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1. Introduction. A Linguistic View of Learning

In the light of new technologies for communication, networking technologies and interactive tools are increasingly being adopted at any educational level. There is a major advantage in this adoption: a notable independence from restrictive temporal and geographical constraints linked to information delivery and retrieval.

Despite some inevitable disadvantages – like the cost of setting up and maintaining all the components of a network – the learning community is working toward understanding the basic principles behind online learning. These principles should be found within the domains of *place design* and *educational taxonomies*. Design principles can be applied in conjunction with educational principles to produce more efficient learning environments. As learning and teaching are seen to be the two sides of education issue, strategies can be adopted to target them both, simultaneously.

Traditional learning methodologies looked at how the transfer of knowledge – from who has it, to who does not – could be supported and facilitated; the focus was on the *teaching* phase. Techniques to improve the quality of communication (for example, speaking skills, taking notes, and vocabulary acquisition) were taught as part of the curriculum. It was important that learners and teachers had a common understanding of the linguistic register used in teaching a subject, so a common set of words could be shared unambiguously. The physical interaction in the classroom was aimed to resolve any possible ambiguity derived from the teaching process. Yet, the learner was still treated as a passive component of the experience, and was pointed toward improving techniques of text analysis and replication. Little was left to a sincere feedback on the educational content and "knowledge transfer" techniques.

Online educational environments address the educational objectives by putting the learner at the centre of the educational experience. They do so by addressing many of the problems that traditional learning environments presented. For instance, using repetition – that is, going over and over again the same concept, perhaps presented in different forms – was used as reinforcement in a traditional environment by putting the same question worded differently, hearing differently worded answers. Many learners might have been annoyed by this procedure. In online educational environments, actions can be taken to eliminate unproductive phases and materials, and to stimulate learners to dig for information and practical examples. Moreover, database technologies can greatly help the dynamic and low-maintenance generation of online material. How all these technologies are working together, synchronised and in an harmony of data, needs to be carefully planned and organised, in order to avoid the most common, and frustrating, technological pitfalls.

Language can be used to unify the numerous kinds of information that have to be included in online educational material. Natural verbal language – words – can be seen as the key to navigate in the information space. Many web based technologies also have adopted words as a way to navigate throughout that un-hierarchical and unstructured database that is the Internet (Kurmann, 1999). Other examples of how verbal, visual and music languages can be used to browse and retrieve information in database-like environments, have been conducted using Java technologies and interesting metaphors, like geographical maps, architectural buildings, and museums (Hirschberg, 1998; Plumbdesign, 1999). Natural language has got many advantages when used for navigation: it is intuitive and immediate; it does not have to be learnt by a user, who should be able to adopt it with minimal effort; its basic grammar and syntax can be used as instruments for navigation and retrieval of information; words can be used as metaphors to recall common concepts and operations.

I propose to use natural language as a learning tool, by using it as:

- a navigational tool – where keywords help constructing a thread then used as a path to move around the online space
- an organisational instrument – that helps a learner to sort out the information that she needs in order to construct her curriculum
- an administrative tool – via the use of text based queries, data is sorted, inserted, and maintained accurate, so it reflows always updated into the online place.

I have experimented some of the tasks above using a variation of a traditional tool – *concept mapping* – as I believe that having data visually represented helps the learner to define his educational goals more clearly. In this paper, I present preliminary results and findings on analysis done on online learning, its stages and facilitating solutions. The sections that follow are an intertwining of supporting literature, empirical research results and methodological fundamentals of learning, education and representation techniques.

