Combining Ontologies, Social Networks and Argumentation into a Dynamic Learning Portal

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Abstract:

Ontologies, social networks and argumentation might not even be related to each other, but they are keystones to our present work. These research areas are shortly presented and then a collaborative software learning tool is described. Also the final product, where different learning actors (teachers, learners and content producers) dynamically enable high order thinking skills is presented. It's a multi-layer based platform with CSAV (Ontology and Computer Supported Argumentation Visualization) features. The idea is to map different knowledge domains and their interrelations, available trough a Web environment. In this paper, we also enlighten our efforts to develop Web Intelligence, supported with the learning theory of constructivism and cognitive apprenticeship, where social interactions play a key factor in learning.

1 Introduction

The original idea of developing an e-learning Portal where users can freely navigate and manage to construct knowledge has been previously presented [1]. When claiming that the usage of learning constructivist theory, ontologies and software agents will enable us to reach our target we have found several questions. So in this survey we are now tracing the outline of a technological and pedagogical project where education, argumentation issues will have a relevant role in the construction of an e-learning Portal. In particular the computer supported argumentation visualization will be our core project. These features are very important for the design and system analysis of our learning Portal. In fact we consider that these three issues (technology, pedagogy and visualisation) are the dimensions of our problem analysis.

The creation of a representation, giving for example a schema based, is always associated with a particular person. This knowledge representation has therefore different approaches, regarding the author's perspective. But our idea is to develop a system where different visual representation will converge to an integrated one and where all the previous knowledge representations are present. We call it a *pedagogical ontology* because this one would be of an enormous importance to allow learners to navigate through it, enhancing knowledge construction. Of course the type of learners (age, knowledge background, cultural heritage or even level of motivation) has to be characterised if we want to succeed our purposes of knowledge construction through a representation map.

Some research on the learning theory that supports our system has already been made and we have analysed some ontologies structures, which are presented next, as some interesting approaches may corroborate our work.

Our first assumption was to use the constructivism theory, according to which all knowledge is constructed and is not the result of passive reception. In other words, learning is an active process through which learners construct new ideas or concepts based upon their current or past knowledge [2].

However when a generic practitioner learns "socially" how to use a tool during a practical work activity, the environment has to be central in the teaching of conceptual knowledge. Knowledge is generated due to the application scenario and intellectual work. Cognitive apprenticeship is a category that describes this learning method based on social interaction and activity [3]. Therefore this new paradigm of learning will strengthen the social theory of constructivism, which was our first choice.

The focus on its educational implications and on the importance of argumentation theories which support our approach will have an impact on the technology semantic web usage, namely ontologies to support and develop it.

We are certain that the ontology usage as a formal representation of the knowledge leads to quite interesting solutions in our Portal. Also the dynamic integration of distinct ontologies from different users adds a value proposition to the entire framework.

Finally by visualizing this integrated knowledge into a friendly user interface we offer a value added activity. It is certain that the *pedagogical ontology* has to evolve and if in some cases it will converge, in others it will diverge completely. The idea is merely to provide a collaborative tool, between actors and then test it with these same actors to see how it works.

While studying science education a different ontology approach was found. Discourse/argumentation ontology is a structured set of suitable links that provide a common language for authors to use when making claims and positioning them with respect to earlier work. It differs from most ontologies because it accommodates more than one view of the data, as researchers often have different or even conflicting perspectives.

The ontology provides structures that are being used to design innovative search, interpretation and visualization tools to allow users to navigate in large and growing models. But from a Dewey pragmatic point of view, knowledge must be constructed in our search for certainty in argumentation bases with a social context environment. Rephrasing it, one might say that in a dynamic environment we have to find the best way to learn or deal with some subfield of a specific knowledge domain. No one has the right solution, which has to be constructed and refined in successive interactions between users.

Our target is to develop a Portal which maps the inputs of teachers and students dynamically improving the learning conditions. We consider that dynamic ontologies can offer an important contribution to this idea. Also topics of interest for the learners are key points for the success of the Portal. One must additionally consider time for the students to learn these map topics, which somehow will be well organized and structured with navigational features.

