

Using knowledge maps applied to open learning to foster thinking skills

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Abstract

The aim of this paper is to discuss the conceptual framework and principles to guide knowledge mapping to foster critical and creative thinking in open content environments. We introduce knowledge mapping techniques and tools and present examples of knowledge maps applied to open learning. Then we present some principles to develop thinking skills, highlighting the importance of mapping techniques to organise knowledge. At the end of this paper, we discuss important issues required? to foster critical and creative thinking through open educational resources and knowledge mapping.

1. Introduction

Some authors argue for a greater study of thinking skills such as creative and critical thinking, mentioning a lower than expected ability to think critically and creatively among academic graduate and post graduate students. They also emphasise the role that critical thinking plays in connecting inquiry, argumentation and inferences in order to facilitate meaningful learning (Carr, 1990; Chaffee, 1998; Halpern, 1989).

In a fast-changing world, the challenge for education is how to move from a system that emphasises content, to one which develops flexible skills (Hedges, 1991; Huitt, 1998). To make sense of contemporary issues, students need to learn how to make sense of information and develop critical and creative thinking. One of the difficulties associated with attempting to develop greater understanding of topical issues among students is the need to capture, structure and make sense of the deluge from search engines, content or research literature. Knowledge mapping techniques and tools can be useful to organise better the whole process of investigation (Okada and Buckingham Shum, 2006).

Due to the open content movement, students can have greater access to a more comprehensive set of resources and high-quality content than ever before. Nowadays, open educational resources, online libraries, public academic journals, freeware tools and collective repositories are part of a larger movement to create a public online space providing open content freely accessible in different formats such as text, image, sound or video (Wiley, 2006; Willinsky, 2006). One of the important challenges in open learning is to provide students and educators with strategies and tools to map relevant information from the oceans of data, concepts and opinion now available.

The literature has shown that simple access to information will not necessarily influence the development of critical thinking or acquisition of knowledge (Rogers, 1995; Golberg, Fishbein & Middlestad, 1997; Salwen & Sacks, 1997). One of the primary requirements for

constructing knowledge is higher order thinking which operates beyond mere exposure to factual or theoretical information. Huitt(1998) has pointed out that critical thinking is a process that may best be improved when students learn to connect their own ideas and knowledge from a specific domain. They can come to pursue their reasoning to some coherent conclusion or outcome.

Mapping concepts, ideas, arguments and references helps students to visualize their reasoning and clarify their understanding. Knowledge maps can be useful to represent argumentative thinking (Yoshimi, 2004) and develop thinking skills (van Gelder, 2003).

2. Knowledge Mapping tools and techniques

Compendium is a software tool for visual thinking. Students, teachers and researchers can use it to cluster and connect icons linked to ideas, concepts, arguments, websites and documents. They can use it just for personal reflection while they study or work on a problem, or share maps with others. They can create knowledge maps to summarise a topic, or design a learning path through open content learning environments. In Compendium users can drag and drop any kind of document or text from an online course or website and include files from their computers such as: video, text, web pages, figures, tables, graphics and sound.