2. Stages of Online Learning

Planning an online educational experience starts with identifying some stages through which learners will gather the information and develop the expertise needed to reach the educational goal. By designing and teaching in online educational environments, I have identified some of these stages, which can be used as parameters for the design of the learning environment and for the composition of educational material:

1. the *generalisation* stage; in this phase the learner is introduced to the background information related to the subject he is about to learn, and is confronted for the first time with the instruments that he will use in the learning experience. It is very important in this stage to present clear and unambiguous material, and provide simple and intuitive tools, so the learner is encouraged to pursue the experience further. The combination of environment – often at this stage identified as the interface – and the content has to be transparent and intuitive. Many learners drop if this phase is not kept minimal and simple;
2. the *focussing* stage; here the learner has already grabbed the principles of the subject studied, deriving them from the background of the generalisation phase, and is now focussed on the development of a specific understanding of topics and skills involved in that subject. It is in this phase that usually the learner understands better why she has chosen that subject and why she should continue with the learning experience. This is a critical phase in which the learner has already spent a considerable amount of time in the generalisation phase, and might become very frustrated if the problems and material presented are not appropriate for her current expectations. The frustration may become disappointment, and eventually abandonment of the learning experience. It is a task and a priority of the educational designer to make sure that the material is introduced gradually and the learner has all the instructions available to be able to follow that material;
3. the *application* stage; in which the learner comes across problem solving activities and applies the principles acquired in the previous two stages. Usually this phase is quite creative and the learner enjoys the first attempts to apply his fresh knowledge. The quality of problems presented in this stage should be in accordance with the material presented and the educational goals. Problem solving can be challenging and enjoyable, as long as the learner has already gathered the needed knowledge and skills. This phase is definitely the phase where computer based learning instruments can be used, as they allow quick tests, evaluations of problems, and trial and error procedures. Trying different techniques and solutions is a learning technique in itself, which can stimulate curiosity and lateral thinking. In this phase, also, the peer group is fundamental to support weaker and slower learners, who need help in order to overcome their difficulties;
4. the *consolidation* stage; after the majority of information has been passed onto the learner, there is a clear need of consolidating that information so that it is absorbed in a longer timeframe. This is achieved by: summarising previous information, proposing new problems or new solutions to old problems, and relying on the peer community to counter check the validity of what has been learned. The repetition of applications and the communication with other members of the learning community makes consolidation faster and more effective. Moreover, research demonstrates how consistently the repetition of information plays a major role in refreshing and consolidating knowledge.

The above stages are all necessary to reach a sensible level of understanding of a subject. Literature supports repetition as a means to reach consolidation of information: the more a piece of information is repeated, the more it is made available to a person, thus, it can be retrieved more easily and quickly (Weiten, 1994). In particular, Weiten describes three phases of how memory works, which is partly related to learning techniques: encoding, storage and retrieval. The first two stages – encoding and storage – can be easily achieved with online tools, for

example, by presenting information in a certain format, and letting the learner customise its presentation. The third stage – retrieval – supports the use of the information collected. Retrieval is linked to the consolidation stage, and supports the organisation of information in a structured framework.

Organising information becomes more important as the quantity of information increases, as the following graph shows:

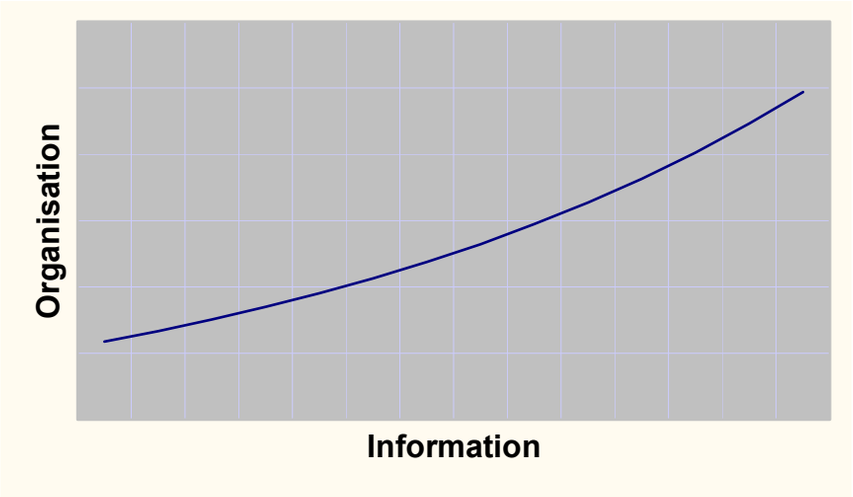

Figure 1. Quantity of information and need of organisation

Some instruments, like concept mapping tools, can make a tangible difference when more organisation is needed, but also at the beginning of the learning experience. At the beginning, the learner not only needs to set her parameters for the organisation of information, but also needs to lay out in a structured framework the subsequent steps of the learning process. The sooner the learner is able to qualify how to approach a subject in a structured framework, the sooner she will be able to pass from the generalisation to the focussing stage, thus making the learning experience more effective.

