. The second level considers the formulation of opinion based on other points of views and a third level where the user's contribution is possible to be added.

The tools analyzed, where users access information and can contribute with their own opinion are the ones we consider more important. These tools are **Discussion Boards (forum), Quick poll & survey** and **e-portfolios** because they combine access to

information and users can contribute with their opinion. Milligan describes this as PLE (Personal Learning Environment) where learners will have greater control over their learning experience, managing resources and activities they participate. In addition, they would personalize their own learning environment and interact with the web system to access content, assessment and other activities (JISC e-Learning Focus 2006).

Later on, these tools, as well as **Wikis**, **Podcasts** and **Blogs,** are described in more detail. In fact, the combinations of Podcasts or Blogs with feeds, and the possibility of adding reader's comments, also become interesting tools. Wikis are an interesting concept of collaborative social knowledge construction, which deserves some in depth analyses later on.

Types of tools	Factual information	Formulate opinion	Contribute own opinion
Alerts	✓		
Wikis	✓		✓
Webcasts	✓		
AudioBlog	✓		
Podcasts	✓	✓	
Blogs	✓	✓	
Chat interview	✓	✓	
Discussion Boards	✓	✓	✓
Quick poll	✓		✓
Survey	✓		✓
E-portfolios	✓	✓	

Table 1: Tools analyses

Furthermore, web based learning systems can be used for e-participation. By definition, this latter concerns about information and communication technologies (ICT) supporting participation in processes involved in government and governance. This might be accomplished if people can actually find or access information, as well as understand it better. This information dissemination can actually broaden and deepen democratic involvement, not only with the number of people involved but also with better quality involvement (Macintosh 2006).

3.2 Related learning tools

Sometimes, the simplest concepts have the greatest impact. For many, technology is intimidating and simplicity is more important than its potential or features. Despite the

book having its own place in learning, there are a lot of interesting web tools that can give a big push up on learning and bring a new dimension into it.

3.2.1 Discussion Boards (Forums)

For instance, forums or discussion boards enable web users to connect different information sources of a particular subject, usually of the community interest. This dynamic knowledge is very important in operational issues, where no book is available. It is like a manuscript or a bunch of connected ideas or notes. We can see these tools on two perspectives. On one side when we are looking for a particular subject, and maybe some one has already presented it in a forum, and someone has already answered it. Alternatively, on the other side we can actually contribute with our own ideas, in a discussion and therefore participate on the collective knowledge construction.

There are some differences between a discussion board and a forum. While in a discussion board, the topics introduced invite us to contribute; in a forum, there is usually a question and answer process around a specific topic, of the overall interest. We can even consider discussion boards and forums the same. It depends on how we use them.

3.2.2 Quick poll & Survey

These two tools are also very interesting. While a quick poll, from which a general perception of the population can be obtained in a short period, is a non-scientific method; a survey is a scientific sample of opinions considered representative of a whole. Therefore, polling can measure opinion, but a survey can actually be a decision maker. Both are usually in an on-line environment and add social aspects, especially active user's participation. There are innumerous online software tools that can be used. For instance for a online survey or polling we can use (Statpac), or (SSIWEB), or even (Free-website-polls).

These issues can be used in collaborative spaces, where feedback input is necessary, for instance to choose tasks to be performed or make a stand on a controversial discussion.

3.2.3 E-portfolios

In addition, e-portfolios are tools used to construct one's identity within social networks and organizations. They are value learning in forms of collection, archive, learned, reflected or presented assets.

With (E-portfolios) learners build and maintain a digital repository of artefacts, which they can later use to demonstrate competence and reflect on their learning.

In fact, with the students' portfolios organized within a platform, it will be interesting to enable all students to quickly navigate through them and compare distinct forms of organization. Portfolios are important means of documenting and evaluating achievements and improvements in student learning, but can also enable students to work out their differences and divergences. By reaching mutual consensus and commitment, students are increasing their level of citizenship.

In addition, on the teacher perspective, portfolios can be used to develop teachers own professional expertise. Teachers can collect all teaching documents that they have accumulated over the years and produce a private teacher portfolio containing central aspects and reflections on their work as a teacher. Later on, this same portfolio can be the starting point for students to build their own portfolio.

The fact that portfolios can be accessed through the internet is certainly interesting for its contribution to the learning process: the living evidence of the learner, the ability to manage his or her own learning and to reflect on it, or even with the others' experiences is highly recommendable.

3.2.4 Blogs & Wikis

Bloggs are a simple concept that has the potential to alter the way in which people encounter and examine ideas, receive news, and even learn. A blog is short for web log, and consists of regular updates, links, and news posted on a personal site. Blogging can be used as a means of disseminating information across an organization (Siemens 2002).

Blogging is using a new medium for connecting and interacting. They all share the format, enabling the social interactions. It is the ability to empower anyone, with a journalistic model, exploiting the true democratic nature of the web.

The uses have still not been completely explored, but they can be associated with: Knowledge sharing and knowledge management (Bottoms Up KM Development), Customer service (Blogging Goes Corporate), Interactive journalism (Instapundit), Communication, Self-expression, Learning (SchoolBlogs), Self-marketing, Campaigning/social reform (Tara Grubb), Community building, Experience tracking (A K-log Pilot Recap) and Storytelling (Nichani and Rajamanickam 2001).

The benefit is the democratization of information with content creation and consumption in a decentralized manner. The user is in control and the audience has acquired a central role, with the possibility of adding comments links and starting a dialogue with not only the author, but other readers as well.

This idea is because the pipe and sharing meaning and understandings are more important than the content. Knowledge acquired and shaped as a social process has a new dimension in learning environments. The spiral processes of learning, where the ideas are the starting point, as for dialogue, are not the ending point is very interesting. Also Wikis

are used for collaborative content creation, with syndication standards and aggregation services, tagging services (folksonomies) or social software services like (Orkut), (linkedin) or (eConozco).

3.2.5 Podcasts

Podcasting derives its name from Apple's iPod, but to create a podcast or even to listen to one, we do not need to own an iPod, or any portable music player for that matter. It is a new type of online media delivery. It is possible to publish selected audio files on the internet and users subscribe via an RSS feed to automatically receive the new files.

Podcasting is very useful for interviews, and then deliver them over the internet to anyone who wants to listen in. Of course, it involves producing our own audio files (usually in MP3, Ogg, or WMA formats) and then publishing them online somewhere, indexed for subscription and reception by an RSS (Really Simple Syndication) reader. They are then downloaded to subscribers' iPods, cellphones, iTunes directories, or other locations to listen to whenever they want. In fact, it is quite simple to produce and deliver podcasts. One can find some interesting examples on (makezine.com) or even at top ten (PodcastAlley).

3.3 Learning Sciences -Argumentation Mapping

Another interesting topic is the argumentation analysis. It is possible to define argumentation as the social activity leading to the development of novel ideas, to the distinction of new concepts and, generally, new ways of seeing the world.

It is a process of making public or exteriorize processes that are private or internal such as reasoning and thinking.

