

WEBMAP

THE COLLECTIVE BUILDING OF INFORMATION NETWORK THROUGH VIRTUAL MAPS IN COLLABORATIVE LEARNING ENVIRONMENTS

Alexandra Lilaváti Pereira Okada

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 develop an information network facilitating collective of building knowledge and collaborative learning. The intention of this work is to discuss some 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, future trends and our next investigation about the virtual maps application are mentioned.

Keywords: Virtual Maps – Information Network – Collaborative Learning Environments

Information and Communication Technologies have provoked a lot of changes. Not only computer networks Systems, but also online information network and people's network have allowed to revise the meaning of communication. As opposed to mass-mediated forms of image production based on unidirectional flow, Pierre Lévy notes, in cyberspace "*everyone is potentially a transmitter and a receiver in a space that is qualitatively differentiated, not fixed, organized by the participants, explorable where everyone communicates with everyone.*" Thus, cyberspace offers both the potentials for communication and community. In other words, any user from any point in the network can not only exchange information at a low-cost and very fast way, but also reconstruct meanings, articulate ideas individually and collectively, and then share new sense and consensus with all users of the network. Instead of transmitter and receiver as two different groups that exchange fixed messages, there is only a great transmitter-receiver group that can communicate and build knowledge at the same time. Breaking the limit of space and time, people can collaborate, identify common intentions, affinities, centers of interest and constitute themselves as communities.

Important investments have been made in science, technology and distance education. Finding ways to allow the inclusion in the Network Society means knowing how to exploit access to communication channels, learning technologies for personal, community, social and economic development. That is a priority for each nation. Considering to social, economical or political interests, even a private, national or global initiative, the inclusion in a knowledge society age has been the main target.

Agenda 21, as a result of many meetings promoted by United Nations, collects vital questions and essential goals to preserve the environment and build a prosperous and safe future for humanity in this XXI century. Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which humans cause impacts on the environment. The first aim of this plan is international cooperation and the fight against Ignorance and Poverty. And for this purpose, Agenda 21 (Chapter 36) establishes some implementation ways: technology, education and

cooperative research.

*(h) **There is a need to strengthen, within five years, information exchange by enhancing technologies and capacities necessary to promote environment and development education and public awareness.** Countries should cooperate with each other and with the various social sectors and population groups to prepare educational tools that include regional environment and development issues and initiatives, using learning materials and resources suited to their own requirements;*

*(i) **Countries could support university and other tertiary activities and networks for environmental and development education. Cross-disciplinary courses could be made available to all students. Existing regional networks and activities and national university actions which promote research and common teaching approaches on sustainable development should be built upon, and new partnerships and bridges created with the business and other independent sectors, as well as with all countries for technology, know-how, and knowledge exchange;***

*(j) Countries, assisted by international organizations, non-governmental organizations and other sectors, could strengthen or **establish national or regional centres of excellence in interdisciplinary research and education in environmental and developmental sciences, law and the management of specific environmental problems. Such centres could be universities or existing networks in each country or region, promoting cooperative research and information sharing and dissemination.** At the global level these functions should be performed by appropriate institutions;*

How can centers of excellence in interdisciplinary research be constituted in order to promote cooperative learning and information sharing and dissemination?

For this purpose, trying to find answers, we emphasize the importance of Learning Communities – collectivities that self-organize and keep and change through the continuous involvement of their participants. These collectivities are composed by human beings, physical, biological and technical elements that constitute cognitive ecologies.

About cognitive ecology, the focus is not only the subject or the object. Ideas do not come exclusively from one subjective world, nor exclusively from the objective world: knowledge is built through inter-relations between subjects or subjects and objects, in their multiple interfaces. According to biological theories, especially those emphasized by Maturana and Varela, knowledge can be built just by subjects who are cognitively and emotionally involved, capable of interacting and transforming reality.

Reconstruction of information becomes more accessible through cognitive ecology. It is possible to break limits of exclusive sources and of excluding ways of knowledge, and thus to interact according to common interests.

