The Building of Knowledge through Virtual Maps in Collaborative Learning Environments

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Abstract: The purpose of this paper is to show relevant issues (resulting from theoretical and empiric research) about how virtual maps can be used to elicit the building of knowledge and to encourage collaborative learning. The intention of this work is to develop strategies for collaborative learning environments from a net of information perspectives, which might contribute to the improvement of significant pedagogical practices. The virtual maps study is supported by rhizome principles whose characteristics allow us to understand the process of selecting and connecting what is relevant and meaningful for the multilinear building of knowledge. In this paper, a brief theoretical and conceptual approach is presented and major contributions and difficulties about the use of virtual maps are discussed. At the end, new questions and future trends about the virtual maps application are mentioned.

Introduction

Few years ago, in the beginning of a discipline at a large college, a professor asked their students if they would like to use a virtual learning environment to promote discussion, group learning, more interaction towards collaborative learning. Then, one of them said *"I prefer just face-to-face classes. Interacting in virtual environment means spending more time*". Although one of the great advantages in virtual learning environments is communication anytime from anywhere, some participants revealed that such flexibility provokes intensive interactions, information overflow, difficulty to organize what is relevant, and consequently, time becomes a great problem.

Due to the rapid growing of online learning and the incredible increase of information in the web, developing methodologies to build knowledge collectively, articulating what is meaningful, has been quite essential to elicit better collaborative strategies in online courses. For that, I have been investigating how to manage information overflow and to incentive collaborative learning through project of investigations using virtual maps built in the Nestor Web Cartographer.

Overview

Nestor Web Cartographer, developed in France by Romain Zeiliger, is a graphic web browser: an editor of html pages and a cartographer with synchronous and asynchronous resources, which supports collaborative learning. This software was developed to promote the construction of a personalized Web space. For that purpose, it dynamically builds a flexible and navigable overview map of the hyperspace when users interact with it. In turn, users can re-arrange the map creating new objects: documents, links, annotations, sub-maps, tours, search keywords and conceptual areas. Consequently, it allows users to solve their own navigation problems: identifying documents, delineating pertinent materials, organizing links into categories, selecting information through contextual navigational. (Zeiliger, Beslile & Cerrato; 1999)

This software encourages users to reflect on their interactions with an information space, to discuss those interactions with annotations, to collaborate with others through the sharing of tours and annotated maps, and to apply their own methodologies to build knowledge-based structures (Eklund, Sawers & Zeiliger; 1999).

Zeiliger, Beslile and Cerrato (1999) emphasize six important issues about this software:

1. *Representing Self-Navigational Experience*: Every visited document is represented as a symbol (icon). Users can re-arrange the layout deleting the non-significant web pages, changing the icons, grouping them in conceptual areas and creating arrows to connect information.
2. *Constructing a Personal Web space*: Users can create web pages using Nestor Editor, insert the converted maps and weave them with the public network. They can build thematic maps and develop personal hypertexts about what is relevant and meaningful.
3. *Note-taking*: Users can attach annotations to every visited public or personal document. When an annotated document is visited, the corresponding annotation is displayed in a separate window. - "The bag": a visible clipboard can be used also to select and gather important information during the navigation process.
4. *Creating Keywords Objects*: Users can also insert keywords, areas and sub-guides in maps. The created keywords are automatically searched in the visited document's text and highlighted when found (both on the map and in the document). This is especially useful when users want to seek relevant information.
5. *Creating and Saving Navigational Objects*: All objects created by users (maps, keywords, conceptual areas, annotations and routes) can be saved to a HTML file, retrieved and published. Those objects are considered as "navigational objects" because they can serve to initiate new navigational operations.
6. *Sharing Maps*: NESTOR allows users to build maps collectively using synchronous and asynchronous resources and also to share objects published in the cyberspace. Nestor users can construct meaningful information through computer mediated communications and collaborative navigation.

Figure 1: Nestor Web Cartographer – Map and Browser window

Since the year 2000, some workshops about web maps have been organized at elementary and high school, university and post-graduation courses to promote educational activities and projetcs for investigation. The aim of the workshop is to know the software Nestor, in order to develop investigation maps with peers and to go deeper into the subjects researched and resources available in Internet. It can be observed that virtual maps can help the users to represent information and ideas by combining words, symbols and lines to organize information.

