Virtual Learning Space with Semantic Web Technologies

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Abstract
The learning process enables us to participate successfully in life, work and relevant communities. In the last decades, most applications that were developed sustained mainly the formal learning within educational institutions and training centres. As the core of practice and the place where we test our knowledge is the workplace environment, the purpose of this paper is to present the virtual learning space within a company and how learning can sustain and increase its efficiency. While formal learning is strongly needed as it sets the foundation landmarks of our education, informal learning builds practical experience, which translates in skills and abilities adapted to the workplace environment. Informal learning is the unofficial, unscheduled way people learn to do their work. In a networked economy, companies need to understand that learning is the competitive advantage. Learning is a productive adaptation to change. This represents learning with a purpose, learning that can extract the earning out of learning. EDU.PROJECT developed by Advanced Technology Systems, sustains the lifelong learning process by creating new learning spaces with semantic web technologies. In this paper we shall explore how the Web evolution can make workplace learning adaptable and flexible and how it has the potential to increase revenues, cut costs, accelerate innovation and develop the flexibility of a company.

Keywords: Informal Learning, Semantic Web Technology, Uniform Resource Identifier, Resource Description Framework.

1. Virtual learning space within a company

Industries increasingly rely on research and innovation. Innovation is characterized by an intense, collaborative process of generating and exploring ideas meant to contribute to the solution of particular problems. Innovators go through cycles of divergence, in which new ideas are generated and explored, and convergence, in which new ideas are valued and detailed. These cycles are built on knowledge elicitation (formal learning) and knowledge sharing (informal learning). In this respect, we propose herein to analyze the virtual learning space within an organisation to identify the strengths of efficient learning modelling.

Education, whether formal or informal, implies complex combinations of interactions between learners, instructors and technologies. At the present, the Internet can be defined as a
hard-working provider of information that lacks efficiency because it delivers information it cannot comprehend. The “Semantic Web”, a term coined by Tim Berners-Lee, refers to a vision of the next dramatic evolution of web technology where intelligence and meaning is being added to the display and navigational context of the current World Wide Web. Semantic Web developments can be used to build attractive and more successful educational infrastructures that facilitate access to content.

1.1. Learning Alternatives within Organisations

People are designed to never stop learning and exploring (Medina, 2008). Learning is what enables people to participate successfully in life and work. It is a knowledge-age survival skill (Cross, 2006) and companies have to consider the importance of its sustainable development. Most learning doesn't occur during formal training programs, but through processes not structured or sponsored by a school or an employer. To truly differentiate between formal and informal, we also find it valuable to examine what is learned intentionally or accidentally.

**Formal learning** includes the hierarchically structured school system that runs from primary school through the university and organized school-like programs created in business for technical and professional training.

**Informal learning** describes a lifelong process whereby individuals acquire attitudes, values, skills and knowledge from daily experience and the educative influences and resources in his or her environment, from family and neighbours, from work and play, from the market place, the library and the mass media.

![Figure 1. Learning Alternatives (Conner, 2008)](image)

*Intentional learning* is the process whereby an individual aims to learn something and goes about achieving that objective.

*Accidental learning* happens when in everyday activities an individual learns something that he or she had not intended or expected.
1.2. The Informal Learning Perspective

Informal education is a lifelong process by which every individual acquires and accumulates knowledge, skills, attitudes and insights from daily experiences and exposure to environment. We learn at work, en route, on the run, in context, in situ, through search, by accident, from children, in press, across TV, by mistake, ah ha! (Conner, 2008). We learn by reading, talking with experts, talking with peers, email or other written correspondence, and through a coach or mentor.

Generally, informal education is unorganized, unsystematic and even unintentional at times, yet accounts for the great amount of any person’s total lifetime learning – including that of a highly ‘schooled’ person (Coombs and Ahmed, 1974). Within this context, informal learning can be identified as intentional learning and a valuable resource we should learn how to use.

