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Creating knowledge maps in Virtual Learning Environments

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Abstract. The intention of this paper is to show a reflexive study about knowledge representation through maps in virtual learning environments (VLE). The aim of this research is to investigate how maps can be used to build information networks, contribute to the collective building of knowledge, and facilitate research and pedagogical mediation in VLEs. For this purpose, the specialization post-graduation online course “Software Use in Qualitative Research” was analyzed. During this analysis, I discuss meaningful learning through maps built using the mapping software Nestor Web Cartographer, CMap tools and Compendium. I then present some important aspects about how maps can contribute to online content design, tutoring diagnostic and assessment applications.

Keywords: Knowledge Representation, Cognitive Diagnosis, Collaborative Learning.

1. Introduction

One of the greatest difficulties researcher-learners face during their researches is structuring the investigation effectively. Researching involves many processes: dealing with lots of data, systematizing relevant information, demonstrating intermediate steps, developing critical thinking and argumentative discussions. And these can all be facilitated in virtual learning environments (VLE). The advantages are not just “communication anytime, anywhere”, but also having all discussions structured and information recorded.

However many academic students are not interested in online interactions. They prefer individual tasks and face to face interactions. In VLE, they need to read lots of information. And an activity in a group means more work and more time. For them, the content doesn't enrich their studies. It is also difficult to verbalize their specific problems and get meaningful solutions.

To convince students, it is important to develop new methodologies for meaningful argumentation discussions and organize relevant information in a VLE.

2- Overview

The intention of this study is to analyze contributions of webmaps to online content design, tutoring diagnostic and assessment applications. For that, I investigated map uses in the specialization post-graduation online course “Software Use in Qualitative Research” offered by Pontifical Catholic University PUC-SP. In 2004, 29 researcher-students from different areas and universities in Brazil participated in this online course. The aims of this specialization course were to

- discuss important concepts about cartography and qualitative research;
- explore some cartography software available in internet;
- develop maps to facilitate the investigation process.

The course content was organized through 3 modules:

Module I - Mapping Information

- participants introduction, research projects discussion and software installation
- some mapping methodologies: ConceptMap, MindMap and ArgumentativeMap
- documentation and bibliographic references through webmaps.

Module II - Qualitative Research

- mapping the investigation: collecting data, interviews, observations, blogs
- mapping categories and discourse analyses

Module III - Improving investigation through maps

- connecting theories and practices through maps
- systematizing the investigation and writing papers from the maps built.

Activities	Module I	Module II	Module III
Reading (papers)	Cognitive Cartography: some techniques to map information.	Qualitative research: mapping the corpus of investigation.	Analysing and interpreting data through maps.
Discussing (forum)	What are the differences and applications related to Mind Map, Concept Map and Argumentative Map?	How can knowledge maps contribute to the qualitative research?	How to identify and organise the most important categories about your collected data ?
Mapping (Portfolio)	Draw your project through a mind map Select the main concepts in your research and elaborate a concept map	Map the main web references (papers, journals, magazines) Organise the content through some argumentative maps	Map your collected data: interviews, observations, blog. Select the main categories and establish connections.
Reflecting (Blog)	How these techniques could facilitate your research?	What are the advantages and disadvantages of knowledge maps?	What were the challenges, difficulties and solutions?

Table 1 - Framework of main activities during the online course

3 - Knowledge Mapping: Background and Cartography Software

Cartographic representation is a way to build schemes to enable understanding through spatial relations (Kitchin and Tate, 1999; Lévy, 1994). Well-designed maps are effective resources for building knowledge because they:

- exploit the mind's ability in establishing relationships in physical structures;
- allow a clear understanding of a complex environment;
- reduce search time and reveal spatial relations that might otherwise not be noticed.

For centuries, maps have been used to store and represent knowledge about the world. They are a concentrated database of information on location and a powerful graphic tool to classify, represent and communicate connections among diverse elements (Dodge and Kitchin, 2002; Hodgkiss, 1980).

Cartography is 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, breaks and ruptures can be easily identified, which allows us to construct new knowledge, rather than merely propagate the old. It allows us to link ideas, thoughts and information and design flexible global structures.