Ecology puts us on the track of conceptualizing a biological space, broadly speaking, for reciprocating interaction between human beings and technology. Both are intimately connected in complex ways, that is, virtually. Pierre Lévy notes, “*intellectual and communications technologies are currently undergoing widespread and radical change. As a result cognitive ecologies are being rapidly and irreversibly reorganized*”

Nardi (1999:49) defines information ecology as a system of people, practices, values and technologies in a particular local environment. In information ecologies, the spotlight is not on technology, but on human activities served by technology. Her notion of ecology is metaphorical evoking an image of biological ecologies with their complex dynamics, diversity of species and opportunistic niches for growth. Her purpose in using the ecology metaphor is to foster thought and discussion, to stimulate conversation for action. Information ecology is a complex system of parts and relationships. It exhibits diversity and experiences continual evolution.

The principal aim of the project “The collective building of knowledge in a collaborative learning environment” is to investigate how to make collaborative learning environments emerge in order to reconstruct meanings, articulate ideas individually and collectively, and then share new meanings, sense and consensus allowing to enrich productions, researches and co-construction of knowledge. For that purpose, the intention of this project is to use the software Nestor Web Cartographer to develop an appropriate virtual environment for learning communities to find new ways of weaving theories and practices through maps of meanings.

EMPIRICAL OBSERVATIONS

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 navigation. (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 projects 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 noticed that 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

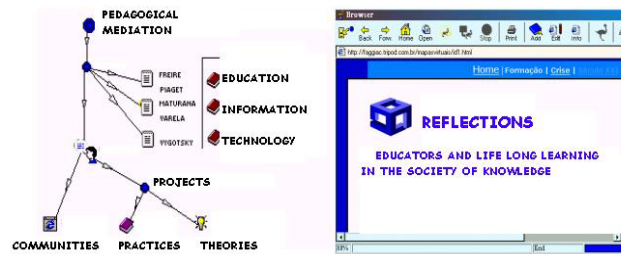
Year	Place	Course and subject observed	Participants
2000 2002	Mackenzie University	Pedagogical Activities using Virtual Maps http://www.projeto.org.br/mapas/	Students from post-graduation course: Technology and Education
2001 2002	Dante Alighieri School	WebMAPQuest – developing projects of investigation 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

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 can be built as the result of collaborative activities, discussions, consensual dialogue, joint assignments and common challenges by working teams.

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

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

(Figure 2: Maps and texts built in post-graduation)



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.

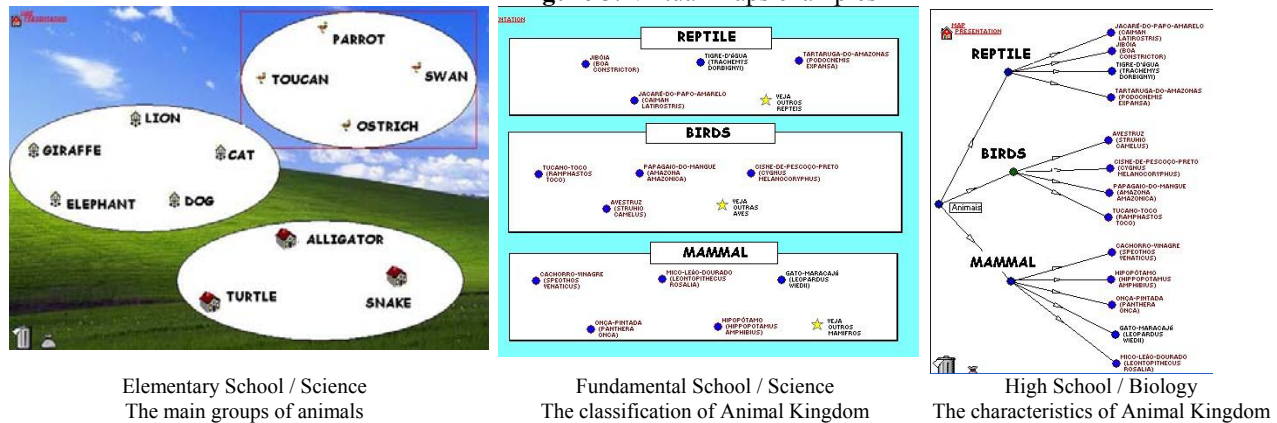
About the use of virtual maps at graduation and post-graduation course, maps were very meaningful to go deeper and discuss theories and practices. Learners are not naturally likely to discuss spontaneously with each other, at least with respect to the subjects they have not yet been in contact with. 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.