In the next sections, concept mapping is described as an instrument to facilitate learning and its phases, also referring to traditional learning techniques and taxonomies.

3. Concept Mapping as a Learning Tool

As learning becomes more and more a self-directed experience, the community of learners and educators is looking for tools that enhance self-driven knowledge acquisition. In the traditional taxonomy of learning (Bloom, 1956; Bloom, 1964), the cognitive domain, which is considered the core of learning experiences, includes these stages:

1. Knowledge; where the learner is engaged in activities like remembering, memorising, recognising, recalling identification and recall of information;
2. Comprehension; with activities like interpreting, translating from one medium to another, describing in one's own words, organisation and selection of facts and ideas;
3. Application; which includes problem solving; applying information to produce some result; use of facts, rules and principles;
4. Analysis; which looks at understanding how something has been put together; finding the underlying structure of a communication; identifying motives; separation of a whole into component parts;
5. Synthesis; a process that aims to create an original product, and to form a new ensemble using ideas that come from the analysis process;
6. Evaluation; in this phase, a learner makes value decisions about issues; develops opinions and judges decisions, and resolves ambiguity regarding a certain problem.

These stages generally occur in this sequence, and, according to Bloom, they are achieved in a progression, from the simplest to the most difficult. In traditional learning techniques, each phase is approached using educational material in the form of written text and exercises. At times, exercises (especially useful in phase 3 – Application) are done in a more manual way, by manipulating objects and observing effects.

I propose that concept mapping can be used to achieve some aspects of the all the above stages of the learning experience, using keywords as drivers through the learning material.

Concept mapping can be described as a process through which one or more participants, using brainstorming techniques, create a map using keywords that are representative of a specific concept. The result of a concept mapping session is a concept map: a series of words laid out in a graphical representation, with reciprocal connections and links. The information collected in the map is easily accessed by looking at how the relationships between words or concepts have been outlined. Concept maps are most useful for visual learners, who can memorise information contained in a picture, and for learners who have good synthesis skills.

Concept mapping has been used in the training of teachers to increase their awareness of the subject taught (Ferry et al., 1998), and by students to reach a better understanding of certain information (Downing and Morris, 1984). By summarising the subject using keywords and linking these keywords to create a map of relationships, individuals are able to clarify for themselves what is involved in a certain subject or communication, and be more effective in using that information. Literature reports on the benefits of concept mapping for organising information, assisting in learning, comprehension of particularly complex communications, refining meaning and literary framework, improved clarity, and successful understanding of the text (Novak, 1984; Novak et al., 1983; Ruddell and Boyle, 1984).

Classical uses of concept mapping have been associated mainly with text comprehension and organisation of written information. As a learner goes through the text, he takes notes on the side. He will use these notes later to memorise the text information. While annotating, the learner is taking possess of the information, and he is somehow re-writing it in order to memorise more effectively. This process is very known and experimented by learners. When constructing a concept map – the result of a concept mapping process – the information collected during the reading is used as a list of keywords representative for that text. Keywords are then organised in a diagram that shows how they are related to each other. It is not a task for the teacher to judge which concept map works better; instead the teacher/coach should help the learner to carefully craft his concept map, so it represents a useful learning instrument.

White and Gunstone (1992) list six uses of concept maps:

- to explore understanding of a limited aspect of a topic;
- to check whether learners understand the purpose of instruction;
- to see whether learners can make links between concepts;
- to identify changes that learners make in relationships between concepts;
- to find out which concepts are regarded as key ones; and
- to promote learner discussion.