Intentional learning is a process of knowledge justification, focusing a sequence of decisions made by students. This simplified definition is what Walton calls *forward-chaining argumentation* (Walton 2005). The author refers abduction reasoning as reasoning from observed data to a hypothesis that would explain them. In addition, Charles Sanders Peirce claimed that all thinking is in signs, and that signs can be icons, indices, or symbols. Peirce placed great emphasis on diagrammatic thinking and even developed a powerful system of predicate logic based on diagrams or existential graphs.

However, Walton considers argumentation can also be *backward-chaining* argumentation, used for instance in scientific explanation.

Therefore, arguments can serve both to foster our knowledge, bringing us from old premises to new discoveries, and to cement pre-existing acquisitions, devising new explanations for old theories (used in abduction and discovery).

Alternatively argumentation, considered a private activity aimed at justifying old ideas or revising new explanations for well-established concepts, are conservative ways of seeing the world. This later case, despite used in everyday argumentation, is not of my interest, because my purpose is to achieve critical thinking to the learners and enable them to reach wisdom.

Abductive reasoning therefore constitutes according to Peirce the "first stage" of scientific inquiries and of any interpretive process. Abduction is the process of adopting an explanatory hypothesis and covers two operations: the selection and the formation of plausible hypotheses. As process of finding premises, it is the basis of interpretive reconstruction of causes and intentions, as well as of inventive construction of theories.

Since the mind is a sign that develops according to the laws of inference, Semiosis, the infinite process of interpretation of sign, is structured as argumentation. Thinking and reasoning are based on abductive, deductive and inductive inferences, aiming at establishing beliefs, habits, rules and codes.

Through the studying arguments of this kind, students should learn how to question any chosen standpoint and motivate it with valid reasons.

The activity that should be supported in a learning environment is critical thinking (Van-Gelder 2005). This is a quite advanced skill that is not easy to acquire and that is based on defeating “cognitive biases”, prejudices and mental laziness.

In a social context, the premises can be better assimilated and reach faster understanding with the social interactions. The interaction is a crucial aspect to understand some particular topic. Sometimes a student by himself or herself is not capable to break some barriers that other students had no difficulty dealing with, and by working closely together, they reach a new level of knowledge.

Up to now, my main concern is finding a structure of an argumentation and its implementation in a computer language, which could be useful to reach understanding and therefore learning.

Some difficulties such as different socio-cultural contexts are likely to have different validity criteria for argumentation (Western scheme of reasoning, e.g., syllogism, or Eastern philosophical tradition, e.g., tetra-lemma characteristic). In addition, the age and academic level of users will determine the educational interfaces based on argumentation models.

Stephen Toulmin in 1957 proposed a wider classification on the usages of argumentation, and a method to map out the inferential and evidential relationships between the various claims involved in an argumentative structure. We can see it on figure 1, where data can give origin to claims, with a qualifier that distinguishes warrants to rebuttals. There are also backings to the warrants that will consolidate the initial claim.

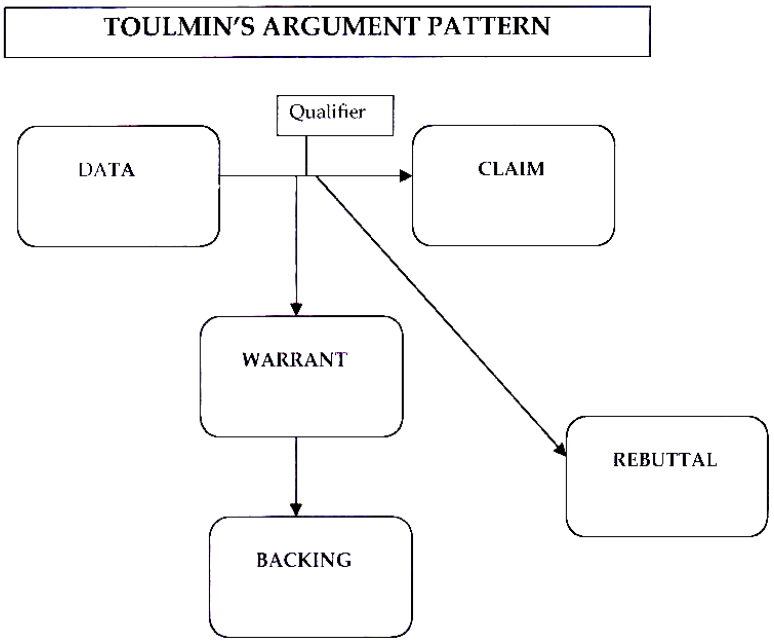


Figure 1 – Toulmin's argument pattern (Sibel Eduran and Sally Barnes 2006)

This activity is called argument mapping where the work of Robert Horn is fundamental. (Horn) uses maps, which, the author says, tackle the problems of information overload and time constraints that students (and generally, learners) have to face in the digital world.

The argumentation map should provide the user with the same functionalities a normal map would do in a territory: guidance through unknown areas. Particular attention to the language, which integrates words and visual elements, is essential to the interrelationship between users. My working claim is on visual techniques, which build, view and evaluate an argument tree. They constitute the guidance and the quality practice a learner needs in order to become a real 'critical thinker'.

Some interesting systems, along this line, can be found, namely the (Scholonto), which employs a detailed discourse ontology and it gives an original way to make sense of different resources without drawing on any specific domain knowledge. It uses an approach called structural computing (Nürnberg, Leggett et al.). It claims the primacy of structure over data in computer science. In fact, this software provides an environment for scholars to make *claims* about *concepts* in documents.

3.3 Technology

Now I will focus on the technological issues. In the first place, a short description of semantic web and then the web next generation. Later on, I will give place to the analyses of some tools.

3.3.1 Semantic Web

(Mizoguchi and Bourdeau 2000) defined the "Instructional Design" paradigm as the evolution of Intelligent Tutoring Systems and Interactive Learning Environments. This new paradigm fosters the introduction of ontological engineering in the educational field.

Three different kinds of ontologies could give support to the description of a learning resource.

- *Domain ontologies:* the content would solve problems related to the content of language ambiguities, and would evolve basic keyword queries into semantic searches.
- *Context ontology*: identify learning contexts such as an *introduction*, an *analysis* of a topic, or a *discussion*, or *presentation* contexts such as an *example* or a *figure*.
- *Structure ontologies:* to specify the construction-grammar to assemble small bits of information into personalized and quick-delivered learning narratives; concepts like *Prev*, *Next*, *References*, *IsBasedOn* etc. constitute the semantic connections to build a "Lego" learning system tailored to meet individual skill gaps.

Another overview of the future implications of ontology usage in teaching and learning is proposed by (Wilson 2004), who gives a clear and useful summarization of the potential benefits of it in the following points:

- Students are provided with advanced browsing and searching support in their quest for relevant material on the web.
- Syntactically different but semantically similar resources can be more easily located.
- The same work involved in creating an ontology can directly benefit learners by helping them to visualize and comprehend the relationships between concepts in their domain.
- Information can be shared across educational applications, enabling reuse not only of learning objects but also of domain knowledge and pedagogical strategies.