Furthermore the integrated element, *pedagogical ontology*, which is going to be developed, lies in the social networks. This is inserted in Web Intelligent as the next Web paradigm shift [4]. The Web can form the basis for establishing these social networks with intelligence, giving a self-organizing structure of users, information and expert communities.

After these contributions we came up with *saDOC*, which stands for a System Autonomous with Dynamic Ontologies in Collaborative environments.

This system is based on an open architecture with interoperability to other solutions in order not to produce but to reuse content already available through the World Wide Web. We believe that we have enough available information, but the information is scattered. The present powerful search engines, like Google, don’t give a unified result to our search. With scattered pieces of information we can reach some level of knowledge, but this only happens because we can build bridges along all these information, and know to some extent what we are looking for. It is this particular issue we are addressing here, these relationships between bits of information.

Some consider the field of pedagogy an answer to relate new concepts to old concepts. We also agree with this position and so that's why pedagogical and learning theories assume an important role in our Portal development. In fact we are sure that learning theories which lie behind the Portal will determine its success. [5] In chapter 2 we will present some learning theories which can clarify our heading. We do not intend to present an exhaust survey, but only some important learning theories we could apply to the Portal.

Next this paper introduces some key points to some technology issues namely ontologies as a tool of the Semantic Web for structuring maps; Social Networks Intelligence as a top layer of the system architecture; and try to use argumentation mapping with the members of the social learning network. In chapter 3 we will pinpoint these aspects as well as their common points of connection. In chapter 4 we will present our approach method to achieve what we are proposed to do.

Finally in chapter 5 some conclusions will be presented in a way ahead perspective. What are the learning theories behind our system? And what are the important technological aspects for building this dynamic Portal? What is the value proposition of our Portal and the new added value it brings? We will try to answer these same questions in the next chapters.

2 Learning Theories

We will give focus to constructivism theories and cognitive apprenticeship, where social interactions emerge, in a collaborative learning environment. These fields of study best describe the usage scenario of the technologies to be used.

Also some fundamental features, which must be a part of our requisites, can be mapped into the classification presented by Hein [6].

- 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 else we know, what we believe, our prejudices and 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.

We believe that a traditional class method can be complemented with the help of a dynamic learning Portal. Some authors call it B-learning, as for blended learning, where both systems interact. One key issue is undoubtedly the learner's goals and motivations which will determine the degree of interaction and engagement. But these issues are directly related to the teacher. He or she still has to do the job of learning and provide 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 Brusilovsky [7] argues, owe their popularity to being versatile. 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 dependent on this model.

The potential of moving these types of systems into the Web-based environment is appealing, and can be justified at least for two reasons: users of a Web system would increase compared to those of a traditional standalone application, therefore a personalization of the service would become fundamental; the other reason is that it leave more autonomy to a learner, better teacher assistance and collaboration between peer student.

Another field of research is CL (collaborative learning). A clear and useful description of this scenario is given by Dillenbourg [8]. Some aspects such as:

a) The number of people involved in the process,
b) The way people learn in collaboration,
c) The kind of collaboration instituted between the different actors,

must be taken into consideration when describing a CL scenario.

Also 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 process. 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 through the use of multimedia technologies and asynchronous interaction, its contents and methods are established 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 basically 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 place a learning process, or to support problem solving).

3 Technologies

Several technologies are presented next. Firstly, we will give credit to various researches in the semantic Web, which have enhanced the traditional web content to semantic web features, namely ontologies. Secondly, Web Intelligence technologies, that forms on the role and impacts of social networks intelligence into the development of intelligent portals. Finally, as far as learning Sciences is concerned, we will present not a technology but a possible usage of argumentation mapping to our structural map. Our purpose is to get use of all three issues altogether and not alone. This approach is quite new. In fact, I have never read this conjugation before. But the idea that lies beneath it is in accordance with the WI which is the new direction for scientific research and development of the next Web shift [9].