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)

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.

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 3: Virtual Maps examples



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.

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.

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.

THEORETICAL BACKGROUND AND EMPRIC ANALYSIS

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 (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 interdisciplinary 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.

Figure2: Internet topology by Young Hyun - (CAIDA)

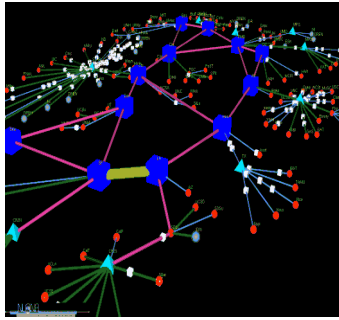
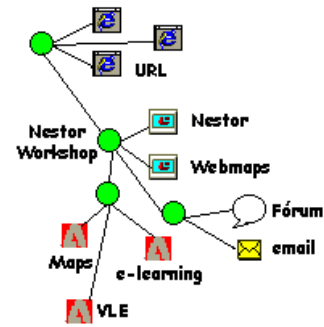


Figure3: Virtual Map about Nestor Workshop



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 build 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 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.

METHODOLOGY OF RESEARCH

The methodology used to develop this investigation is based mainly on qualitative research. It involves description and interpretation of the data obtained by researchers in their contact with the situation studied. Thus, not only results will be analyzed but also (mainly) processes will be investigated. The purpose is to reveal the collaborative learning context — biased perspectives of each participant involved in. Thus, interrelations between subjects or between subjects and objects, in their multiple interfaces were studied in order to be better understood.

For that purpose, the method chosen to realize the qualitative research is participatory action research.

As emphasized by Baskerville “Action research is an established research method in use in the social and medical sciences since the mid-twentieth century. Toward the end of the 1990s it began growing in popularity for use in scholarly investigations of information systems. The method produces highly relevant research results, because it is grounded in practical action, aimed at solving an immediate problem situation while carefully informing theory”

Participatory Action research is one of qualitative methods whose focus is to find with the participants the best ways to improve their context, their organization and their performance. It is typically designed and conducted by participants who analyze the data to improve their own practice. This method allows us new opportunities to reflect collectively about actions and interactions, to explore and test new ideas, to exchange information and experiences, ways and resources; to share feedback with fellow team members; and to make decisions.

We do believe that Participatory Action research can help us in many ways. Through this method, it is possible to understand researchers' personal and collective engagements and also their scientific praxis based on their experiences, theories, context and interests. The Participatory Action research can also be used to find out how maps can be used to build knowledge taking into account each individual's representation which involves multiple references to be negotiated during the interactive process.

This perspective leads us of the multireferential approach developed by Jacques Ardoino. From his stand point, several languages and fields of knowledge can be approached in a such way as to ensure the understanding of problems in their complexity without reducing them. This approach might be an answer to articulate practical theoretical sense overcoming the dissociated and fragmented "views".

NEW QUESTIONS, FUTURE TRENDS AND OUR NEXT INVESTIGATION

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 build and evaluate maps. This issue is the focus of this investigation project.

About collaborative learning, we could realize that virtual maps can be 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 is important to emphasize 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.

The challenge of our next investigation is to research how to build collectively efficient and meaningful virtual maps, dealing with the large flow of information (categories, analysis, interviews, etc) having in mind the constitution of collaborative academic learning communities in order to discuss and to reflect about their components, connections, researches and interactions.