- Learners can be provided with the intelligent and personalized support that they would otherwise miss out (for example, personalized courses can be generated on demand).

In a similar way, the author outlines also the implicit risks of a serious employment of the technology in the educational areas:

- The ontology development process can be difficult and costly: the more expressive the ontology is the more complex and time-consuming this task becomes; moreover, achieving an 'objective' representation of a domain is next to impossible.
- The context within which ontology is supposed to be used tacitly constraints the definition of its concepts; so, in order that knowledge can be effectively shared, this contextual information must be formalized as well.
- Rich and complicated ontologies, far from the hierarchical structure of taxonomies, carry great expressive power, but are hard to comprehend especially for end-users.
- Since communities from different backgrounds (like library science, knowledge engineering, and business) are involved in the ontology development process, there is a lot of overlap and reinvention, or many situations in which the same things are defined differently.

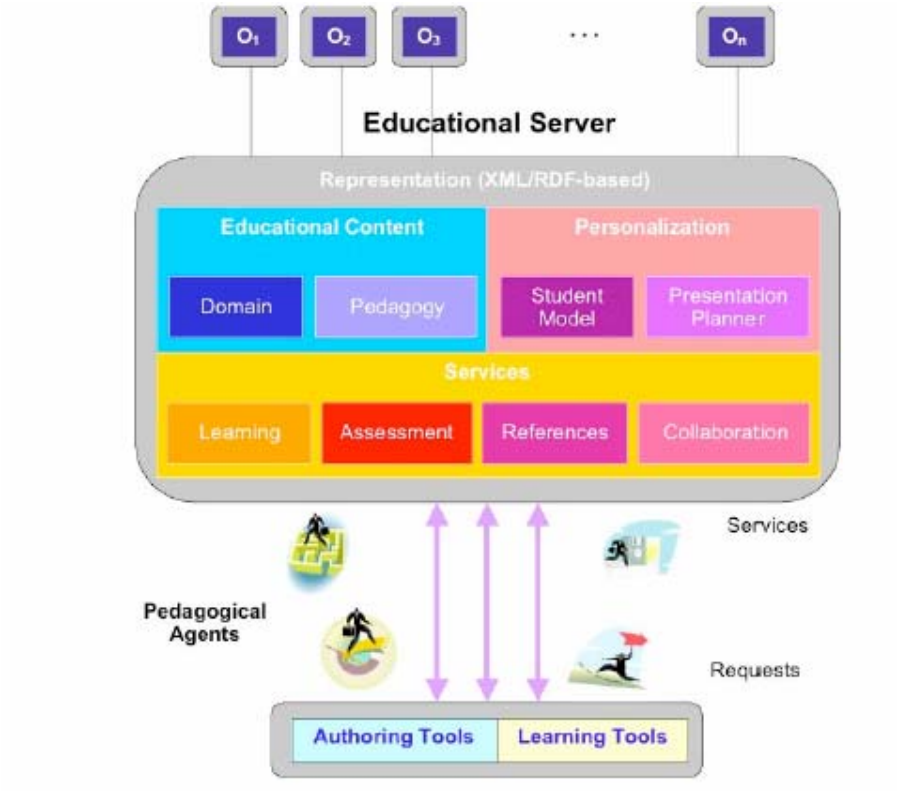


Figure 2- Schema of a Semantic Web Educational Server (Devedzic, 2004)

A precise discussion of the relationship between SW and e-Learning is also offered by (Devedzic 2004), who stresses the possibility of an improvement in AIED (Artificial Intelligence in Education).

The model presented by the author is very useful as it takes into consideration different SW technologies and all the possible protagonists and scenarios involved in any learning activity (figure 2).

We can briefly summarize its main features:

- Ontologies are the backbone of the system and are used to codify different levels of shared understanding, like vocabulary, the semantic interconnections, rules of inference, and to provide the structure used to semantically markup the resources available (this markup is then recorded in other formats, like XML, for better interoperability). The kind of ontologies needed to cover the whole learning experience should be about *domain* characteristics, *pedagogical* approaches, *student* models, and *presentation* styles.
- Services like search agents, information brokers, filters and integrators constitute the interface between the users and the knowledge base of the system. Moreover, they guarantee also interoperability between different applications on the web at the semantic level, allowing the end user to be employed in complicated operations of *learning* (course offering, integration of educational material, tutoring, presentation), *assessment* (on-line tests, performance tracking, grading), *reference* (browsing, search, portals) and *collaboration* (group formation and matching, class monitoring).

(Stutt and Motta 2004; Stutt, Collins et al. 2005), instead describe in a detailed way a scenario where one of the major problems of the SW, the competing and overlapping nature of its ontologies, would be overcome by the existence of a multiplicity of community-based Semantic Learning Webs (SLWs). In fact, since the nature of the medium is distributed, it makes sense to let agents construct ontologies and repositories in a distributed way. Communities would build so-called “knowledge charts”, in order to represent the information of their interest, while specific “knowledge browsers” would navigate these digital spaces looking for consistency and correlation between concepts. The issue the authors address is essentially the need of *context* of the learning process. In fact, relying on various communities and not on a central and ‘objective’ repository means technology offered by the SW could support one fundamental learner’s necessity: the possibility of structuring and locating a single piece of knowledge within a local panorama (the *knowledge chart*), and possibly, be able to move on to even further related areas (other *neighbouring* knowledge charts).

Such a scenario is then instantiated using some existing technologies and pointing out where more work has to be done. In particular, ontologies are used to represent domain knowledge (the content of the learning), argumentation schemas (the relations between

pieces of knowledge) and pedagogical narratives, while other useful technologies deal with the visual representation of knowledge charts, information extraction for automatic ontology population, annotation and semantic browsing of the resources.

3.3.2 Web 2.0

Web 2.0 has emerged, with its characteristic architecture of participation, where users contribute to growing pools of information, becoming co-developers of web sites and citizen-producers and publishers, working in a range of media**.** web 2.0 is manifesting in a number of very popular sites and massively distributed on online applications.

In addition, Ajax and PHP, two popular web 2.0 technologies can work together to create next-generation applications, with forms validation, file upload monitoring, database-driven information display and manipulation, web services, Google Maps integration, and more. Also with this, we can take advantage of advanced JavaScript capabilities to create next-generation, highly responsive web applications and manage cross-browser issues, ensuring our applications run on all major web browsers.

In the next figure, a comparison between web 1.0 and web 2.0 is illustrated. There it can be seen that web 2.0 is much more about change in people and society than about technology. Sites like (Myspace), (Youtube), (Digg), (Bebo), and (Flickr) clearly represent this recent web strand (O'Reilly 2005).