3.1 Semantic Web – Ontology

Mizoguchi and Bordeau [10] defined the "Instructional Design" paradigm as the evolution of Intelligent Tutoring Systems and Interactive Learning Environments. This new paradigm is fostered by the introduction of ontological engineering in the educational field.

There are three different kinds of ontologies that could support the description of a learning resource.

- *Domain ontologies:* the content would solve problems due to language ambiguities, and would evolve basic keyword queries into semantic searches.
- *Context ontology*: identifies 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:* 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[11], 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.

In a similar way, the author also outlines 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, the more complex and time-consuming the task is; moreover, achieving an 'objective' representation of a domain is next to impossible.
- The context within which an ontology is supposed to be used tacitly constraints the definition of its concepts; so, to have knowledge 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, and often the same things are defined differently.

A precise discussion of the relationship between SW and e-Learning is also offered by Devedzic, [12] 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 1).

We can briefly summarize its main features:

- Ontologies are the backbone of the system, they are used to codify different levels of shared understanding, like the vocabulary, the semantic interconnections, rules of inference, and the resources available are structured with semantic markups. 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 engage 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).

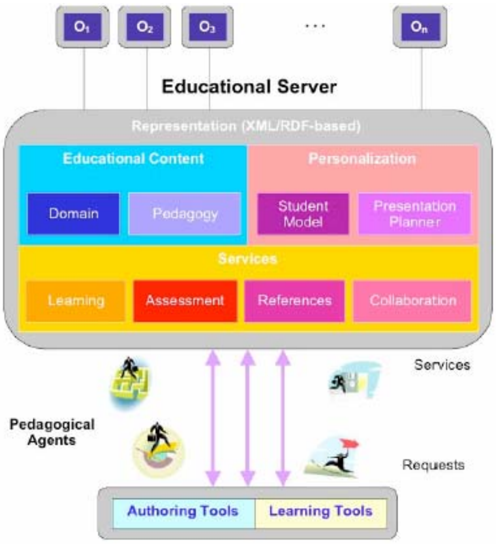

Figure 1- Schema of a Semantic Web Educational Server (Devedzic, 2004)

However Stutt and colleagues [13, 14] describe in a detailed way a scenario where one of the major problems of the SW, namely 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 this 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, the 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).

The interpretation of information is fostered by navigational capabilities. 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 the knowledge charts, information extraction for automatic ontology population, annotation and semantic browsing of the resources.

3.2 Web Intelligence- Social Networks

In Web Intelligent, the development of intelligent portals is based on the paradigm of Wisdom Web computing in which AI (e.g. knowledge representation, planning, data mining, intelligent agents, and social intelligence) and advanced IT (e.g. ubiquitous computing, social networks, wisdom Web and data/knowledge grids) are incorporated to make a reality of intelligent portals. Our field of interest is directly related to this strand but unfortunately there is no right solution to our problem. It's said that new tools and infrastructure components necessary to create intelligent portals will be produced but for the time being we have to wait to see their development. [15], [16].

However, one important contribution lies on the four conceptual levels.

- *Internet-level communication, infrastructure, and security protocols.* WI techniques for this level include Web data prefetching systems built upon Web surfing patterns to resolve latency issues. Prefetching routines comes from an adaptive learning process based on observations of user surfing behaviour.
- *Interface-level multimedia presentation standards.* The Web functions as an interface for human-Internet interaction. The Web interfaces require adaptive cross-language processing, personalized-multimedia-representation, and multimodal-data-processing capabilities.
- *Knowledge-level information processing and management tools.* The Web serves as a distributed data and knowledge base with semantic mark-up languages and agent-based autonomic computing functions (searching, aggregation, classification, filtering, managing, mining, and discovery).
- *Application-level ubiquitous computing and social intelligence environments.* This top layer establishes social networks that contain communities of people, organizations, or other social entities. Social relationships— such as friendship, co working, or exchanging information about common interests— connect these entities. The study of WI thus encompasses issues central to social network intelligence (figure 2) [4].