Table 1: Table about Nestor Web Cartographer Workshops

Year	Place	Course and subject observed	Participants
2000 2001 2002	Mackenzie University	Pedagogical Activities using Virtual Maps http://www.projeto.org.br/mapas/	Students from post-graduation course: Technology and Education
2001 2002	Dante Alighieri School	WebMAPQuest – developing projects of investigation with Maps. http://dantealighieri.com.br/webquest.php3	Teachers from Elementary and High School
2001	PUC-SP University	Researching through Virtual Maps http://bbalmeida.tripod.com.br/epistem.htm	Post-graduation Researchers.
2001	Virtual American Center - OEA	Developing texts and creating maps http://www.projeto.org.br/nestor/	Teachers and researchers from South America
2002	UNEB University	Mapping Virtual Learning Environments http://www.projeto.org.br/virtual/	Teachers from Pedagogy graduation course

Theoretical Background

For centuries, maps have been used to store and represent knowledge about the world and beyond. They are a concentrated database of information on the location, a powerful graphic tool to classify, represent and communicate connections among diverse elements Hodgkiss (1980).

Cartographic representation has been an important issue as a way to build schemes in order to understand and apprehend what can be organized through space relations (Lévy, 1994). Well-designed maps are effective sources to build knowledge because they allow the mind's ability to be exploited to establish relationships in physical structures, to get a clear understanding of a complex environment, reducing search time and revealing spatial relations that might otherwise not be noticed (Kitchen and Tate, 1999).

Cartography can be one of the most promising resources to express the non-linear dynamic of building knowledge. Maps are always transforming, they have no beginnings and endings, just middles in continuous change. They can also represent, in perspective, new angles, points of view, different contexts and multiple levels, in order to create new alternatives. (Deleuze and Guattari , 1995). Once the map is created, it is important to put the tracing back on the map and to inspect the breaks and ruptures that allow us to construct new knowledge, rather than merely propagate the old (Alvermann, 2000).

The notion of rhizoanalysis, developed by Deleuze and Guattari(1980), has been applied by several educational researchers (for example, Alvermann 2000; Morgan 1997). They see knowledge as continually assembling and reassembling over time, taking directions that cannot be anticipated or directed, resisting notions of closure around an ontological center or 'an authority'. This model has been useful for rethinking the notion that knowledge can be traced back or plotted carefully on a hypertextual structure organized within various hierarchies.

Web of knowledge and knowledge in network are the result from flexibility, plasticity, interactivity, adaptability, cooperation, sharing, supporting and self-organization. It means that knowledge is in process of building and rebuilding itself. It is a group of connected elements and it can represent a new way for the human community to use knowledge in order to develop itself. (Moraes, 1999). The net metaphor seems to be the key to emergence of knowledge as a new interdisciplinar work. The better you apprehend the meaning, the more you know. In other words, the meaning of "A" can be built through multiple relations established among "A", "B", "X", "T G K" being or not the references in the subject that is been studied. (Machado 2000, p.35)

About the concept of net and rhizome, Deleuze and Guattari(1995, p. 14) and Pierre Levy (1994, p.25) presented six principles:

- Metamorphosis – there is the need for a constant change.
- Multiplicity - the components and connection have multiple scales.
- Heterogeneity - the structure is always different.
- Exteriority - the feeding information should come from outside.
- Acentrism - there is no beginning, no end, and not one center, but mobility of the centers.
- Proximity – the interaction allows association of components.

Figure 2: Internet topology byYoung Hyun - (CAIDA)

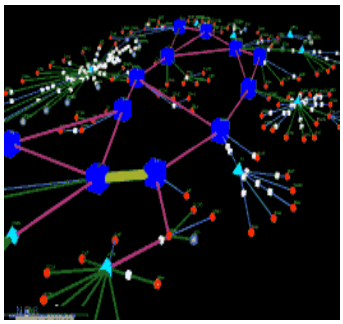
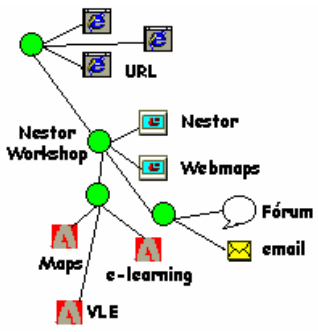


Figure 3: Virtual Map about Nestor Workshop



In fact, those principles can be considered as the essence of Internet, non-linear access of information and non-linear building of knowledge. It also allows the association of an unimaginable amount of information routes. All characteristics allow understanding how the interaction can occur and how different elements can be connected.

The learners can establish meanings as resulting from a constant updating, in multiple levels, considering different areas and the movement of diverse points of view, local and global, individual and social

ones, through the interaction, association of persons, ideas, interests, information or knowledge. The metaphor of network and rhizome allows to associate different elements and to conceive the building of knowledge as a non-linear process.