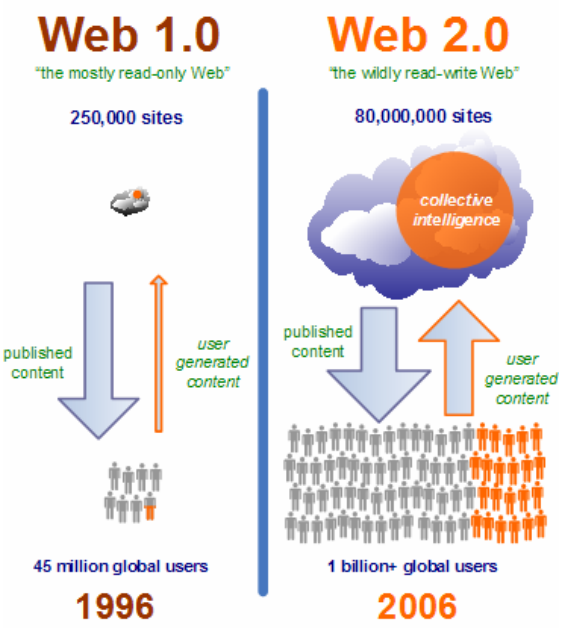


Figure 3 – Ten years of web evolution (Hinchcliffe's 2006)

Also in the next figure, we can visualize the elements present on the web 2.0. We can find, on the right side, some tools and technologies, in the centre we can see people as the cloud interacting in both two ways with a web system. This system is software that gets better with the people interaction, provides innumerous services and gives control to the user. There are some properties represented: trust, tagging, beta, small pieces, permalinks and, of course, user control.

Figure 4 – Elements of web next generation (Hinchcliffe's 2006)

3.4 Related technologies

3.4.1 Web feeds (rss, atom)

In the typical scenario of using web feeds, the content providers publish a feed link on their site which end users can register with an aggregator program (also called a *feed reader* or a *news reader*) running on their own machines. When instructed, the aggregator asks all the servers in its feed list if they have new content; if so, the aggregator either makes a note of the new content or downloads it. Aggregators can be scheduled to check for new content periodically. The kinds of content delivered by a web feed can be html, or links to webpages, or just notify users of content updates, with summaries in the web feed rather than the full content itself.

The distinction between rss and atom is due to the dissatisfaction with rss, mainly because of the multiple incompatible and widely adopted versions of RSS. The intention of atom was to ease the difficulty of developing applications with web syndication feeds.

3.4.2 AJAX and PHP

Ajax is not just a JavaScript based language, but also several technologies, which bring transparent communicating and manipulating data in conjunction with a server-based technology into web applications. From the server-based technologies capable of working in conjunction with Ajax, the most suitable is perhaps PHP, a very popular scripting language.

Ajax incorporates standards-based presentation using XHTML and CSS; dynamic display and interaction using the Document Object Model; data interchange and manipulation using XML and XSLT; asynchronous data retrieval using XMLHttpRequest; and JavaScript binding everything together.

AJAX is also a key component of web 2.0 applications such as (Flickr), now part of Yahoo, (37signals) applications, as well as other Google applications such as (Gmail) and (Orkut) (O'Reilly 2005).

3.4.3 Social software

Social software is a tool that allows people to connect with others, to share ideas and collaborate. The most important feature of this type of software is the networked nature of communication. It supports group interaction and other communications systems that host many-to-many interactions. Some examples can be found at (Groove), or (Friendster). It can also include collaborative filtering technology like Amazon's recommendation software and EbayDotCom.

However, to get a meaningful definition we must agree on human desire to socialize, and because of that, we create software to ease contacting each other. Most important is that the software does not control the connection it just facilitates the connection.

More important is the collaboration aspect, where tagging comes along. That is the importance given to *Social tagging software,* which enables users to create shared bookmarks to online resources with additional metadata. Social tagging websites like bookmarking services (e.g. del.icio.us) or photo sharing services (e.g. Flickr), use “tag” images and share bookmarks respectively with a large user community.

The advantage of these social tagging systems is that the user is free to choose any descriptive terms and is not restricted to a preconceived vocabulary, taxonomy or ontology. This bottom-up approach, which results in semi-structured information spaces, is “social classifications”. This differs significantly from the knowledge engineering and semantic web approach that induces having shared ontologies of well-defined terms and structures to enable machine computation.

Social tagging is not a formal approach to knowledge modelling, it is rather a complementary mechanism to the highly structured top-down approach. There are several good examples of social tagging software with different services.

(Swik), a search engine that learns from your community;

(O'Reilly's CodeZoo), houses socially shared tags;

(del.icio.us), a social bookmarking service;

(Flickr), a photo sharing service;

(Technorati), service to find Blog postings;

(Suprglu) service, for aggregation;

(43Things) a social list;

(voo2do) also an on-line to-do list;

(Ma.gnolia.com) to find web sites and build community online;

Next table tries to provide an overview on the user's motivations on tagging. On the vertical axis, there are the benefits of tagging; while on the horizontal axis is the content creation. The social bookmarking tools usually fall on the category users tagging other content. However, Flickr users are generally managing their personal collections for private use or for sharing with friends and family. The Suprglu service is a new way of gathering all our content on del.icio.us or flickr on a unique place. The blog aggregator *Technorati* uses tags supplied by the user (either presented within an RSS feed or linked to from the HTML page) to describe their blogs so that others may discover them (Tony Hammond, Timo Hannay et al. 2005).

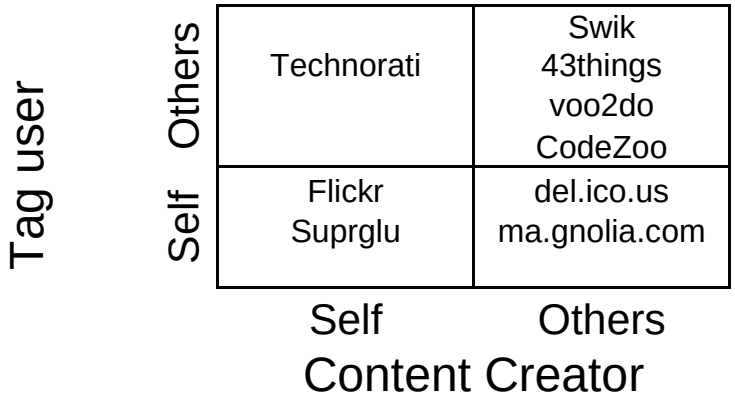


Table 2: The benefits of tagging users Vs. content creator

Additionally there are interesting services associated with social tagging:

(Flock) a social web browser;

(Elgg) a social network;

(Bebo), the next generation social networking site;

(Google docs and Spreadsheets), authoring and collaborative Working tools;

(Netvibes*),* integration tools.

(Drupal) an open source content management platform.

Surprisingly (Fitzgerald 2006) managed to integrate several available tools: (Moodle) a course managing system with (Drupal) and (Elgg).