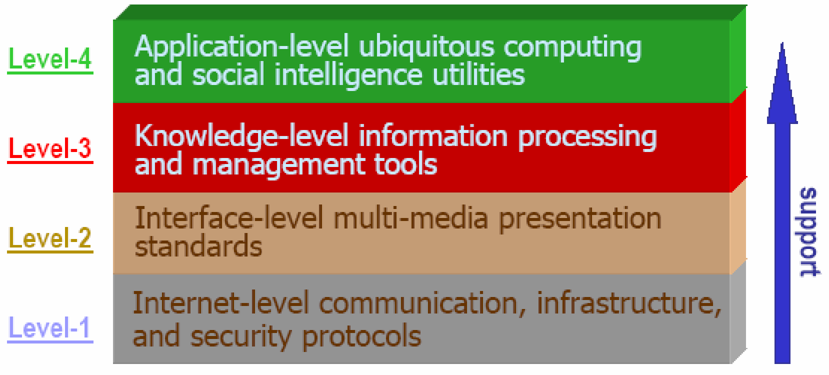

Figure 2 - Four Levels of WI Support (Ning Zhong, 2004)

Another contribution relies on the integration of Web local information or global information with the use of PSML (Problem Solver Mark-up Language), to collect content and knowledge from semantic Web. The core of PSML is a distributed inference engine that can perform automatic reasoning on the Web. It incorporates contents and meta-knowledge collected automatically and transformed from the Semantic Web with locally operational knowledge data bases. A feasible way to implement such PSML is to use existing Prolog-like logic language (such as KAUS) plus dynamic contents, meta-knowledge collection, and transformation agents.

In addition, the pages adaptative ranking gives a scoring and ranking of documents not only depending on the content of each document, but also historical behaviour of users who have conducted similar searches [17]. Some research using Fuzzy Logic with PROTOFORM language introducing the Concept of WIQ (Web IQ) gives interesting solutions to our dynamic issue of content ranking [18].

3.3 Learning Sciences -Argumentation Mapping

It is possible to define argumentation as a 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 external processes that are internal and private as reasoning and thinking. In opposition, 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 [19]. The author refers abduction reasoning as reasoning from observed data to a hypothesis that would explain them. Also 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.

But Walton believes argumentation can also be backward-chaining argumentation, used for instance in scientific explanation. So arguments can serve both to foster our knowledge, leading us from old premises to new discoveries, and to cement pre-existing acquisitions, devising new explanations for old theories (used in abduction and discovery). Or, on the other hand, argumentation can be considered a private activity aimed at justifying old ideas, revising new explanations for well-established concepts and, generally, defending conservative ways of seeing the world. This later case, despite being used in everyday argumentation, it is not of our interest, because our purposes is guide learners into critical thinking and enable them to reach wisdom.

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

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

Using such an approach, students should in fact learn how to question any chosen standpoint and motivate it with valid reasons.

The activity that should be enhanced in a learning environment is critical thinking [3]. 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. For us the interaction is a crucial aspect to understand some particular topic. Sometimes a student is not capable to break some barriers by himself, whether other students show no difficulty in performing exactly the same task, and by working closely together they reach a new level of knowledge.

Up to now our main concern has been to find the structure of argumentation and its implementation in a computer language, which could be useful to reach understanding and therefore learning.

Some difficulties are expected, namely different socio-cultural contexts are likely to have different validity criteria for argumentation. Also, the age and academic level of users will determine the educational interfaces based on argumentation models.

Stephen Toulmin in 1957 proposed a wider classification of the usages of argumentation, and a method to clearly map out the inferential and evidential relationships between the various claims involved in an argumentative structure.

This activity, called *argument mapping*, and the work of Robert Horn is fundamental in this respect. In [20] he uses maps which, the author says, tackles with 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: guidance through unknown areas. Particular attention is to be paid to the language which integrates words and visual elements. We are claiming that visual techniques to build, view and evaluate an argument tree constitute the guidance and the quality practice a learner needs in order to become a real ‘critical thinker’. We have no warrant this is true, but this is what we intend to find out in the results evaluation of the Portal.