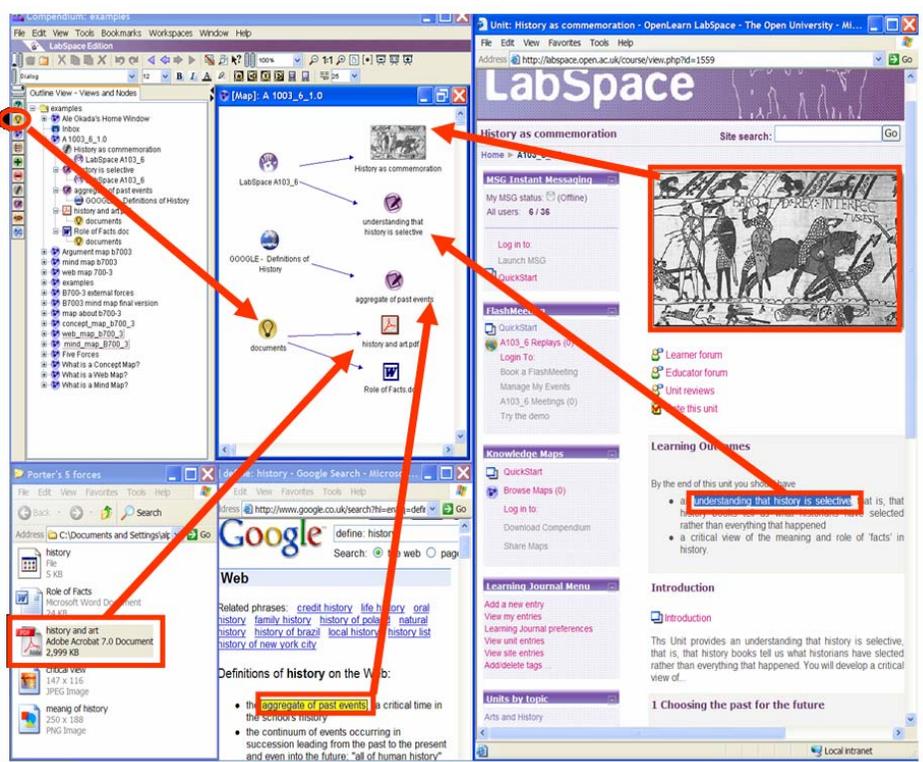


Fig 1. Compendium – you can drag and drop any kind of document or text from the web.

Compendium (<http://www.compendiuminstitute.org>) was initially developed by Verizon in 1993 and then, by the Open University UK. The purpose of this software is to manage business information, model problems, and map argumentation discussions. It can be used as an individual or group tool to develop new ideas, goals, logical concepts and

collaborative scenarios. 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 argument 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.

There are diverse knowledge mapping techniques useful for developing understanding and consensus within groups, as well as to facilitate individual thinking and learning.

2.1 Mind mapping

Mind Map is a graphical representation used to generate new ideas from a main topic. It was developed by Tony Buzan around 1974 when he published his popular book "Use Your Head". Thoughts are often difficult to express in a linear order. Ideas initially come to mind without a logical structure. Mind Mapping allows ideas to be represented non-linearly, using keywords, sentences and pictures in a graphical form. The elements are connected by lines and arrows, with short descriptions. This flexibility helps in eliciting new ideas and is ideal for creative brainstorming.

The guiding principles for creating mind maps are:

- Write down the central idea
- Think up related ideas which radiate out from the centre
- Collect as much information as possible: What? Why? Who? When? Where? How?
- Look for branches out and connections between the ideas generated
- Use lines, colours, arrows and personalize your map with your own symbols to assist in your recall and understanding.

