In-depth Learning Through Conceptual Navigation in Virtual and Hyper Space

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Abstract

WWW-based technologies offer a wide spectrum of communication facilities in professional organizations. Two main paradigms emerge as it comes to the question how to manage and facilitate the synergy between domains of expertise and how to make knowledge effective. The first paradigm is closely related to the traditional method of delivery courses, documentation and quality control via proven procedures. Its accent is on the consolidation, validation and broadcasting of expertise via courses. Life-long learning in this paradigm is the attitude at the employee to stay receptive for ever-new information, and the attitude to be willing to change oneself. The second paradigm is based upon human resource management, the learning organization and the impact of peer-to-peer learning. Its underlying notion is that expertise is between rather than in the individuals. In other words: knowledge manifests during the interaction when several persons are sparring on a certain decision or design task.

In this presentation I will bring forward how new methods and tools allow teams to share expertise so that the quality of the team solution exceeds the best individual solution. The strategy to achieve this result is to assess cognitive styles and make team members aware of the added value of complementary personalities. As e-technologies offer new unique pedagogical methods to enhance student learning, it seems to be an urgent and valid question how to manage learning communities within and between business sectors that have only few disciplines in common. The key mechanism in the procedures for generating, sharing and managing expertise is in finding appropriate representations that allow specialists to express and apprehend conceptual networks. Concept Mapping and Mind Mapping are such techniques that elicit the human mind to become aware of tacit knowledge. Also conceptual representations make it easier for partners to accept the difference in generated ideas and to share underlying intuitions for critical stages in problem solving. In demonstrations it will be explained how conceptual representations for orientation and navigation get more and more impact in the training sector. In the next decade these methods become vital for learning in Virtual Environments like VR learning games.

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I. Conceptual Awareness for Learning the Unknown

The introduction of technology in the domain of learning and teaching is not new. Mankind has used external representations from the early beginning in order to get more grip on the world, but also on his/her own mind. Famous examples are the drawing, the map and in particular nowadays the video registration. As vectorized representations were introduced, it became questionable if and how this flexibility could be used as a tool for learning. Computer Simulations, Expert Systems and nowadays Virtual Reality and Agents for extending our actions, are good examples. In this presentation I will elaborate on the continuous tendency to reify knowledge and concepts as informational objects rather than processes. Concept mapping is one of the more prominent members in the family of cognitive tools. Its role is not restricted to learning; its functioning can best be classified as "facilitator for idea generation." The question to be addressed in the presentation and discussion is if and how we can further extrapolate the concept-oriented approach for the further formalization of media-based learning?

II. Conceptual Support for Learning

The intelligent support of learning cannot simply build upon existing didactic or pedagogical theories; it needs to re-analyze the nature of learning as theories from the past were developed in contexts with a different infrastructure. Even further: the existing theories on learning were created because of "new" technological paradigms and artefacts rather than "clean" psychological or hermeneutic research. The current dominant paradigm in learning and teaching is still one of "shaping behaviour": The teacher, the situation and the media should provide the right information and control to the student. The leading themes are behaviourism and control theory. Alternative approaches from the era before the information age were scrutinized or just forgotten.

- The narrative learning theory is one: it claims that learning is essentially an existential process where learning partners can only really share experiences and under

standing if they are willing to access the level of one's life story. "Woven stories" is a research project in co-operation with the group of Erkki Sutinen; Joensuu University (Finland); Gerdt et al [3] and Harviainen et al. [4]. Its basic attempt is to formalize the building and dynamic reallocation of story fragments so that learners experience semantic transitions rather than end-points of information trails.

- Learning by imagination (Anschauung[1]) is a second one. It postulates its main approach that learners need to get access to the essence of a topic to be learnt by exhaustive observation and contemplation. Quite often this paradigm is narrowed down to the attempt for more and more realistic visualisations. In fact the Kantian thesis on "Anschauung" pleads for the mental- instead of the visual imagination. Talking about Virtual Reality, it is entirely the question if and how far visual expressiveness helps the learner to understand and remember. Egan and Nadaner [5] have again articulated the mutual dependency between Narrative discourse and imagination.

- Conceptual awareness is a third dimension that seems to be ignored in the attempts for new learning systems.

"… So our initial teaching might begin with the myth stories that explain, in an affectively engaging way, the vital importance of heat to human life, along with its attendant dangers. Thus we can tell the stories of Prometheus and Zeus and of Sol and Phaëthon, and we can tell of Hephaestus limping around his smithy. The daring of Prometheus in giving fire to humans and the terrible punishment meted our by Zeus show the importance that control of heat has played in human civilization. It is a power that has made us like the gods. Phaëthon's escapades show what destruction can follow when this terrible servant gets out of control…"

Memory, Imagination and Learning: Connected by the Story.
Kieran Egan[2]

"Though a long tradition on the development of concepts during the early schooling phase is well-known, it has not well penetrated the practice of learning tools nowadays. The basic principle of concept-formation (which states that the omitted measurements must exist in some quantity, but may exist in any quantity) is the equivalent of the basic principle of algebra, which states that algebraic symbols must be given some numerical value, but may be given any value. In this sense and respect, perceptual awareness is the arithmetic, but conceptual awareness is the algebra of cognition."