The notion of Cartography is useful in educational research. Knowledge can be continually assembled and reassembled over time. That means reconstructing and deconstructing information and resisting notions of closure around an 'ontological center' or 'concept'. Mapping helps us to construct information by plotting it carefully on a hypertextual structure organized within various hierarchies.

There are some types of cartography software that can be used to create concept maps, mind maps, virtual maps and argumentation maps.

3.1 Nestor Web Cartographer

The software Nestor was developed in France by Romain Zeiliger in 1996. Its main purpose is to map web information. It is a graphic web browser: an editor of html pages and a cartographer with synchronous and asynchronous resources to support collaborative learning.

This software dynamically builds a flexible and navigable overview map of the hyper-space when users interact with it. Nestor automatically registers all the URLs accessed in a map, showing the process of navigation. The map can be re-arranged and new objects can be created: documents, links, annotations, sub-maps, tours, search keywords and conceptual areas. (Eklund, Sawers and Zeiliger, 1999).

3.2 Cmap Tools

CMap was developed by IHMC – Institute for Human Machine Cognition, Florida in 1993. Its main purpose is to map our thoughts, ideas and opinions through a set of

hierarchical concepts. Its interface is very simple. Double-clicking anywhere on the map screen adds a new concept. It is also possible to include images, URLs and other different kind of files: video, text, web pages, figures, tables, graphics and sound. The concepts are linked easily when the user drags the arrows. And the software offers large range of styles to improve the map design: fonts, objects, lines and background. Concepts maps can be created individually or collectively. Moreover, it is possible to create online discussions inside the same map. So users can discuss the map content and design.

3.3 Compendium

This software was initially developed in Verizon research labs in 1993, and then in Open University – Knowledge Media Institute. Compendium is a semantic hypertext concept mapping tool, created to manage business information, model problems, and map argumentation discussions. (Kirschner, Shum Buckingham and Carr, 2003).

It can be used as an individual or group tool to develop new ideas, goals, logical concepts and collaborative scenarios. Like the other software, different files can be included in the map: video, text, web pages, figures, tables, graphics, sound. However, one great additional advantage is the export and import of maps. Compendium can automatically include files and external references.

A key feature of Compendium is its ability to categorize information. It offers a set of different types of “nodes”: question, idea, pro, con, reference, note, decision, list and maps views. This node classification allows one to organize better the structure of the map and understand the argumentation discussion more easily. Moreover, a set of tags can be defined and used to establish new classifications and new search processes. This is useful to emphasize diverse elements in different maps. This is the greatest difference between Compendium and other software. Users are provoked to create new ideas and also to think more about questions, assumptions, arguments, counter-arguments, agreements, disagreements, contradictions during the process of mapping.

4- Methodology and Analysis

The methodology used was based mainly on qualitative research. It involved description and interpretation of data obtained during the course from researchers in their contact with the situation studied. For that, chat, forum, blogs were observed and the main comments were selected. Thus, not only results were analyzed but also (mainly) processes were investigated in order to understand contributions of maps as knowledge representation - biased perspectives of participants involved in.

4.1 - Students Productions and Tutoring Diagnostic through Knowledge Maps

During the online course, teachers used knowledge maps to present the material and activities. Students navigated through these maps to understand the content. During

their activities, they also produced knowledge maps to organise their researches. The methodologies used to create knowledge maps were Mind Mapping, Concept Mapping and Argumentative Mapping.

4.1.1 Mind Mapping

This mapping technique was developed by Tony Buzan, around 1974 when he published his book “Use your head”. This strategy facilitates the registration of thoughts through a creative visual representation.

Our mind is full of ideas that can be expressed through keywords, sentences, pictures. Our thoughts normally are difficult to represent in a linear order. The ideas can initially appear without logic structure. This information can be easily mapped through words, sentences or symbols annotated in different spaces and connected through lines and arrows with some short descriptions. This image that represents a “brainstorm” constitutes the mindmap.

During this course, Mindmap was used as the first step to represent collective and personal investigation projects. The students were encouraged to record their initial ideas using mindmaps built through CMap.