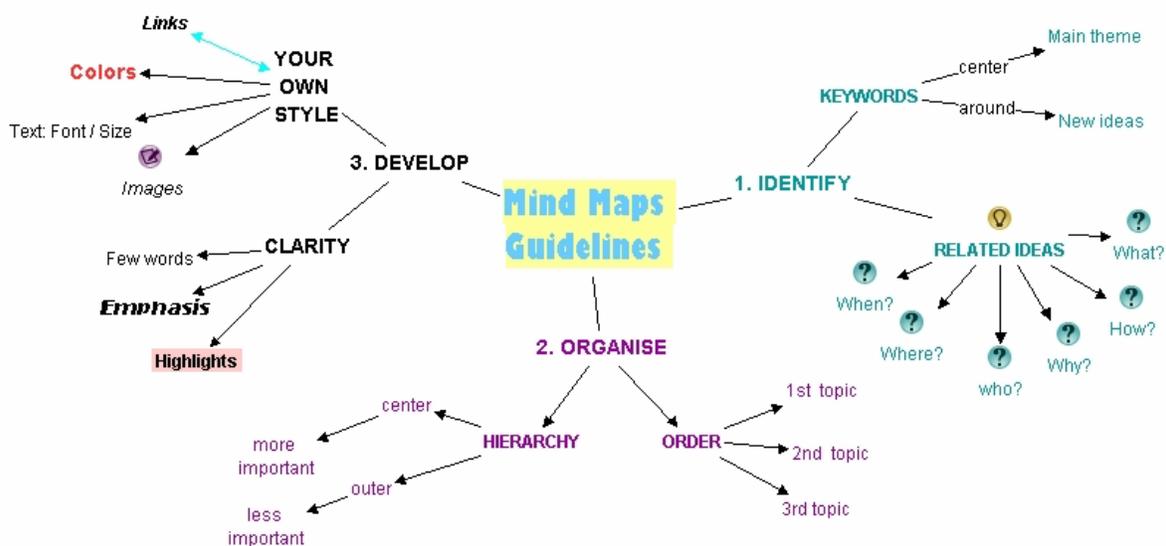


Fig 2. Mind Map about Mind Maps guidelines
<http://kmi.open.ac.uk/projects/osc/compendium/mmap/>

2.2 Concept Mapping

Concept Mapping is a diagram showing the relationships in between concepts through propositions. A concept is a label given to “an idea of a class of things” or “a perceived regularity in phenomena” – often, but not necessarily expressed as a single keyword. A proposition is a statement or assertion comprised of two or more concepts with linking words resulting in a clear and meaningful sentence.

Ex: [concept maps] --help to organize → [information]

Concept Mapping was developed by Joseph Novak around 1972, based on Ausubel’s theory of meaningful learning. This constructivist approach emphasizes that learning with understanding only takes place when new concepts are connected to what is already known. Meaningful learning involves the assimilation of new concepts and propositions into cognitive structures. The associations between prior and new knowledge can be represented through a tree structure with objects and lines, from global to specific concepts.

The guiding principles for creating concept maps are:

- write down a main concept on the top of your mapping area
- identify new concepts related to the topic based on your prior knowledge
- describe general concepts connecting them with specific concepts
- for each connection write a verb or preposition in order to clarify the association
- create new links to data, examples, graphs and images related to the concept
- using different colours for text and background in order to group and classify concepts.

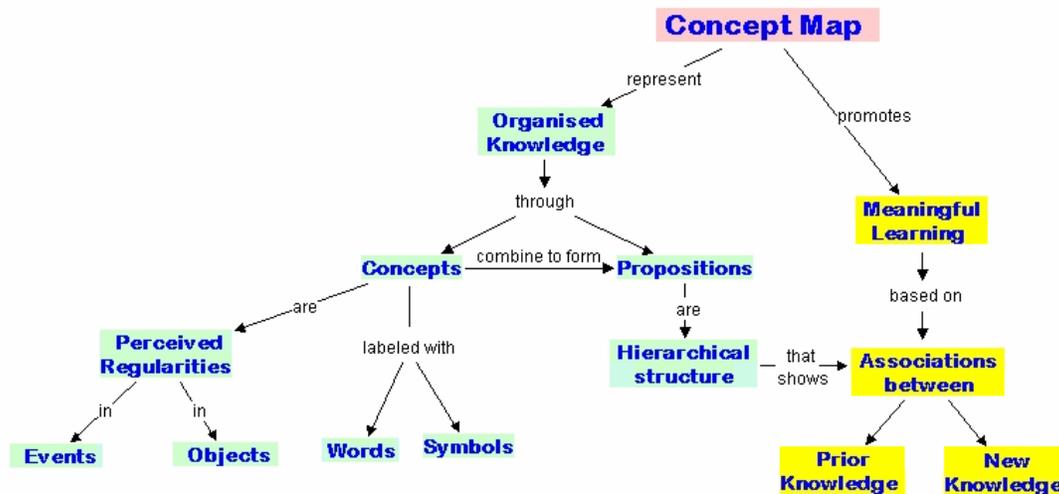


Fig 3. Concept Map about what a Concept Map is.
<http://kmi.open.ac.uk/projects/osc/compendium/cmap/>

2.3 Argument Mapping

Argument Mapping is a chart presenting an overview of reasoning. It helps learners to clarify their ideas, organize statements and reach conclusions. This mapping technique was invented by J.H. Wigmore to help in the analysis of legal arguments (Austhink, 2007). This class of technique deconstructs an argument into claims, reasons and objections. Argument maps show the evidence for each claim, and how they are related in the structure of the argument. Students can create dialogue maps individually or collectively (Conklin, 2005) to prepare and present arguments in synchronous and asynchronous debates.