3.5 Structuring information

On my research project, the main difficulty lies on how to structure information in a collaborative space, where all users can reach for new material and compare it with the existing one. The previous section, social tagging, is a free structured approach to classification with users assigning their own labels, which is variously referred to as a 'folksonomy'. This free tagging approach to classification is jumbled, by contrast to a formal classification system which generally is predictive both of the ordering of terms that are used within it, and of the terms that will be allowed by. This is a top-down, very flexible classification scheme, but far cheaper. Also the terms used are the very terms that users might be expected to use in the future when searching for this information.

However, there are several approaches on structuring information. For instance, the Concept Maps usage within web 2.0 where we can use (CmapTools) to produce interesting maps with links to pages. Also even with social tagging software, such as (del.icio.us) and with (Technorati) it is possible to relate similar topics with simple tagging. It is possible to see dynamic tagging, for instance in (Thecloudsearch) or in (TagLines) an automated Folksonomy tool from (Francis Shanahan), using mushups. Even the (Digg) website for community share, discover, bookmark web content, or the (43Things) enables interesting approaches to structure information.

All these structures occur in something that aggregates them, and users have an important role for them to grow. However, this chaotic messy space enables individuals to learn and form connections. Another tool is knowledge trees usage, as a cartographic mode to make complexity visible by (ArBor & SenS).

Also for structuring information we can use (ISO Topic Maps) or (W3C rdf schema 2004), but web2.0 technological development tools can provide social, collaborative, participative services driven by RSS feeds. web services programming via AJAX and APIs. For example Veerendra Shivhare has made an interesting “live tree” view of Amazon’s entire product catalog just using AJAX and calls to Amazon web service. (Amazon Catalogue Tree),(Ajaxian).

3.6 E-learning 2.0 Vs Web 2.0

The web is changing mainly because of user's interaction - technological and participation - social paradigm. In fact, the new generation of users, which was grown up with the internet as an integral part of their lives, see it not for information search, but rather as a communication platform. These same users, the so-called N-Gen, Next Generation or Network Generation are the ones who attend classes in a learning system, which is not attractive enough. If they are growing up in a technological framework optimized for participation and collaboration, they will not be comfortable in the old roles of instructor and student. Therefore, if we want to be successful in an e-learning environment we must provide the same enthusiastic aspects they are becoming to be familiar within the web. Therefore, e-learning systems based on web 2.0 will give some answering solutions to the problems raised. The connection between these two is well described in (Downes 2005), who based on some Connectivism principles, considers that e-learning systems must have a learner-centred design for N-Gen students, and teachers and learners should act as peers within social networking environment. He states that social software ought to provide services built upon a web platform with "microcontent".

In fact, if we look to traditional learning applications and systems managing learning objects within a pre-defined learning architecture, we must now migrate to an open learning environment composed of interoperable open-source platforms and tools aimed at supporting the social interactions of peers on the N-Gen (Fumero, Aguirre et al. 2006).

In order to develop a brand-new pedagogical model and implement it for the next generation web, we must consider profound implications for learners, and for society, with the emergence of web 2.0.

Additionally, learning applications written in open source code are also contributing to the development of participatory and collaborative e-learning environments. Open source standards such as the (Schools Interoperability Platform (SIF)), (Opengroup) allow data to move easily between courseware applications, while open source course management systems such as (Moodle), (Plone), (Atutor), (Dokeos), (Bodington), and others, are highly modularized, allowing teachers and learners to select, edit, or extend learning components most appropriate for their purposes. Moreover, with open source code, instructors, designers, and students can readily develop new modules and add them to catalogs of available educational components, allowing the learning platform itself to evolve collaboratively according to the needs and imaginations of the participants.

This cultural shift from the static presentational forms of web 1.0 to the dynamic participatory architecture of web 2.0 – requires a parallel conceptual shift from what we call Learning 1.0 to Learning 2.0**.** This shift is fundamental for e-learning, which is being shaped by the power of the new information and communications technology.

The N-gen users now accustomed to the give and take process of media sources of communication and entertainment will feel at home in the context of self-directed learning, acquiring and contributing as natural parts of the learning process.

The following table presents the differences between traditional and innovative e-learning systems.

In Learning 2.0, learners and teachers are in a cooperative relationship. Learners play an active, participating role in the learning process. In this context, the learners shape the learning environment as much as they are shaped by it.

The fundamental difference of Learning 1.0 to Learning 2.0 is the shift from architecture of presentation to architecture of participation. This change would enable learners to take an active, collaborative role in shaping their learning programs. This shift would be exemplified in specific environments, which draw the students into the processes of communication and creativity (Sinclair, McClaren et al. 2006).

E-learning 1.0	**E-Learning 2.0**
Focus on Content Presentation	Focus on Learning Processes
Focus on Access & Download	Focus on Communication & Interactions
Fixed or Static Design	Co-developed with Learners & Instructors shaping Design
Individualized	Customized/Personalized
Teacher-Directed	Cooperatively Activated
Static	Evolving
Information/Content	Knowledge & Understanding
System-paced	Learning-paced
1:many	Collaborative & 1:1, many:many
Search and Retain	Contribute, Tag, and Share (Folksonomy)
Tests and Examinations	Demonstrations and Prototypes
Prescribed	Negotiated and Contracted
Web of documents	Web of data
Web as Media	Web as platform
Communities of Practice	Social-Networking
Pre-defined learning architecture	Open learning environment
Feedback limited	Feedback rich

Table 3: E-learning Comparison

4. Project Approach

4.1 Description

Web learning environments, where students have no guidance, does not result in effective knowledge. In fact, pure discovery learning, without any guidance does not result in knowledge acquisition. Therefore, guidance in the form of scaffolds is a solution for these environments. As (McKenzie 1999) reported, a web system must provide a structure, support for the student investigation, keep students on the right path, while seeking "the truth" about whatever issue (de Jong 1998). Having this in mind, I headed my research on two dimensions: collaborative environments and technology development.

As far as the first dimension is concerned, learning has a socio-cultural perspective. The process of learning incorporates different forms of signs, symbols and tools in social activities (Vygotsky 1978). Furthermore, learning and intellectual development are undoubtedly related to social interactions: the learner constructs knowledge due to interaction with others (Driscoll 1994) .

I also consider the Zone of Proximal Development as one of my approach theory. It was described by (Vygotsky 1978) as "the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers". In other words, a learner can perform a task with teacher tutoring or with peer collaboration that could not achieve alone. Also the conectivism approach, as previous referenced supports my theoretical framework architecture.

In what concerns the second dimension, technology issues, I will try to relate emergent web concepts as mediation tools for knowledge construction. Namely, the use of Ajax techniques or some projects available at the sourceforge.net, namely the (Scuttle) project, which allows multiple users to store, share and tag their favorite links online. Scuttle is released as open-source under the GNU General Public License. Furthermore I must reference (The Enterprise Wiki -Confluence), despite being a commercial solution it is rather simple tool for collaboration and knowledge sharing. Also under the GNU Free Documentation License the (MediaWiki), which was originally written for wikipedia , is an interesting Wiki solution.