The delimitation of that research is to investigate some University academic communities in Brazil and some countries that have similar areas, programs and researching interests. For that, our plans is to contact some researchers, and PHD professors from different countries who are interested in collaborative learning environments, and starting a virtual academic community.

The focus of that investigation will be how to promoting collaborative learning, and how to transform learning from virtual maps in order to contribute with the collective build of knowledge as network.

REFERENCES

- ALVERMANN, D.E. (2000) *Effective Literacy Instruction for Adolescents*
<http://www.coe.uga.edu/reading/faculty/alvermann/effective.pdf>
- ARGYRIS, C. AND D. SCHÖN. (1991) "Participatory Action Research and Action Science Compared." in W. F. Whyte, (ed.) *Participatory Action Research*, Newbury Park, N.J.: Sage, pp. 85-96.
- BASKERVILLE, R. (1997) "Distinguishing Action Research From Participative Case Studies," *Journal of Systems and Information Technology*.
- BASKERVILLE, R. AND A. T. WOOD-HARPER. (1996) "A Critical Perspective on Action Research as a Method for Information Systems Research," *Journal of Information Technology*.
- BASKERVILLE, R. (1999) *Investigating information systems with action research*.
 <http://www.cis.gsu.edu/~rbaskerv/CAIS_2_19/CAIS_2_19.html>
- BELISLE, C.; ZEILIGER, R. & CERRATTO, T. (1999). *Implementing a Constructivist Approach to Web Navigation support*. <http://www.aace.org/dl/files/EDMEDIA1999/edmedia1999p438.pdf>
- BLUM, F. (1955) "Action research--A scientific approach?," *Philosophy of Science*, (22) 1, pp. 1-7.
- CLARK, P. (1972) *Action Research and Organizational Change*, London: Harper & Row.
- CROOK, C. (1994). *Computers and the Collaborative Experience of Learning*. London: Routledge & Kegan Paul.
- DELEUZE G. & GUATTARI F. (1995) *Mil platôs. Capitalismo e esquizofrenia, (Anti-Oedipus: capitalism and schizophrenia)* v. 1, Rio de Janeiro, Editora 34.
- DODGE, M & KITCHEN, R. (2002). *The Geography of Cyberspace Directory*
http://www.cybergeography.org/geography_of_cyberspace.html
- EKLUND J, SAWERS J & ZEILIGER R (1999). *NESTOR Navigator: A tool for the collaborative construction of knowledge through constructive navigation*. <http://ausweb.scu.edu.au/aw99/papers/eklund2>
- GERLACH, J. M. (1994). "Is this collaboration?" In Bosworth, K. and Hamilton, S. J. (Eds.), *Collaborative Learning: Underlying Processes and Effective Techniques, New Directions for Teaching and Learning No. 59*.
- HODGKISS, A.G. (1980) *Understanding Maps: a systematic history of their use and development*. Dawson, Folkestone.

- HYUN Y (2002) *Internet Topology* http://www.cybergeography.org/atlas/fakevbns_large.gif
- KITCHIN, R. & TATE, N.J.(1999) *Conducting Research in Human Geography*. Longman, Harlow.
- LEVY, P (1994) *L'Intelligence Collective: Pour une Anthropologie du Cyberspace* (Paris: Éditions La Découverte).
- MACHADO, N. J. (1999). *Epistemologia e didática: as concepções de conhecimento e inteligência e a prática docente*. 3a. ed. São Paulo: Cortez.
- MORAES, M. C. (1997). *O Paradigma Educacional Emergente*. Campinas: Papirus
- MORGAN, W.(1997). *Critical literacy in the classroom*. New York:Routledge.
- OKADA, A. (2001) *The Collective Building of Knowledge as a Net of Meanings in Virtual Learning Environments*. Master's Thesis. São Paulo PUC-SP University.
- WHYTE, W. F., D. J. GREENWOOD AND P. LAZES. (1991) "Participatory Action Research: Through Practice to Science in Social Research." in W. F. Whyte, (ed.) *Participatory Action Research*, Newbury Park, CA: Sage.