Argument maps also derive from the Issue-based Information System (IBIS) developed by Rittel in the 1970s to solve ill-structured "wicked problems". IBIS is a rhetorical grammar with three core elements: issues, positions and arguments, which can be rendered as textual outlines and graphical maps that grow with the conversation. Argument Mapping is a useful technique to plan, structure and analyse reasoning based on issues, statements, arguments and counterarguments. Learners can create argument maps to organize their critical thinking in a discussion forum, essay or presentation, talks in web videoconferences.

The guiding principles for creating argument maps are:

- Write down the main question
- Think up possible answers to identify your main statements or claims
- Reflect about each statement and identify some arguments “pros” and “cons” or “reasons” and “objections” related to the topics
- Identify new questions and include notes, references and data.
- Pursue until the best conclusion or outcomes are found
- Use lines, colours and arrows to structure your maps and organize the design

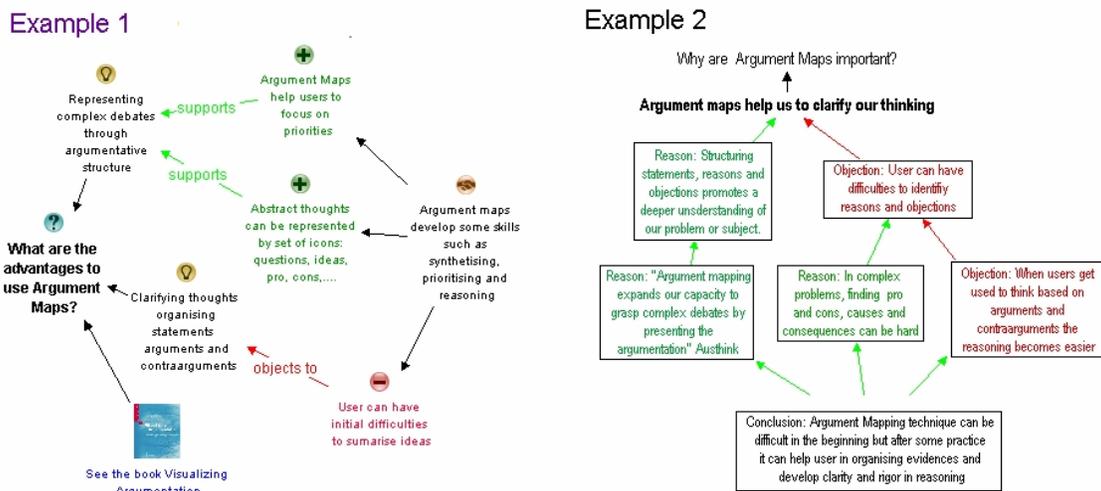


Fig. 4. Two examples of Argument Map
<http://kmi.open.ac.uk/projects/osc/compendium/amap/>

2.4 Web Mapping

Web Mapping is a graphical and hypertextual representation of important websites grouped by categories. Internet users can create webmaps to collect the most significant materials on the web. It appeared recently as a result of the rapid growth of the internet. The huge number of websites and overflow of information can cause users to become lost in cyberspace. Users can record their navigation through maps using icons, hypertext and hyperlinks (Dodge and Kitchin, 2001). Cartography tools let users select what is relevant in cyberspace and index and retrieve hypermedia web material.