The idea is, on a button up approach, build a formal Knowledge platform through a representation map, with semantic social networks, where people can dynamically be connected and interact online. In this area there is an interesting project, (Knowledgetree), which is a commercial open source document management system and might give some support on my learning tool.

In other words, the system gets the teacher closer to students work, namely in scientific reports, within group activities. The platform can have different usage levels, from individual assignments, to group class, or even at a higher dimension at a community level - the true social involvement. Also by introducing argumentation methods in discussion processes, or even with inquiry approaches, students must support their

claims, as well as use the discourse scientific methodology. Additionally, the teacher will be ale to monitor the research tasks and group discussions, giving support contributions. Not forgetting that with a dynamical structured topic tree, the teachers and students are building the curricula, which is not forced, but rather constructed. Going a step further the tool could be used as an assessment for measuring the student's activities (collecting and discussion). In addition, it enables students to continue their class assignments to other places, which breaks the classroom walls. Another aspect is the social involvement of the students, where they will get involved by seeing their peer's contributions.

Next, I first identify the problem, describe it and then analyse the system approach. I present an architecture layer, as well as the deployment diagram. After that, I describe the use case diagram and introduce a learning scenario where teachers and learners interact. Finally, I describe the next phase: construction and deployment of the system. I call it **L-Tree** as for learning trees of knowledge.

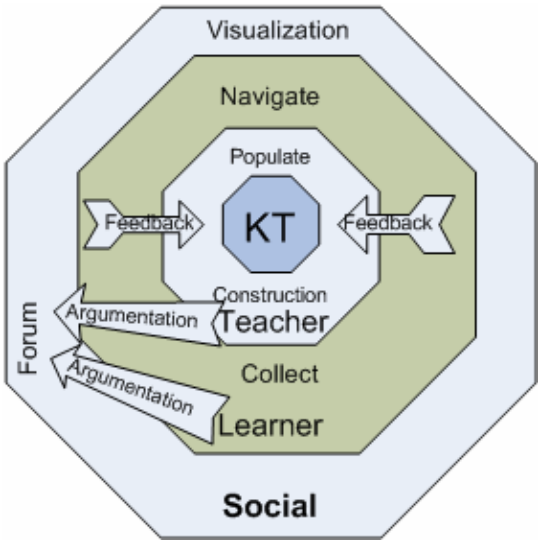


Figure 5: Layered Architecture

In learning environments, from the student's point of view, motivation is a key issue and despite social phenomena being crucial, each student has his or her own learning rhythm. In addition, the freedom of choice and not being tied or to the curricula or teacher's perspective is very important. On the teachers' side, being able to synthesise all the learning content and having some feedback on the student's level of achievement is crucial. Both perspectives have led me to the finding of a solution for an e-learning network environment, where both actors interact.

I am developing a web solution based on this concept and on figure 5 there is the layered architecture with the Knowledge Tree (KT) in the centre.

The teacher has the ability to construct it and populate it with content. The student can navigate through the KT and more important than that, he can make a collection of subjects (different resources: doc, ppt, pdf, url, podcasts, quizzes, and others), enabling the teacher to become aware of this collection. A third layer, the social layer, where both

actors: teacher and students will interact in an argumentation visualization system: Forum. In this layer, the student can have some system information about the learning content and discuss the matters with other students or even the teacher.

Another way of presenting the system is with a deployment diagram (figure below) where the L-Tree Knowledge system presents the teacher's inputs and outputs as well as the student's interactions in the System KT and in the Social KT.

The system KT comprises, on the teacher's side, the structure construction and its population; and on the student's side, the navigation and collecting facility. This will be the system core. In addition, there will be the learner's feedback associated with monitoring tasks. The students can also construct his or her knowledge tree with their own content material. The subjacent idea is to use different colours for different sources.

The Social KT comprises the forum, where all users can socially interact according to their collection of items – *visualization* and put some discussion around their interests – *argumentation*.

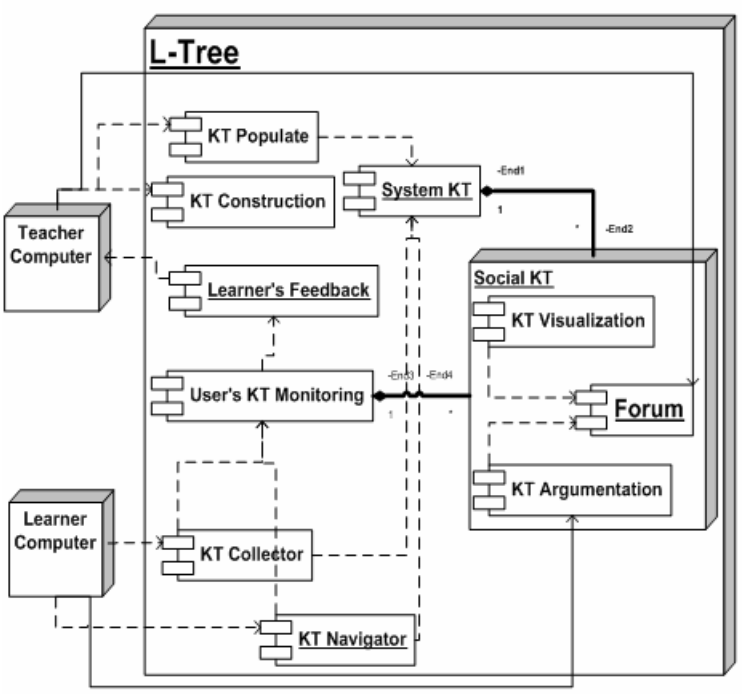


Figure 6: Deployment Diagram.

Furthermore, the use cases diagram of teacher and students in figure seven presents, in more detail, all the system sections and introduces the pedagogical scenario approach.

More important than having to specify and develop a software-learning tool based on learning theories is to provide an interesting software solution, from which users can truly get profit.

Some characteristics such as open system, integrating learning resources, interaction with users, collaboration facilities and personalised knowledge acquisition are essential for the success of this learning system.

The teacher might have some possible scenarios when constructing activities. Also the forum should have some argumentation schemas enabling students to interact with, for example according to (Toulmin 1969) argument pattern (data, claim, warrant, backing and rebuttal), as we can see in figure 1, or with polling and voting facilities. Another issue is the user's KT monitoring, where learner's feedback will be available namely for student's assessment.