From this point of view some interesting system can be found, namely the ScholOnto [21], which employs a detailed discourse ontology and gives an original way to make sense of different resources without drawing on any specific domain knowledge. It uses an approach called structural computing [22]. 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. It is our intention to do a deep analysis to this system and try to find out others like this before developing saDOC.

An interesting project that uses an argument based ontology with a visual tool associated is DUNES (Dialogic and argUmentative Negotiation Educational Software) consortium. They also consider the constructivist approach to learning and that learning would occur when the learners are fully engaged in what they are doing. Such engagement reaches its peak when learners are given the opportunity to discuss topics together. Therefore they consider achieving some engagement by introducing assignments to learners, introducing tasks and tools that guide and scaffold their learning. [23].

DUNES uses a visual argument representation of knowledge for better understanding and learning. The benefit lies not only in being able to represent the “pure logic” of an argument but also in running a coherent discussion while using argumentative ontologies.

The content of a DUNES-based course is developed in such a way that students may become - to a large extent, and imperceptibly - self-learners, while the teacher “facilitates” the discussion apparently standing aside (but actively, silently moderating the discussion) and letting the students learn as they develop their argumentative skills.

The maps add order to the discussion, clarifying its direction and smoothing its flow, while enabling a simpler representation of large amounts of information. Trends may then be detected; common views expressed and changed perceptions observed.

Another interesting diagramming software for the analysis of arguments is the Araucaria tool developed by Glenn Rowe and Chris Reed at the University of Dundee, UK [24]. This software tool supports argumentation schemes and is used for analyzing arguments. All arguments are saved in a portable format called "AML", the Argument Markup Language, which is based on XML. It's interesting to note that Araucaria is intended to be a tool for student, instructor, and researcher usage. Students learn how to reconstruct arguments, diagram them, and apply argumentation schemes. Instructors provide their own examples, sample analyses, and alternate sets of argumentation schemes. In research the instructor provides examples of argument analyses to support claims. It was written in Java.

4 Method

The goal to implement an open system in learning environments is a huge task as it has to construct and represent knowledge, supply services and functionalities in adaptable nets of learning. Nevertheless, having this objective in mind, it is easier to develop some tools that promote activities of learning, enabling knowledge to be more than a set of aggregate terms.

Therefore we are considering in using an available course management system like Moodle, which is free and is based on a social constructionist pedagogy .[25]

The construction of ontologies will be an important aspect of our project. Currently the open standard OWL (Web Ontology Language) and dOWL (dynamic Web ontology language), a sub specification on dynamic ontologies of W3C are milestones in this field. [26] With ontologies it's possible to generate graphs with configured topics and associations to carry reasoning, which can give answers to multiple questions based on the same knowledge. Furthermore this declarative structure allows learning to occur through inference and adapt behaviours based on the experience [27].

At this point we are considering the analysis of the KAON framework [28]. KAON is an open source ontology management infrastructure compounded of tools for ontology management and application. It is deployed with a set of tools that assist the user in understanding and browsing ontologies, retrieving relevant material, querying semantically annotated resources repositories, organizing the collected documents and updating the ontology.

Also we are considering trying some ontology systems such as Protégé [29], and Jena [30], in particular the use of RDF/XML (Resource Description Framework using Extensible Markup Language syntax) which allows XQuery and SPARQL (SPARQL Protocol And RDF Query Language) [31] to be used for searching. The possibility that Jena and Protégé offer to save in relational database format also makes it possible to use SQL (Structured Query Language). Using these standards it is possible to represent information in Jena, Protégé, or other ontology systems. All this flexibility is useful when different organisations are not all using the same systems.

Starting with the premise that knowledge is always associated with people and each one has a different approach to the same issue, it would be interesting to converge these structures of associated knowledge to a particular person into an integrated structure of knowledge. We will be able to call it *pedagogical ontology*.