The guiding principles for creating argument maps are:

- Write down the main subject
- Use a search tool investigate interesting websites related to this topic
- Drag and drop the urls into Compendium map
- Include information, title and also tags to classify your references
- Organise your map grouping urls by categories
- Use different icons, images and keywords to structure your references

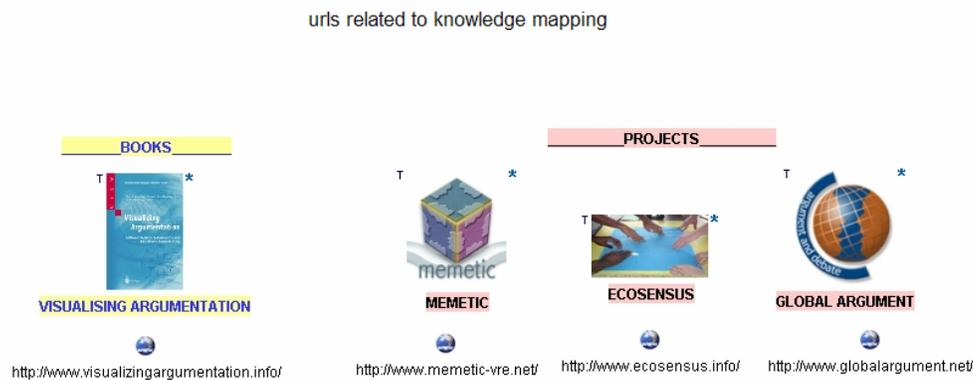


Fig. 5. Web Map about knowledge mapping
<http://kmi.open.ac.uk/projects/osc/compendium/wmap/>

3. Critical thinking through knowledge mapping

Critical thinking has been discussed in the learning and research context over the last several decades. There are many definitions of critical thinking and from different perspectives based on Philosophy, Psychology and Education. Jonassen, Carr and Yueh (1998) compiled several definitions to describe critical thinking as a process which is part of complex thinking and it is connected to content basic thinking and creative thinking. Based on The Iowa Department of Education definitions, he describes these four kinds of thinking and illustrate them through a map (Jonassen, 2000).



Fig. 6. Critical Thinking and the complex thinking process (Jonassen, 2000)

- *Content/Basic Thinking* refers to the skills, attitudes, and dispositions required to learn accepted information, such as basic academic content, general and 'common sense' knowledge. It involves three stages: problem solving, designing and decision making.
- *Critical Thinking* involves three critical skills: analysis, evaluation, and making connections.
- *Creative Thinking* comprises the generation of new knowledge and involves skills such as synthesizing, elaborating, and imagining. Multimedia activities that would fall into this category include scanning objects of family heritage to create a digital video or reflecting on various student projects in a web-based electronic portfolio.

Van Gelder (2003:101) highlights 4 advantages of using maps to develop thinking skills compared to prose:

1. Maps present explicit and precise relationships between statements, avoiding different interpretations. Graphical representations rather than texts show clear diagrams of arguments and connections.
2. Maps offer a rich set of representational resources: colours, automatic links for navigation, non linear structure, icons, tags to classify the statements and numbers to quantify the nodes. All these elements can facilitate analysis and interpretation.
3. Maps can contemplate the non-sequential nature of arguments. Argumentation can be a complex structure of statements, pros, cons, questions, references, comments. Maps as graphical schemes can represent easier juxtapositions of ideas, argumentation, multiple structures and hierarchies.
4. Maps can display metaphors. Diagrams can be used to represent mental schemas. As graphic representations, they allow show structure in different formats and shapes, based in images or symbols. It is possible to make the stronger reasons bigger and highlight group statements using different templates, etc.

4. Developing critical thinking through Knowledge mapping applied for open learning

Open Content Initiative is a movement whose aim is to make a selection of higher education learning resources freely available on the internet to anyone, anywhere in the world. One example is the project OpenLearn, launched in October 2006, developed by the Open University UK. Its aim is to release 5,000 learning hours of content of the OU's distance learning resources by April 2008. All this content can be freely accessed and modified by any learners and educators under the Creative Commons license.

Through OpenLearn, students can access higher educational materials in their own time from anywhere in the World experiencing informal graduation studies free. They can learn at their own pace, alone or in communities managing their learning process by themselves. Open learning is an opportunity for informal study and collaborative interaction in areas of interest. Participants can assess their own progress by mapping their learning journal, discussions in forums, chat and webconferences and also self assessment exercises.