Ayn Rand in <http://www.aynrand.org/objectivism/pobs2.html>

The central thesis to be defended here is that the information age has articulated the informational aspects in learning. The WWW is the obvious manifestation of the learning resource. Searching and exploring are the dominant ways to reach the information that you may need. The reorientation towards the three aforementioned developmental aspects of learning is supposed to bring a necessary complement in the resource-based learning approach that is dominant today.

III. Learning and the Nature of Concepts

Human learning and -development is a process that occurs even in rather poor conditions. Information management, meta-cognition and incentives like competion and cooperation are stimulators, but not exclusively prerequisite for learning. In many situations we see the learning process as a side effect. At the same time the pre-arranged learning (often called "instruction") tends to incorporate more elements of the incidental and situated learning. These and the more epistemological studies make it clearer that concepts are not abstractions; they are situated in real episodes of human life and it is hard to overrule them by formal facts or procedures. One of the more observational phenomena that support the experiential nature of concepts is the fact that they allow a quick and diverse generation of new knowledge. This would be hard to describe in case concepts were systematic and formal derivations of subsumed objects or categories. The power of concepts is in the fact that they serve both as formal and perceptive anchors; At the moment of encoding not all features need to be included. At later stages, some of the initially trivial features can be restored so that unforeseen attributes of the encoding situation become re-activated. As concepts emerge between large and mutually irreconcilable knowledge domains, it is the question what precisely their role is. An important function of concepts is its metaphoric capacity: One conceptual context can easily be mapped upon an other context; for instance the easiness by which a student takes up a social mechanism between parents and applies it for making an excuse to his/her teacher. The swiftness of concepts brings us to a deviant apprehension of its nature. And again we see here an unnecessary side effect of our imagination of the human mind as an information processor: As if knowledge is data rather than a program. Concepts as side effects of inter-situational knowledge can easily bee seen as 'broken particles' that allow the larger knowledge chunks to slide side by side; they act as bearings. To make our imagination of concepts still more clear, we can say that concepts are "transitions" rather than "states"; they emerge willy-nilly during the fast interchange of topics due to external pressure or the flow of discourse. This may explain why asynchronous communication reveals a smaller

idea output than the face-to-face sessions. Though often explained in terms of perceptual richness, it is more likely that the key factor here is rhythm that makes the real–time interaction more productive. The notion of concepts as transitional entities, conflicts with the standard representations like concept maps. Here the nodes are descriptive entities, close to objects. The links are relations and manifest as bridges between the given facts. The relation as operator and the node as operand seems quite evident from a grammatical / epistemic point of view, but questionable if we observe the way concepts behave as interchanges between states of thought. A more in-depth discussion on the epistemic versus semantic nature of concepts can be found in Yeh & Barsalou[3] [7]. They claim that concepts take different forms across situations, with each form containing properties relevant to its respective situation, and that situational information enters into a wide variety of tasks as long as conceptual knowledge must be accessed, not when it can be bypassed using superficial response strategies.

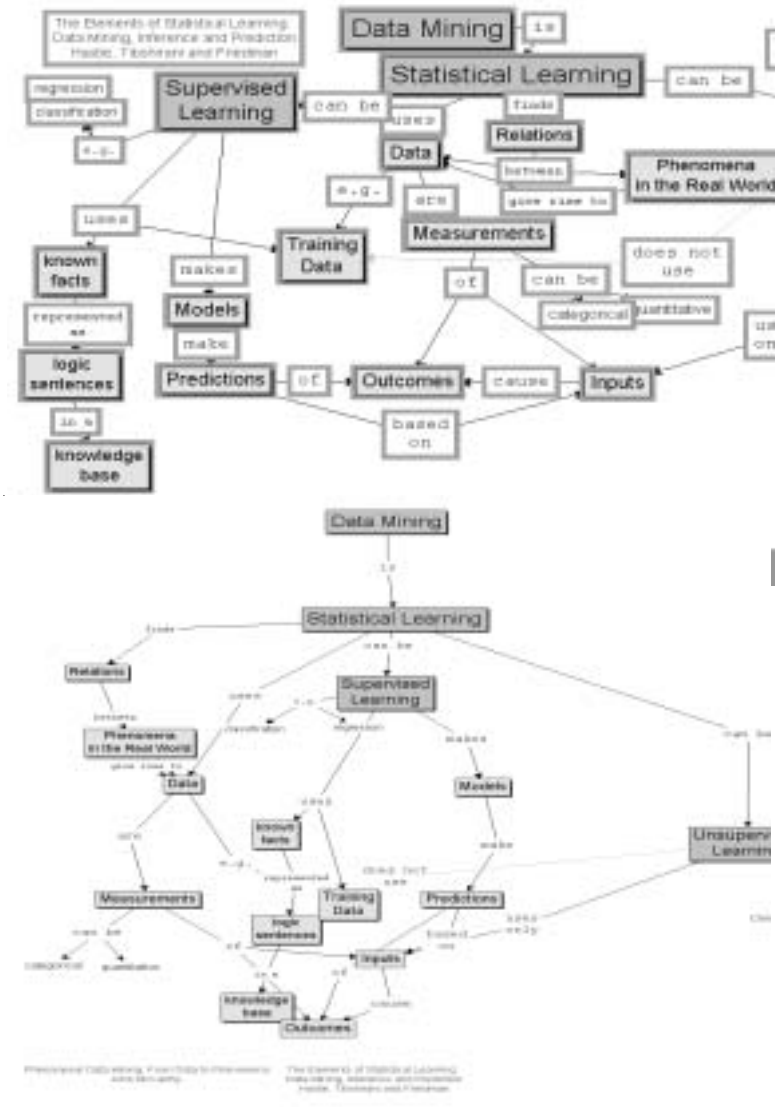
IV. Concept Maps as Reflective Reconstructions