Although in the field of lifelong learning and of the learning society the focus remains on formal provision, qualifications and accountability (Smith 1999), we should also consider the importance of learning beyond classroom (Bentley, 1998), of the necessity of informal learning (Coffield, 2000) and of the informal and incidental learning in the workplace (Dale and Bell, 1999). Many state that informal learning and formal learning are at the opposite ends of the learning spectrum (Cross 2006), but we believe that learning should be regarded as a lifelong process, even if we are more or less aware of it, where informal learning is consolidated through formal learning. While formal learning provides a sustainable framework for our professional development, informal learning is a continuous process that composes the mass amount of our knowledge and it needs to be seen as fundamental, necessary and valuable in its own right (Coffield, 2000).

According to Atos KPMG Consulting, informal learning accounts for over 80% of learning that occurs in organisations today (Cross, 2006):

![Figure 2. Informal Learning in Organisations](image)

However, most corporations over-invest in formal training while leaving the more natural, simple ways we learn to chance.

2. The Business Case

Things change very fast. Everything is faster, more interconnected, and less predictable. Getting aligned with this new world is the road to profit and longevity for organizations, well-being and fulfilment for individuals. Knowledge is embedded in people and unlike information, knowledge creation occurs in a process of social interaction. As our service-based society is evolving into a knowledge-based society, there is an acute need for more effective collaboration and more effective knowledge sharing systems (Hamza&Stefan, 2007). The job environment has changed. Now corporate learning means keeping up with new things you need to know to do the job, maybe
even daily. The traditional barriers separating training, development, knowledge management, performance support, informal learning, mentoring, and knowing the latest news have become obstacles to performance. They are all one thing and for one purpose: performance.

If learning used to focus on obtaining a degree or a certificate, the new learning focuses on what it takes to do the job right. The workplace is an open-book exam. What worker does not have a cell phone and an Internet connection? Using one’s lifeline to get help from colleagues and the Internet to access the world’s information is encouraged. Besides, it’s probably the team that must perform, not a single individual. The new learning means having great connections sources that know, advice that helps and alerts to what’s important and ready answers to questions.

Capital Works reported that we learn at work through the following means (Conner 2008)

![Figure 3. Means of Learning](image)

Informal learning is the unofficial, unscheduled way most people learn to do their jobs. It is like riding a bicycle: the rider chooses the destination and the route. The cyclist can take a detour at a moment’s notice to admire the scenery or help a fellow rider. Formal learning is like riding a bus: the driver decides where the bus is going; the passengers are along for the ride. People new to the territory often ride the bus before hopping on the bike. Traditional training departments put almost all of their energy into driving busses. For experienced workers, most bus rides are as inappropriate as kindergarten classes. Mature learners, typically a company’s top performers, never show up for the bus. They want pointers that enable them to do things for themselves as executives want execution. They want performance. Informal does not mean unintentional. Informal learning is a profit strategy.
2.1. The Technological Perspective of Learning

One of the objectives of Learning is the delivery of individualized, comprehensive, dynamic learning content in real time (Devedzic, 2006). People and organizations need to keep up with the rapid changes and advancements of knowledge related to different disciplines, as well as to keep ahead of the rapid changing global economy.

The working place is an incentive, yet demanding environment that requires expertise. Real-time, accurate information is essential in a rapid changing world and the web technologies facilitate access to a diverse and complex structure of acquiring information. The convergence of the Internet and learning translate in using the Internet technologies to create, foster, deliver, and facilitate learning, anytime and anywhere (Obringer, 2005).

To comprehend the full potential of the Internet resources and how we can better their usability in virtual learning spaces, we need to follow their evolution, and analyse their impact. The Internet growth can be represented on four main level of development (Davis, 2008). If Web 1.0 was the web that connected and assured accessibility to information, Web 2.0 is the Social Web, focused on connecting people, “putting the “I” in the user interface and the “we” in the Web. Web 3.0 is the Semantic Web that aims to represent meanings and to connect knowledge, and Web 4.0 is the Ubiquitous Web will connect intelligence and will help people and things to reason and communicate with each other. We are now in the era of the transition from Web 2.0 to Web 3.0 when semantic technologies for consumers and enterprise applications emerge. How does this transition impact upon the virtual learning space within a company?