The OpenLearn project was developed in Moodle platform integrating three knowledge media tools developed by the Knowledge Media Institute at the Open University: MSG Instant Messaging, Flashmeeting web videoconference and Compendium knowledge mapping tool.

Date	Title	View Map	Description	Author	Download
19 Feb 2007	Concept map		Concept map - Climate Change	Leandro	
17 Feb 2007	Argument map		Argument map - Climate Change	Alex	
10 Feb 2007	WebMap		WebMap - Climate Change	Okada	

Fig. 7. Openlearn - Global Warming unit in Moodle integrating a knowledge mapping tool <http://labspace.open.ac.uk/course/view.php?id=1854>

OpenLearn users can use these tools for constructing knowledge together. Students can create knowledge maps using Compendium and share in the OpenLearn environment. They can discuss the content using Flashmeeting and all main topics will be automatically mapped in Compendium. They can publish maps about the discussion as well. Any other participant can download these maps, edit and include new information and upload them again.

In order to analyse the application of knowledge maps for open learning to foster critical thinking we selected an unit in the OpenLearn Project about Global Warming. This first example is a mindmap which shows some issues to be investigated.

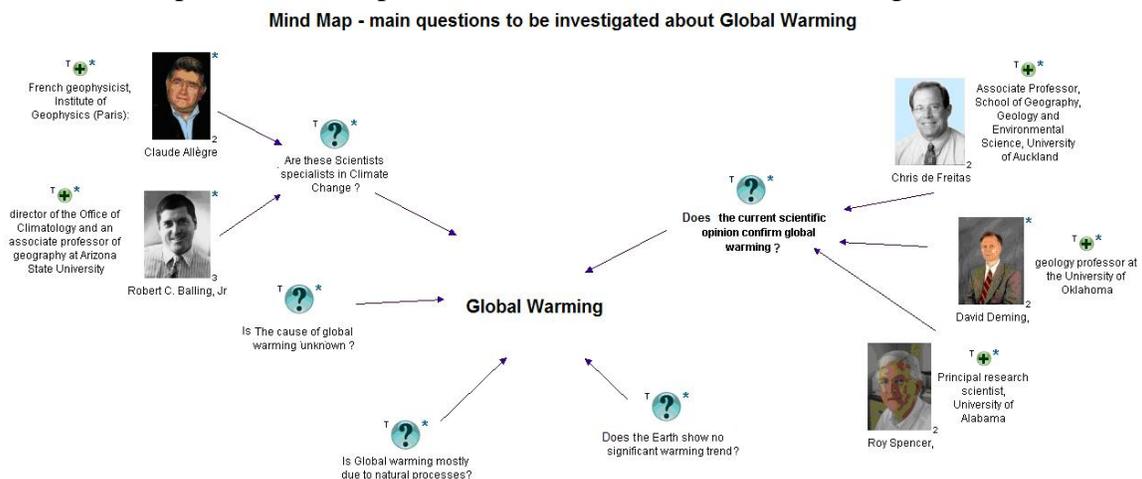


Fig. 8. Mind Map about questions related to Global Warming

Participants can drag and drop questions from the unit “Global Warming” into Compendium and they can add new issues and also their own questions. Through knowledge maps they can organize problem solving, research design and also decision making.

The second example shows a webmap about learning materials related to global warming created to organize references to answer the main questions.