Early appearances of concept maps are thought templates in the mystical traditions like heretic and cabbalistic traditions. The sefiroth has been mentioned in many publications as one of the precursors to extra-mental representations. The static versus dynamic role of concept mapping became clear during the 1950s when the London underground maps needed to be displayed. Though it displays around 300 stations, still the gestalt of the lines and change stations are so clearly positioned that the reader perceives a low amount of cognitive overhead; it is as if the eyes are led to the important centres (Figure 1). As the centre stations have been given more space and the outer stations less space, the mechanism of the fish-eye has been used. Earlier maps have been more literal representations, where the exact topology was maintained. It led to a difficult understanding for the traveller however. Beck has introduced the principle of a schematic overview, for the sake of knowing when to change a line. His contribution was to partly ignore the topographic attributes of nodes, in this case the stations. The underground map seems a reasonable metaphor for new coming orientation devices on the WWW. Its size is the limiting factor at the moment; the graph structure[4] and creating its layout is an NP-complete problem; Aroyo, Stoyanov & Kommers [1] and Kommers, Ferreira and Kwak, [6]. For the sake of learning orientation new tools have appeared recently.

Star Tree Studio[5] is a solution to Web navigation problems that enables Web designers and webmasters to create, edit, and modify information, which is then presented as *Star Trees*™ (Figure 2). Here the isomorphism between the actual location of a document and its spatial position in the map structure is completely detached. Each Star Tree is a branching structure of nodes that represents HTML pages or some other hierarchical structure, in the form of a graphical and interactive branching tree. The user typically sees the main point of interest in the middle as a red node. The circle of peripheral nodes is just the start of long entailments. They will appear if the user goes in that direction. In this way the fish-eye browsing as defined by Furnas [2] has arrived in quite an elegant way. The fish-eye metaphor can be generalized into concept space; awareness is the capacity to enlarge the resolution of the focal field while being conscious where the second and higher order associations exist. In this presentation a number of available concept mapping programs will be demonstrated (Figure 3). Each of them has its own action repertoire.

Figure 1. The Optimized London Underground Map.

Figure 2. Fish-eye Browsing in Star Tree.



Figures 3. Concept Map Re-arranged by IHMC CMap Tools[6](Footnotes)

Endnotes

[1] See the overview by Hans Zimmermann http://home.t-online.de/home/hanumans/sais.htm, in reflections on Herbart's work: …. (Vgl. Herbart, Johann Friedrich: Pestalozzis Idee eines ABC der Anschauung als ein Cyklus von Vorübungen im Auffassen der Gestalten wissenschaftlich ausgeführt..... <http://pestalozzi.hbi-stuttgart.de/forum/hinz/herbart.htm>.

[2] <http://www.educ.sfu.ca/people/faculty/kegan/MemoryIm.html> and <http://www.educ.sfu.ca/people/faculty/kegan/default.html>.

[3] <http://userwww.service.emory.edu/~barsalou/Papers/Sit_Review_Files/situations_review_00.pdf> (2000).

[4] <http://www.businessweek.com/bwdaily/dnflash/jan2002/nf20020122_8839.htm>. See recent news article by Stephen H. Wildstrom.

[5] <http://www.inxight.com/products/st_sdk/>.

[6] <http://cmap.coginst.uwf.edu/docs/>.

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[2] Furnas, G. W. "Generalized fisheye views." In *Proceedings of ACM SIGCHI '86 Conference on Human Factors in Computing Systems*, pages 16-23, 1986.

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[7] Yeh, W., & Barsalou, L.W. (1996). The role of situations in concept learning. In G.W. Cottrell (Ed.), *Proceedings of the eighteenth annual conference of the Cognitive Science Society* (469-474). Hillsdale, NJ: Lawrence Erlbaum Associates.