Through maps web users can weave information:

- in a continuous space of changing - the cyberspace (metamorphosis): learners can built maps, exchange them, insert ones in others, re-size parts of a map, transform and publish anytime and anywhere. Even when a map is published, it is automatically updated because their components can be changed independently;
- by building a network of information in multiple scales (multiplicity): learners can build and see maps in multiple views, create a map area and have it transformed into a submap; can shrink or enlarge the map area ,unfolding concept areas works, linking from one map to another allowed in tours.
- by interconnecting different components: sounds, images, texts (heterogeneity): learners can copy and paste texts and images from Web documents to the map
- by feeding information even outside the web, as experiences and practices (exteriority): learners can create the own pages, annotations with relevant comments;
- by navigating, building diverse hypertexts without a unique center (acentrism) learners can use this map to go back directly to any visited document or link; the maps can contain several navigation paths. Learners can register tours using diverse links without one center.
- by logging on and interacting with anybody anywhere and anytime (proximity): Learners can invite another learner to work in pairs, chat or navigate and search together.

Virtual maps: main thrust and trends

About the elaboration of virtual maps during the workshops, it could be noticed that interaction takes place at a high level due to collective activities and common purpose. The environment contents were dynamic and determined largely by individual and group needs. The knowledge built was the result of collaborative activities, discussions, consensual dialogue, joint assignments and common challenges by working teams.

Working in small groups was a good way to share maps, interlink heterogeneous paths, develop new contents, methodologies, appropriate problem-solving, critical thinking arguments and consensus. These skills are essential to work together collaboratively: to listen, hear, understand, and finally accept the view point of fellow group members. (Crook, 1994)

During the Nestor Web Cartographer Workshop, participants used virtual maps in various purposes:

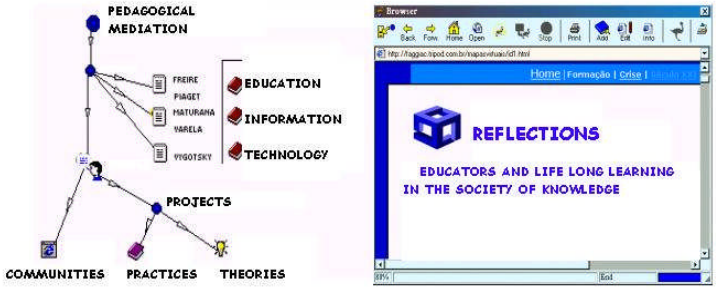
- Graphic representation to facilitate navigation
- Visual bibliography with different references resources
- Map of the virtual learning environment
- Registration of the cognitive process
- Semantic hypertext with diverse signs
- Relevant information guide
- Theoretical and practical connections
- Way to organize information to facilitate writing

These virtual maps built in the Nestor Web Cartographer were developed in a continuous space of changing, in multiple scales, interconnecting different components: images, texts, personal and public documents, including information even outside the web as previous knowledge and diverse hypertexts without a unique center, and as it could be noticed, the participants could get closer to each other.

About the use of virtual maps at graduation and post-graduation course, maps were very meaningful to go deeper and discuss theories and practices. Learners are not naturally likely to discuss spontaneously with each other, at least with respect to the subjects they have not yet been in contact with. It could be realized that in the small working team, spontaneous argumentative dialogues resulted from shared common grounds, theories read and papers written, accessed through maps built.

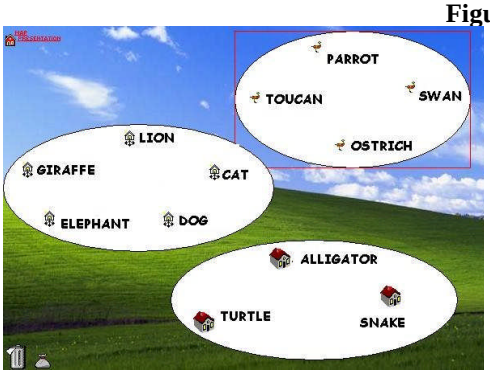
As soon as the maps elaboration started in peers, the communication between participants was established. This implied that points of view had begun to be constituted, so students could discuss together, in pairs or in teams. The maps were improved and texts were built collectively. Spontaneous and argumentative interactions were an essential condition for the development of a consensual and critical knowledge.