Web Map - Learning materials about Climate Change

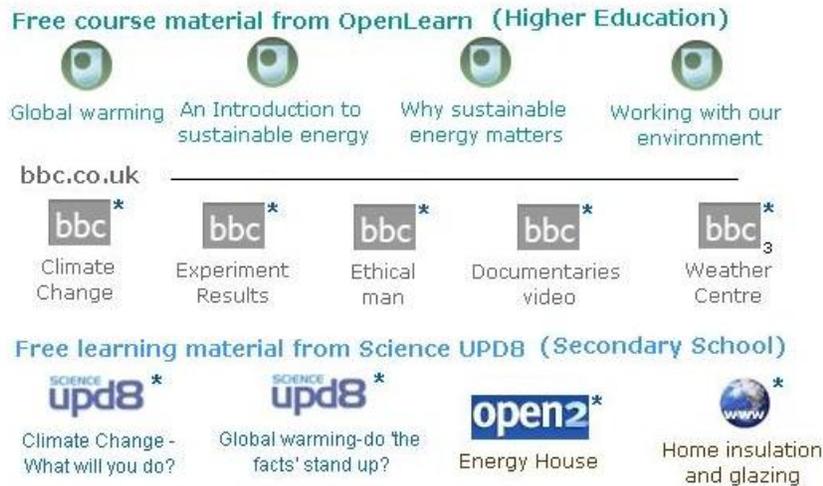


Fig. 9. Web Map about references related to Global Warming

Participants can drag and drop the most interesting webpages from the unit “Global Warming” into Compendium and add new urls from the web. Through knowledge maps they can analyse the content, connecting new references and evaluating their learning path.

The third example is a concept map about key concepts related to global warming based on the content from the webmap.

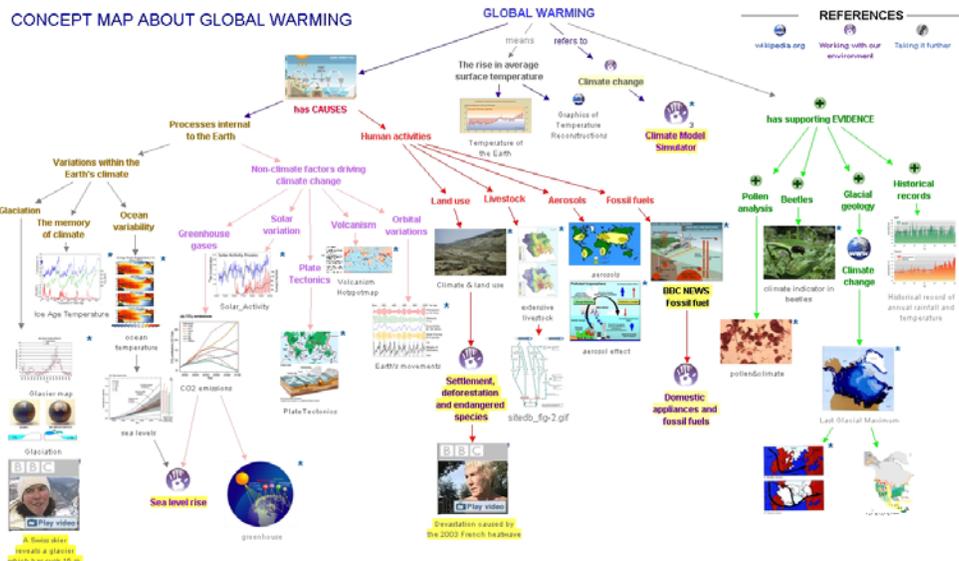


Fig. 10. Concept Map about keyconcepts related to Global Warming

Participants can drag and drop key concepts from the material selected into Compendium and they can add new keywords based on their existing knowledge. Through knowledge maps they can synthesize their learning, elaborate new products, such as writing an essay or structuring a presentation. They can visualise their imagination through maps. The fourth example shows an argument map about a global warming web video clip.

Argument Map from the perspective of Dr. Magee

Global Warming debate shifting from "if" to "when"