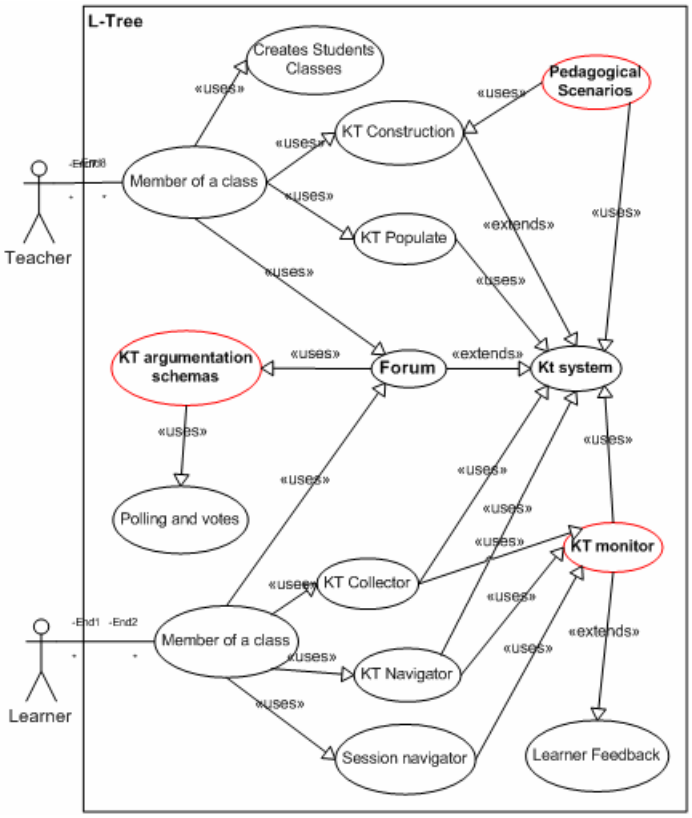


Figure 7: Use cases diagram.

4.2 Research Methodology

The method used up to now can be synthesised to an exploratory research on learning theories and representation of knowledge. Also some social software for networks were tested, namely (InFlow), (Apache Agora) by Stefano Mazzocchi and web 2.0 technologies such as Ajax.

Now I am studying the Ajax basics with PHP and MySQL database into the mix (Babin 2006), (McLaughlin 2006). One advantage of using Ajax and PHP together is that they handle tasks such as manipulating and displaying images on web pages so well. To explain a new programming language, for example, teachers often use a photo gallery application. Another aspect covered and a very important one is the incorporation of web services, such as the google search engine.

The actual method is writing this research proposal with the state-of-the-art and then analyse some software tools such as e-portfolios, blogs or podcasts with feeds to incorporate them in this platform as resource contents. At the same time, I wrote some documents, to submit to some conferences in this field, namely XATA, ICL and plan to track some other important conferences namely: CSCL, E-LEARNING sponsored by IADIS, ICALT. Also some people's work related with this field of interest is worth mention: Pierre Dillenbourg from EPFL, Lausanne Swiss; Jim Slotta from University of Toronto, Canada; Vania Dimitrova. from University of Leeds; Lora Aroyo from CWI, the Netherlands; Kirsty Young, University of Technology Sydney, Australia; Peter Brusilovsky, School of Computer Science, Carnegie Mellon University; Maggie McPherson, University of Leeds, United Kingdom, George Siemens and his elearnspace site; Dion Hinchcliffe's blog ; Tim O'Reilly, CEO of O'Reilly Media; or Joshua Schachter, CEO of Del.icio.us.

As for the next phase, after the L-Tree system specification, I consider developing it with rapid prototype by using Ajax and php technology. Also very important should be deploying it with some delivery feedback to make some adjustments.

Then, I will validate my hypothesis with two classes and I will do two experiments. In the first one, both classes will be submitted to two ninety minute lesson and to an assessment at the end. In the second one, the first class will have two ninety minute lesson and the second class will have one ninety minute lesson plus ninety minutes using the tool. At the end, both will have an assessment activity. I will then see if there is any change in the students' performance on the assessments. In addition, I plan to do two other field experiments. Firstly, use it with or without teacher coaching and secondly with synchronous or asynchronous argumentation facilities. I plan to use both classes on these two last experiments. At the end, I will give to students and teachers a form to evaluate the tool.

This same high school class will later on use this system and I will be able to retrieve some more data to analyse, to see its performance on the long run. My current approach uses a tree of knowledge approach and enables users to navigate through it and collect the objects they choose. The social network is very important and my idea is to add some feedback from previous users into the system and enable an open discussion through the forum usage. In addition, discussion with argumentation visual techniques should be interesting to provide another learning perspective.

4.3 Related Projects

Directly related to this project there are some interesting references. The SEE-K project, which is a platform for collective laboratory from (Trivium Soft 2006), is accessible via a Internet navigator and does not require a heavy technical investment. Trivium Soft has two explorative types: a traditional method with relational data and a cartographic mode to make visible complexity (ArBor & SenS).

Another interesting project is (BitTrees) which was designed to be a flexible way to store and share information in a social way. The objects are stored in a hierarchical tree, with relationships and organizing all data in a personalised manner. All the objects can be pieces of text, links to images on the web, links to websites and personalised discussions. One interesting thing is the ability to view the object in the form of a blog using a treeview and link other user's objects into his own tree.

On a wider perspective, there are also some projects worth mentioning based on the participatory approach. For example, the (Ancient Spaces) project currently under development in the Faculty of Arts at UBC, which will enable a class of undergraduate archaeologists to reconstruct collaboratively an ancient town as their own 3D learning environment, combining a digital democracy with the techniques of peer-review and guidance from teachers as well as content and programming experts. Yet another interesting one can be found at Carnegie Mellon University, the course in (Building Virtual Worlds), which enables an interdisciplinary team of graduate students to create an immersive virtual space. The course culminates in a raucous stage show, where a juried selection of the best work is shared with the campus community.

These projects all have interesting points in common. They point to a future in which the community of educational researchers, teachers, and learners are using computer gaming, social networking and content sharing concepts.

In fact, some research in interactive media is being done, namely by Professors (Janet Murray 1998), at Georgia Tech or (Henry Jenkins 2006) at MIT, and supported by the work of the (Woodrow Wilson Center for International Scholars in Washington). A new field of (Serious games) is emerging, which seek to forge productive links between the electronic game industry and products involving the use of games in education, training, health and public policy. They are trying to use the growing popularity of MMORPGS (**M**assively **M**ultiplayer **O**nline **R**ole **P**laying **G**ames), present in multiplayer games, like (World of WarCraft), where tens of millions of players master the geography, politics, and often culture of a simulated world better than those of their own. These worlds immerse the user in a comprehensive 3D space, where they must design their own avatar and interact with others in order to understand and adapt to the environment's unique culture, geography, economics, physics, history, and larger-thanlife challenges.

As in real life situations, learning would occur in the processes of creative co-development and personal participation, and create a three-way dialogue between teachers, learners, and the evolving, participatory learning architecture. There are

innumerous other interesting projects, but these references just show some strands, that I am tracking for my current research.

4.4 Aims and Outcomes

Develop a tool which supports social networks of learning around learning activities, and actively improve user's social learning capabilities. Therefore, there are two complementary deliveries.

-Organize and structure the learning content available to the teacher,

-Dynamically improve the students learning process on the proposed activities.

To reach these two deliveries one can take advantage (1) of the teacher expertise, (2) of the learners' interaction through social networks in web systems and (3) of web 2.0 technologies, namely Ajax with php.

The Outcome should be a tool where teachers and students can complement their class work by building bridges of knowledge.