2.2. Building the EDU.PROJECT

Emerging technology has changed the focus of corporate learning systems from task-based, procedural training to knowledge-intensive problem-solving with deep conceptual learning. The learning space has to provide a viable construct for making sense of the array of systems designed to support knowledge management, document management, eLearning and performance support. A learning environment with a well-defined architecture can guide the convergence of multiple systems into a seamless environment providing access to content, multimedia learning modules, elegant access to content, ubiquitous virtual spaces, and authoring tools that enable content vendors, guilds, and universities to rapidly develop and deliver a wide range of learning artifacts.

Advanced Technology Systems – ATS promotes the development and application of Semantic Web standards to improve its ability to use data for generating new knowledge to improve future outcomes. In addition, expressiveness and versatility of formats that can be used has been leveraged to provide an appropriate terminology and accessible view of data.

EDU.PROJECT addresses the challenge to promote education driven alignment of EU RTD and Innovation efforts towards fostering Take-up of Semantic Technologies (ST) in business environments and contribute to a faster and widespread adoption of ST within enterprises by offering semantic solutions. It aims to provide a clear definition of benefits and opportunities of ST, i.e.: producing through technology educational content; identifying and understanding drivers and inhibitors for the uptake and deployment of new solutions in workplace environment and to facilitate community building, by promoting interdisciplinary exchange of knowledge, as well as shared visions for future coordination and development of the virtual learning space.

EDU.PROJECT provides new technologies for lifelong learning and creates next-generation support services to enhance competence building and knowledge creation in organizational settings. It introduces the notion of computer-aided semantic annotation of multimedia learning content. Starting from the acknowledgment of the weak points of fully
automatic annotation, and the observed gap between manual and automated annotation approaches, this proposal sets the new goal of combining human and machine intelligence to maximize the performance and benefits in a semi-manual annotation scheme. Therefore, instead of trying to substitute human intelligence, the machine will complement it. Hence the novelty of EDU.PROJECT lies in the difficult task of online aggregating human and machine knowledge with the ultimate target of minimizing human involvement in the annotation procedure.

2.3. Semantic Web Value

Much of the Informal Learning content is provided via the Internet. The demand for accurate content is constantly increasing. We have rapidly become accustomed to a wide network in which search engines provide potential hits numbering in the tens or hundreds of thousands for many relevant and important terms. Daily, tens of thousands more web pages of information are added to the net, yet our capacity to find and retrieve, much less manipulate and organize this material is only at a very rudimentary state. The Semantic Web deals with this challenge by allowing content to become aware of itself. This awareness allows humans and agents to query and infer knowledge from information quickly and in many cases automatically. Through the use of metadata organized in numerous interrelated ontologies, information is tagged with descriptors that facilitate its retrieval, analysis, processing and reconfiguration.

Innovation within organisations has been partially affected by the fragmented gathering and storing of data, reflecting the compartmentalization of science and practice in each domain of activity. It has also been affected by the programmatic necessity of keeping up with advances, which has led within every discipline to a multiplicity of special-purpose databases. Another issue relates to knowledge being expressed in ambiguous, idiosyncratic terminology specific to many domains. At the moment, knowledge is housed in modules that need to be integrated. Neither seamless integration nor simple extensibility of data stores is the norm. Without aid of a well-defined, standardized knowledge representation, the expense of ad hoc integration is formidable to impossible.

Semantic Web technology, and its various engineering specifications, seeks to remove some of these barriers, by combing a highly-distributable addressing and naming mechanism (Uniform Resource Identifiers: URIs) with a formal knowledge representation (RDF and OWL), a mechanism for rendering document dialects in this knowledge representation (GRDDL), and a common query language (SPARQL).