An approach to develop such ontology is to use an argumentation based visual tool. Diagramming techniques are useful tools to negotiate a shared knowledge structure among people with different initial standpoints. In fact there are a lot of practical issues connected with the idea of using argumentation diagrams to foster knowledge integration among different people.

Some practical questions were raised and we will try to put forward in a concrete, although tentative, solution to some of these puzzles.

The Portal presented here must be learning subject independent. Any teacher should be able to use it with his or her students. To summarize our ideas we present it in figure 3.

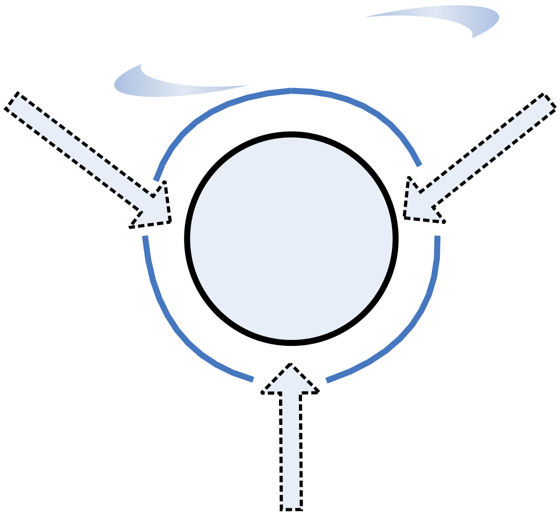

Figure 3 – Learning Portal functionalities

The core idea is to promote interaction between users. All the process will start by the ontology created by the teacher around a particular subject – Knowledge Map. But how would we manage different argument reconstructions among different users and with on line interaction around a particular learning subject? Because the Portal is intended to monitor all users' actions, the students will have to accomplish their understanding through a particular navigational map but they could leave clues for future users. The teacher will see the multiple paths used by the students and how they are coping with. If the learning objective isn't well reached then he will change the initial knowledge map. On a different level of interaction, the open discussion- the students have already managed to reach the learning objectives, they are invited to build their own learning maps by themselves, and then the system will try to merge all student ontologies with the teacher ontology. This aspect can be considered with social networks because the students must be organised and work between them. If the system fails, in this automated process, another possibility might be versioning the teacher ontology. In this case the students are invited to interact by adding in changes to the teacher ontology.

Furthermore it might be interesting to try to put some agent software to relate ontologies from different teachers, or different teachers can build ontologies step-by-step in a collaborative environment. This could be accomplished online by teachers for the same level of instruction.

Do we expect people to naturally converge on the same ways through different approaches to same subjects by using diagramming arguments? It would be interesting to build not a unique solution, but rather different approaches on an integrated point of view.

Do we plan to foster such convergence with suitable means? Well, we believe this is the main issue. First the ontology construction must assume interoperability between all the ontologies usage. I mean the systems ought to pinpoint the usage of Topic Maps [32] or rdf schema [33]. More certainly we will need to choose only one. In this case the majority is using accordingly to the W3C so we might choose this one.

After that we 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 will be our goal.

To sum up we are conscious this platform will have an increased proposal of value in the form of interaction between people. We are sure that joining efforts of the users in a collaborative environment will have best results on learning in an integrating manner.

5 Way ahead

On the next generation of Web empowered products, systems, services, and activities will emerge. This saDOC learning portal might be considered as a Wisdom Web system with services for knowledge construction.

On the other hand W4 (World Wide Wisdom Web) wants to discover the best means and ends to mobilize distributed resources to enrich social interaction, which is also our objective.

Therefore after presenting our idea and analyzing some relevant trends related to our problems, some enlightenment has appeared.

To summarise we are giving relevance to four points: (1) technology issues which are in a rapid emergence, inserted in the Semantic Web strand, namely ontologies, (2) learning theories background, giving particular focus to constructivism with cognitive apprenticeship, (3) external spatio-visual representations, i. e. argument maps, which play an important role in learning activities and finally (4) the social networks, where all actors will collaborate to enhance knowledge creation.

In the near future a detailed layer framework will be presented and the next step will be developing some independent blocks to have some test bed results.

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