Concept maps are then used as reference for a certain issue, as visualised in the following:

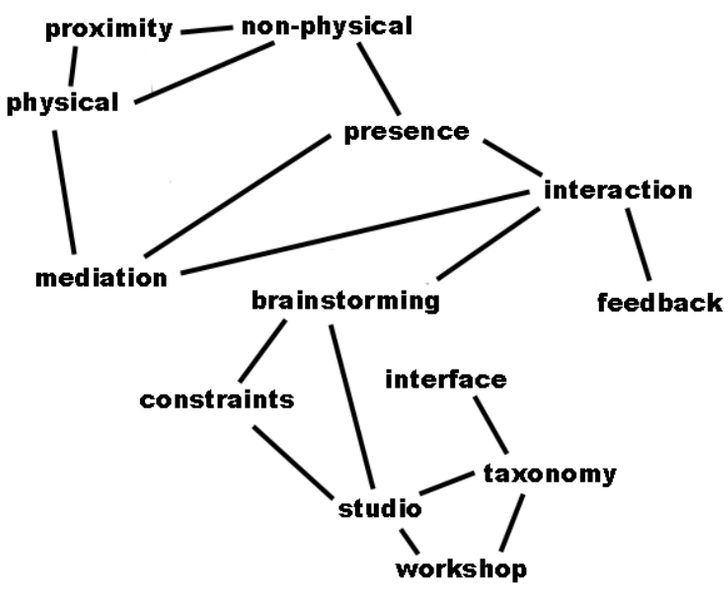

Figure 2. An Example of Concept Map

In the picture above, each word is linked to others not by meaning or specific linguistic reference, but by that learner's understanding of the connections between concepts. What links two words together for one person might be completely different for another. *The purpose of concept mapping is not the production of a map which represents in absolute terms the relationships between concepts, but the production of a visual layout, which can make that specific issue clearer – and certainly more understandable – to the learner who produced the map.* It is fundamental for the success of the learning experience, that each learner produces her own concept map. This for obvious reasons: using somebody else's schematisation of a concept is as difficult to retain and use as it would be to impersonate that person's mental structure.

Some authors present concept maps as flowcharts of ideas, with defined hierarchical levels for each concept and connection (Kelly and Odom, 1997), or with different visualisation techniques that cluster information together (Trochim, 1989). These flowcharts can be read linearly, represented visually with symbolic items like arrows, boxes, circles, like in the figure below:

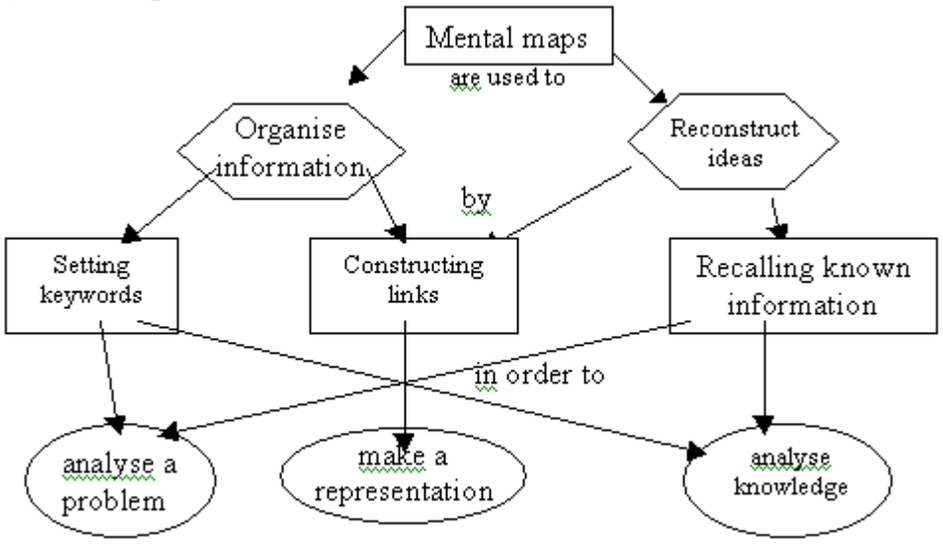

Figure 3. Concept map as a flowchart

An advantage of using concept mapping as a leaning technique lies in the possibility to have a visual representation of information. Being able to vary the quality of the representation – for example by using colours as keywords backgrounds – helps substantially the learning process. Literature on the advantages of concept mapping for learning and training purposes is wide and well established (Ault, 1985; Mikulecky et al., 1989; Novak, 1984; Novak et al., 1983; Okebukola and Jegede, 1988).