The multifaceted nature of URIs alleviates some of the accessibility challenges associated with physically separated components. The common knowledge representation empowers domain experts with a language for capturing terminology formally and with little ambiguity. Assertions can be added at a later point with no impact to the organization of physical storage and minimal impact on existing terminology. SPARQL provides a common query language for accessing assertions expressed in such terminology. Finally, GRDDL bridges gaps between messaging dialects and more expressive terminologies.

2.4. Simple Data Modelling: Semantic Web Made Easy

The Semantic Web is generally built on syntaxes which use URIs to represent data, usually in triples based structures: i.e. many triples of URI data that can be held in databases, or interchanged on the World Wide Web using a set of particular syntaxes developed especially for the task. These syntaxes are called "Resource Description Framework" syntaxes.
A URI is simply a Web identifier: like the strings starting with "http:" or "ftp:" that we often find on the World Wide Web. Anyone can create a URI, and the ownership of them is clearly delegated, so they form an ideal base technology with which to build a global Web on top of. A triple can simply be described as three URIs. A language which utilises three URIs in such a way is called RDF. The World Wide Web Consortium (W3C) has developed an XML serialization of RDF. The RDF XML is considered to be the standard interchange format for RDF on the Semantic Web, although it is not the only format. For example, Notation3 is an excellent plain text alternative serialization.

The first layer of the Semantic Web above the syntax is the simple datatyping model. RDF Schema was designed to be a simple datatyping model for RDF. The three most important concepts that RDF give us are the “Resource” (rdfs:Resource), the Class (rdfs:Class), and the “Property”. We can create a class called “Dog”, which contains all the dogs in the world:

```
:Dog rdf:type rdfs:Class.
```

Then we can say that “Happy is a type of Dog”:

```
:Happy rdf:type :Dog.
```

We can also create properties by saying what term is a type of rdf:Property, and then use those properties in our RDF:

```
:name rdf:type rdf:Property.
:Happy :name "Happy".
```

Why did we have to say that Happy’s name is Happy? Because the term “:Happy” is a URI, and if people can guess what we refer to the name of a dog, machines cannot.

RDF Schema has other properties we can use. If we want to say that the class “Dog” is a subclass of the class “Animal”, we simply say:

```
:Dog rdfs:subClassOf:Animal.
```

Thus, when we say that Happy is a dog, we are also saying that Happy is an Animal. We can also say that there are other subclasses of animal:

```
:Duck rdfs:subClassOf:Animal.
:Bear rdfs:subClassOf:Animal.
```

Then we can create new instances of those classes:

```
:Quacky rdfs:type :Duck.
```

And so on. You can see that RDF Schema is very simple, and yet allows one to build up knowledge bases of data in RDF very very quickly.

The next concepts which RDF Schema provides us, which are important to mention, are ranges and domains. Ranges and domains allow us to say what classes the subject and object of each property must belong to. For example, we might want to say that the property "bookTitle" must always apply to a book, and have a literal value:

```
:Book rdf:type rdfs:Class.
```

And rdfs:domain always says what class the subject of a triple using that property belongs to, and rdfs:range always says what class the object of a triple using that property belongs to.

RDF Schema also contains a set of properties for annotating schemata, providing comments, labels, and the like. The two properties for doing this are rdfs:label and rdfs:comment, and an example of their use is:

```
:bookTitle rdfs:label "bookTitle".
rdfs:comment "the title of a book".
```
Once information is in RDF form, it becomes easy to process it, since RDF is a generic format, which already has many parsers. With Semantic Web it becomes easier to publish data in a repurposeable form that can be processed by anyone.

3. Conclusion

Although the most valuable learning takes place serendipitously, by random chance, most companies, however, focus only on formal learning programs, losing valuable opportunities and outcomes. It is time to consider that informal learning is the driving force of the real learning culture of the organisation, and if managers can influence this, they will radically change the way their organisation learns.

To truly understand the learning in an organization we need to recognize the informal learning already taking place and put in practices to cultivate and capture more of what people learn. This includes strategies for improving learning opportunities for everyone and tactics for managing and sharing what you know. Semantic Web developments can be used to build attractive and more successful educational infrastructures to facilitate access to content.

REFERENCES

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