In more detail, the system will have an object repository. It might have multiple items: documents, simulations, quizzes, podcasts, animations, games, or other activities, provided mainly by the teacher. However, these learning contents are dynamically classified. Each student will collect the more appealing ones. In addition, the tree can classify all the objects according to a specific subject. With this dynamic, interactive and visual learning collaborative tool, the resources are personalised and organised by learners. The system should give some information to the teacher regarding the objects the students have in fact studied and to the student, which objects his or her colleagues have chosen. The discussion tool will enable students to contribute with their opinions.

In a social perspective, we can better enhance knowledge acquisition by enabling learners to interact together. Therefore, the system should present to learners some information regarding who collected the objects. The web system should also have some intelligence because by giving suggestions to users which object should be interesting, it is in fact contributing to the learner's success. The difference between system and peer suggestions is mainly the fact that it is dynamic and does not depend on previous students' choices.

I hope that after the completion of this research study, the development of the web system will result in an interesting solution, which can be used by students and teachers. The difference between this one and the other systems will mainly be its effectiveness and social support for learning activities based on my learning theory approach.

I also intend to conjunct argumentation and visual representation of some structures from different users who are working together in a social network. This, by itself, will be a

daunting task. The representation of knowledge in a graphical web system with some navigability and multiple paths is an interesting outcome.

To sum up, I am conscious this platform will have an increased proposal of value in the form of interaction between people. I am sure that joining efforts of the users in a collaborative environment will have best results on learning in an integrating manner. Because instead of duplicating existing classroom activities, we are rather creating new, richer, more contextual learning experiences, into a socially mediated, technology-enabled environment. With this tool we can enable users explore personal ideas and interests in a learning environment with visual information around key words. If this environment is an object repository, then it will permit users to classify all content around a knowledge structure- tree, conjugating different points of view. Also with collective feedback, or alerts to teacher, we truly are providing a social learning virtual environment. After developing this approach, our proof of concept will be testing and validating it.

4.5 Work plan including time table

The research is carried out between January 2007 and March 2009 in a total of 27 months. The major tasks predicted are the following:

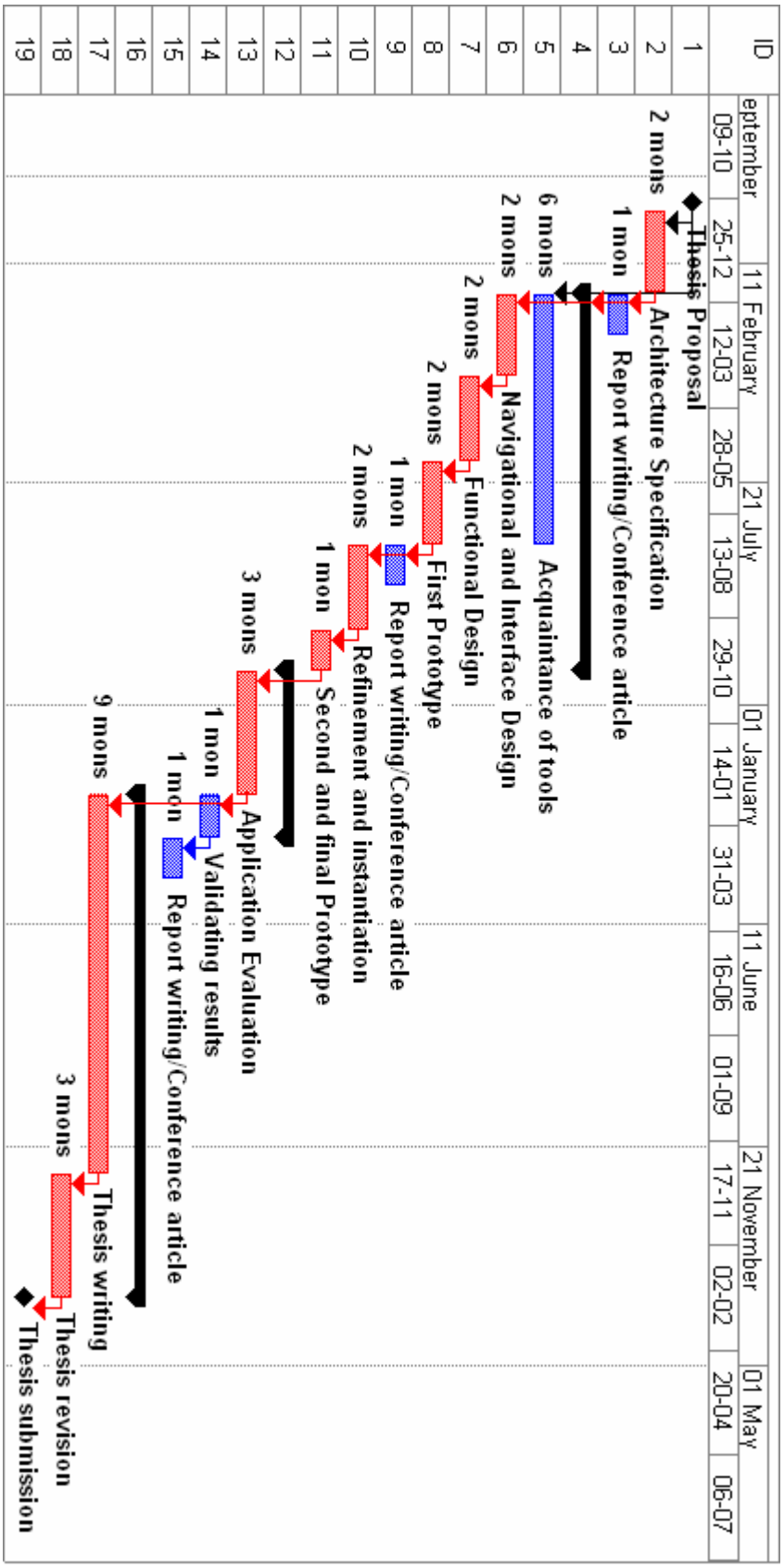
- **Architecture Specification: three months,**
- **Application Development: twelve months**
  - Acquaintance of tools : three months,
  - Navigational and Interface Design: three months,
  - Functional Design: two months,
  - First Prototype: two months,
  - Refinement and instantiation: one month,
  - Second and final Prototype: two months,
- **Proof of concept : four months**
  - Application Evaluation: three months,
  - Validating results: one month,
- **Thesis Report : twelve months,**
  - Thesis writing: nine months,
  - Thesis revision: three months,

Next, I present the Gantt project chart. One final remark, there are three working reports. One report elaborated after analyzing other systems and specifying the Portal architecture, another after the First Prototype, and finally another for the application

evaluation. These reports can result in a conference paper, or even a published article in a journal.

I consider essential for tracking my work, to write this working progress reports, mainly because by doing that I will be documenting all my work, which can give place to some publishing and later on write the thesis more easily.

PhD Proposal	ProDEI
Title	L-Tree
Project Start	28-12-2006 8:00:00
Project Finish	11-03-2009 17:00:00



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