With the visual representation of keywords on a map, a learner is also able to refine language and vocabulary, identify the key issues of a text, organise these key issues into a meaningful chart, re-use the map in the future with a reasonable success. Constructing concept maps gives learners improved confidence of the content: they feel that they can master information, for example, by linking it to previous readings, incorporating it with more ease into their knowledge frame. For teachers, maps are useful if they are constructed to reveal the connections between the various aspects of a subject, thus opening the opportunity to more examples and clarity in the teaching. Concept mapping can also be used as a collaborative tool for learning and training purposes.

4. Concept Mapping as a Collaborative Tool

Usually the learning experience is seen as individual and unique to each learner. Using collaborative tools in learning experiences has been the subject of recent research on how effective learning becomes when done collectively (Davidson, 1998), and within computer mediated environments (Gay and Lentini, 1995). This research shows that while learning requires a "quiet" phase of knowledge acquisition and comprehension, it also benefits from the interaction with others who are trying to achieve the same educational level.

Collaboration is seen as a result of successful interaction between parties: only when the participants can agree on the majority of issues, or "agree to disagree" as it is often proposed, then collaboration is successful. The

results of collaboration are usually recognised as a collective effort that has taken input from most of the parties, each one will try to reach the maximum level of satisfaction, or the minimum dissatisfaction. However, learners see the experience as involving mostly the individual, and rarely it is seen as a collaborative activity. Notwithstanding the learners' perception, there is evidence that learning can also become a collaborative activity by using techniques that engage multiple parties (Hoadley and Hsi, 1993). Learning can then be seen as a continuous collaboration between the learner and what surrounds him. Traditionally, learning was a face-to-face activity, which involved tutors in charge of "troubleshooting," that is, solving problems as learners encountered them. New communication technologies applied to learning, mostly using Internet protocols, shall consider collaborative issues in the design of material and techniques.

Concept mapping is a technique that can involve multiple parties, especially in the preliminary phase of collecting keywords regarding a particular text. In a brainstorming session, all participants are engaged in an activity that results in the creation of a list of keywords. Individually, each participant organises the keywords in a map and then confronts them with the others. From the comparison, the individual can understand more about her own concept map, and modify it in order to be more comprehensive and thorough. Collaboration is achieved when each individual is able to criticise and modify her map by learning from others in the same group.

Concept mapping falls very well in the category of constructivist learning (as theorised by Bruner, 1966), which are mainly self-driven and aim to stimulate the learner to find his way through the educational material. It also enhances those individual aspects that are involved in personality description. In other words, each learner is left free to choose the modalities of his experience. This is even more obvious when using computer-based learning instruments.

In an informal survey conducted by the author after the majority of a semester course was totally run on a computer-based learning environment, students declared that the computer environment facilitated collaboration (87.5%), but at the same time most of them (54.2%) preferred face-to-face lectures to computer-mediated ones. Students were asked to collaborate in online design sessions using a variety of environments; for most, the collaborative sessions lasted more than one hour (58.3%), with a net majority of students using a videoconference-based environment (91.7%). The main advantage attributed to taking a computer-based course was identified in the possibility to access the learning material from anywhere, any time (45.8%), followed by the possibility to put questions that normally would not be put in face-to-face interactions (20.8%). Only a small percentage of students (12.5%) thought that a traditional lecture style course was better for them; yet, a considerable number of them were not decided about their preference (41.7%). In a final survey, asked to recommend whether to continue to run that course totally online or not, about 60% of students answered positively, 30% were not decided, and only 10% disagreed, and felt a traditional based course was a better option.

Although the literature regarding whether computers ease or block collaboration is substantial, there is not a definitive result on the impact of technology on the collaborative process. Computer-Mediated Communication (CMC) literature has not provided unbiased methodologies to understand processes behind collaboration (Kiesler et al., 1984; Lea, 1992; Matheson and Zanna, 1989; Walther, 1992), neither has it focused on CMC aspects engaged in learning (Kaye, 1992; Koschmann, 1993/1994; O'Malley, 1995).