Figure 4: Virtual Maps and texts built in post-graduation course

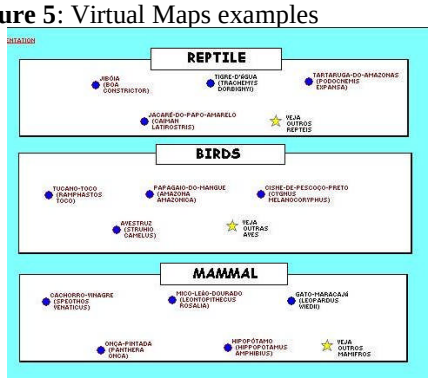


Concerning high school and elementary courses, maps were a great guide to navigate more easily, to select relevant information, and to establish meaningful connections. The semantic graphic scheme could facilitate the writing. Students said that from the map built, elaborating a text about the research was much easier. “Maps were a great way to organize and to elaborate new information in the web. Besides that, creating and published web pages with maps and a text were a great opportunity to share the research and to enrich the whole group. According to the students, cartography was a good strategy to organize a great amount of information using maps containing others maps.

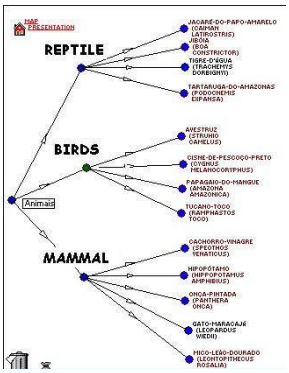
Figure 5: Virtual Maps examples



Elementary School / Science
The main groups of animals



Fundamental School / Science
The classification of Animal Kingdom



High School / Biology
The characteristics of Animal Kingdom

Some benefits of projects and educational activities using virtual maps observed during the workshops are:

- Clear insight and comprehension about the investigation process and organizational structure;
- Easy and practical way to seek relevant information
- Cooperative learning, closer engagement in problem with peers --solving activities or sharing ideas
- Using graphic and semantic organizers to representing ideas by combining words, symbols, and lines
- Answering and generating questions to understand various aspects of the map and the investigation.
- Using maps to facilitate the text structure – developing writing from organized information
- Summarizing -integrating ideas, different elements and resources references.

Virtual Map allows a rhizoid structure enables to address both spatial (space) and temporal (time) connections, knowledge can be traced back or to be plotted carefully on a hypertextual graphic organized within various hierarchies. Architectural metaphors can be used to express abstract thoughts, ideas, and emphasize significant connections and relations.

Virtual Maps represent a semantic scheme where information can be indexed, catalogued and referred continuously. Virtual maps can be published in web pages and can be changed at any moment. Their elements (web pages and other files indicated) are automatically in transformation too. Instead of fixing knowledge onto static pages, a virtual map is analogous to rhizoid thought. It is similar to a flow that moves haphazardly - and usually ephemerally - across a network.

Beyond facilitating Web navigation, Nestor virtual maps also support **re-composition** tasks : most users would use the browser to select pieces of information that are eventually destined to be **re-composed** as a new document. Selecting relevant Web information is an operation that users often perform through **de-constructing**

the documents they visit – because their current intention cannot match exactly the intention that prevailed when the document was published. Then they have to re-organize and enrich the information pieces they have gathered in order to construct a new document which reflects their point of view. The original documents and the produced one are often HTML files – or in any case documents that are designed to "present" something to an audience. Let us call them "presentation documents". On the contrary, a virtual map is more appropriate as an intermediary document which is destined to facilitate reflection and re-composition. The map is a free-structured graphical document, it allows for direct manipulation and it is more likely to support the internalisation/externalisation process coined by Vygotsky.

Conclusion and future work

This study about elaboration and uses of virtual maps has revealed the importance of interaction and pedagogical mediation in identifying such characteristics of the communication net and of the knowledge net as: metamorphosis, multiplicity, heterogeneity, exteriority, acentrism, proximity; and also in realizing that they bring forth some behavioral change such as: detecting changes, seeking depth, evincing diversity, allowing reflection from different angles, identifying diverse interest centers, encouraging proximity. Some difficulties observed were about methodologies to evaluate maps. This issue will be the focus of our next investigation.

About collaborative learning we could realize that virtual maps was a way to innovate, bring new alternatives in order to contribute to the process of organizing a great information flow and better managing research time. It could be observed that knowledge cannot be defined just from virtual maps, technology and informational resources, but in the attitude of the human being when establishing "what, for whom, how and why". Therefore, it is essential to search and to propitiate a conscientious and critical look on the net to its positive aspects (construction) and negatives ones (limits and contradictions), making possible deconstructions and new non-linear reconstructions. Perhaps the new challenge will be building efficient and meaningful virtual maps managing time to discuss and to reflect about their components and connections instead of dealing with the large flow of information and the long time spent during researches and interactions.

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