4.1.2 Concept Mapping

This is another mapping technique developed by Prof. Joseph D. Novak around 1972. His research is based on the meaningful learning theory presented by David Ausubel. New approaches can be developed from experiences and concepts already built. The connection between pre and new concepts can facilitate the understanding process. This strategy is also based on constructive theory. The learners can construct their knowledge from connection among diverse concepts. This process facilitates the systematization of new information through organization of concepts and their connections.

Participants used concept maps built in Nestor Web Cartographer to present their project theories, web references and also organize concepts discussed in Forum and Chat.

4.1.3 Argumentative Mapping

This is another kind of mapping technique that appeared in the early 1970s with design theorist Horst Rittel. Argumentative design is focused on the inference or evidences structured among claims and reasons. This representation of statements shows different viewpoints, issues, positions, pros and cons organized by logical connections. Through argumentative maps, it is possible to represent thoughts more objectively, clearly and rigorously. This representation allows us understand complex structures of knowledge through overview of coherent structure of arguments.

This technique was used mainly by teachers as a way to register their feedback about collective productions occurred during chat and forum. Students could see the systematization of discussions in groups and feel more confident to write from concept

maps. Nowadays they are trying to use this strategy to represent their theoretical arguments approaches used in their investigations.

The fact that all information when is included in the map is already represented by an icon (? question / ! idea / + pro /- against, etc) facilitates comprehension of the map structure. The visual representation of the arguments encourages the users to reflect and map new elements. This provokes new ways of thinking. The tags Compendium can attach to nodes (problems, insights, benefits) also help in interpreting the map. Users can list all questions, or all advantages recorded in different maps relating to the project. This enriches the process of searching and analyzing lots of information.

4.2 - Online Content Design through Webmaps

The online content during the course was presented through webmaps. In Modulo II – Qualitative research the main activity was the Round Table with professors specializing in qualitative research. In the first step, students made initial questions about qualitative research. Professors were invited and sent a paper. The discussions were organized using a forum. This helped the participants to reflect more about the content and to map the main concepts. Then they systematized the meaningful information in their working teams, answering their first questions.

Students commented that the webmap facilitated the navigation and visualization of the process and each element to be integrated. They also wrote that it was more interesting to navigate around the content and at the same time see all possible connections using hypermaps than hypertext. This allowed them to understand easily each stage and the whole activity.

4.3 - Assessment applications

The whole process was recorded by the maps built by teachers and students and some reflections about the process. Evaluation was carried out in two ways: teacher feedback on each student’s map portfolio and through students’ observation.

Another measure of learning was learners’ reflection on their own mapping process. They reconstructed their maps and wrote some reflections in their online annotation – blog. Some questions orientated this process:

What were the difficulties and strategies used to map your research?	<i>“Organizing lots of data in the screen was difficult, the solution was create submaps”</i>
What were the advances and results obtained through knowledge maps?	<i>“Representing my knowledge through maps helped me to write better”</i>
How can you evaluate your mapping process?	<i>“The mapping techniques and teachers feedback helped me to improve my maps.”</i>
What do you expect for the next module?	<i>“It would be interesting a course focused in writing paper from knowledge maps”</i>

Table 2- Examples of answers recorded in the students’ blog

5 - Conclusions and Future Research

During this course the maps used to measure learning had three benefits:

- allow students to recognize their way to represent their thoughts and their process of learning
- encourage participants to make interventions and improve their productions;
- help students to apply the mapping techniques in their investigation projects

Some benefits about mapping using Nestor, CMAP and Compendium are:

- Easy and practical way to seek relevant information
- Cooperative learning, closer engagement in problem with peers
- Answering and generating questions to understand various aspects of the investigation

Some difficulties

- Summarizing -integrating ideas, different elements and resources references
- Writing and systematizing information from maps
- Clear insight and comprehension about the investigation process

It is clear that organizing good mapping structure is essential to understand the argumentation process. However, there are many difficulties involved, in particular related to the process of reading, evaluating and improving the maps. These problems will become the focus of my next investigation.

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