In the learning experience, there is definitely a moment in which an individual needs to focus on issues that are specific to his interests or capacities. This phase can become particularly intense and difficult if the learner has not assimilated well enough some of the basic concepts. Mental processes that lead to the organisation of learning material into visual maps seem to be particularly helpful for understanding parts of a topic, which normally would escape even a careful reader. Moreover, when a group of people is concentrating on the same issue, without a competitive driver (like a test), more collaboration is observed, and therefore, the learning experience becomes more engaging while it is shared with other. Often learners help each other in a peer-who-knows to peer-who-doesn't-know relationship, which is extremely beneficial for both parties. Experiences done on pre-service teachers show that learners can influence each other in the way they approach a particular topic and especially in the way they analyse and evaluate it (Ferry et al., 1998).

Brainstorming activities resulting in visualisation of ideas and directions are traditionally used at strategic and co-ordination levels. Most importantly, the use of visual signs aids reduces the ambiguity of concepts expressed verbally. Visualisation of ideas into flowcharts reduces the amount of words used to synthesise concepts, and therefore makes the collaborative process quicker and more thorough.

Using online tools, collaboration is enhanced by virtue of the connectivity that a network provides. The learning experience, seen as a collaborative process, relies on the flow and currency of ideas among participants. An individual learner can benefit from the shared environment, when the learning community – that is the group of people involved in the same learning experience – provides instruments and information that assist the final learning achievements. One of these instruments that uses the capabilities of the online environment is a concept mapping tool that is linked to databases containing educational material, and can be mapped using visual tools.

5. Current Research and Open Discussion

As online learning is becoming a requirement for educational institutions, an increasing amount of research needs to be done to define the design principles behind collaborative environments for online learning. Designing learning environments using new communication technologies, and in particular the Internet and its protocols, raises issues about:

- the kind of content that can be delivered effectively using online tools;
- the learning stages that need to be considered when organising online educational material;
- the various approaches from the learner's and teacher's sides to make the learning experience as effective as possible.

Currently, research addresses only tangential issues involved in online learning techniques, such as interface design, and the generic collection of educational material that is then transposed into Web compliant formats. Educational environments that fail to provide a hierarchical collection and access to information also fail to remain flexible and open to new developments. For example, an educational environment that only relies on Web based material – eg. formatted in HTML – will only allow the learner to read from the screen, or print on paper, without being able to annotate, cut and paste, link and enrich what is being read directly on the Web page. Learning is *taking posses of and mastering information*: that is manipulate, modify, and customise it to one's needs. High flexibility must be given to the orchestration of learning material.

The best examples of online educational environments are not the ones that present the educational material in a graphically captivating way, although the interface is fundamental for accessing the online material. The most successful ones are those which allow maximum flexibility, for example by supporting multiple protocols and formats, at the same time providing a solid and stable structure that learners can recognise over the course of their learning event. Concept maps used as navigational tools provide an excellent and flexible instrument that each learner can personalise to her needs and skills.

Concept maps have got the double advantage of visually represent an information map and linking it to useful material contained in a database. The learner does not get lost, has a referring map to which she can come back to review previous steps, and, mostly, learns how to organise her information so "it makes sense" for her. This stimulation is of great aid in the last stages of learning, when information needs to be readily available in order to be used.

Internet technologies are an optimal ground for the development of a variety of tools that can be linked to each other, forming a consistent network of information and formats. The TCP/IP protocol appears to be the winning technology for the transmission and sharing of data. Accessibility and standardisation of these protocols will allow in a near future to have more integrated and stable environments for learning and training.

Much research and hypotheses have to be tested before stating valuable conclusions on the principle of online learning. In this case, empirical research tests hypotheses even before the latter are formulated. At this stage, there is not a definitive ground on which we can implant strong principles for the design of online learning environments. However, it is easy to see the great advantages and effectiveness of online learning, coming from all directions and converging into the multifaceted flexibility of the synchronous media. This opportunity itself makes the quest worth pursuing.

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