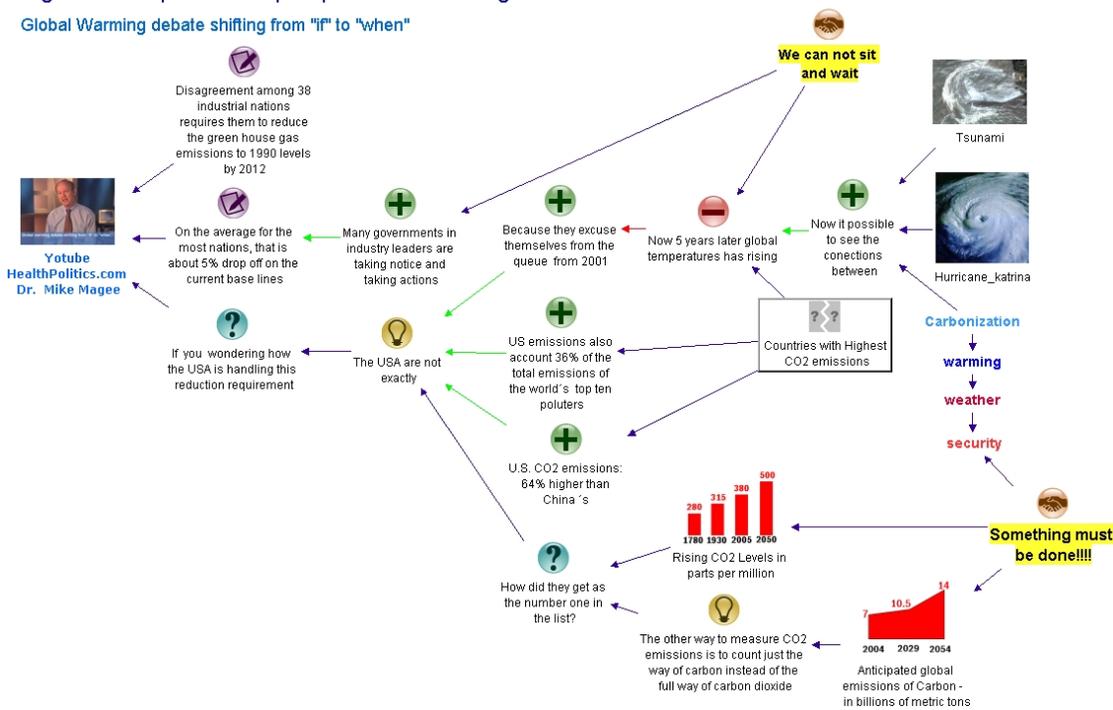


Fig. 11. Argument Map about YouTube video clip related to Global Warming

Argument mapping is very useful in identifying the line of reasoning from any kind of material: video, paper, forum discussion, learning journal, etc. Through Argument maps,

students can also structure and visualise their own line of reasoning. From the argument maps they can write an essay or prepare a presentation with clarity and coherence.

Participants can drag and drop the main statements: questions, pros, cons and evidence such as facts, data and graphs. Through knowledge maps they can show complex thinking processes which integrate content, basic thinking, critical thinking and creative thinking.

5. Conclusions

Knowledge mapping is a useful strategy for e-learning and open learning where students can map diverse open educational resources in order to organize their learning. Knowledge maps allow students to recognize their way to represent their thoughts and their process of learning. Participants can identify easily the new concepts and connect them to their prior knowledge. They can visualise others' and their own line of reasoning, developing clear and coherent thinking.

Knowledge Mapping can facilitate meaningful representations and foster critical thinking. Within open learning, knowledge maps can be used in diverse contexts in order to develop thinking skills:

Thinking skills		Knowledge maps techniques
Content/ Basic Thinking	Problem Solving Designing Decision Making	Mind Map of questions to be investigated, new issues and goals
Critical Thinking	Analysing Connecting Evaluating	Web map about the learning path including the most interesting and important references
Creative Thinking	Synthetising Elaborating Imagining	Concept map about the most relevant keyconcepts and new horizons to be explored
Complex Thinking	Integrating content/basic critical and creative thinking	Argument map show the main line of reasoning which systematize the whole reseach

Table 1. – knowledge mapping techniques applied to develop thinking skills

Users can publish Compendium maps creating an open content repository of useful information interpreted graphically. Compendium as a sense-making tool helps learners to organise layers of interpretation, linking resources and annotating their own viewpoint about any learning material. Participants of open learning communities can search, analyse and reconstruct maps, spot new connections and find new peers.

Students, educators and researchers can use knowledge maps as a strategic tool to support online learning. Knowledge Mapping facilitates knowledge management and help learners to be active researchers and practitioners.

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