

## ITINERARIES: CAPTURING INSTRUCTORS' EXPERIENCE USING CONCEPT MAPS AS LEARNING OBJECT ORGANIZERS

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**Abstract.** An Itinerary is a concept map that serves as a guide for students on how to study or learn a particular topic. By its concept map structure, the Itinerary provides alternatives for the learner to choose how to proceed through the activities provided. An Itinerary doesn't describe the topic, it recommends how the topic can be studied, and is therefore different from a traditional descriptive concept map. Itineraries provide a level of abstraction that is more manageable by Instructors when organizing online courses than Learning Object and their repositories, and provide inherently the experience of the Instructors that create them, facilitating reusability. Itineraries were used as the mean to organize and present content for Cmappers.Learn, a site open for anybody interested in learning about concept mapping and its uses.

### 1 Introduction

Distance, eLearning, and online learning have come to be accepted as means by which students can obtain quality education. Until recently registering for an online course was a last resort, used only when the lecture-based course was not an option, or as a way to take elective courses that are not part of the core curriculum. This has changed as online courses have evolved, new technologies are available to support the process, and students are much more comfortable with these new technologies. Mixed mode courses, in which some activities are carried out online, are also popular. At the Technonomy Conference held in early August 2010 in Lake Tahoe, Bill Gates noted that *"Five years from now on the web for free you'll be able to find the best lectures in the world. It will be better than any single university"* (Siegler, 2010).

Online courses are usually administered through a LMS (Learning Management System), software for which there are versions available both commercially and as open source, that takes care of the management of the course (e.g. lists of students, grades, etc.) and provides tools such as email, discussions or forums, chats, blogs, testing, and posting of online material. However, most LMS don't provide much functionality beyond mimicking the brick-and-mortar classroom. In fact their whole structure is based on traditional classroom courses and thus the syllabus is assumed to be sequential, an online equivalent of that of traditional classroom courses. For the professor or instructor, preparing an online course is much more time consuming than a traditional classroom course since it usually requires preparing a lot more material, finding appropriate resources, and organizing them through the LMS.

One of the advantages expected from an extensive proliferation of online courses was the reusability of content from other instructors. An instructor preparing a course would take advantage of online content that had been used by others teaching the same topic, simplifying the course preparation task. Taking some pieces from one place, other pieces from another instructor somewhere else, etc., instructors would be able to piece together the content of a course tailored to their needs, reducing the effort required if new content had to be prepared. The idea of an online, digital resource that can be used and re-used to support learning brought about the term *Learning Object*.

### 2 Learning Objects and Learning Object Repositories

The Institute of Electrical and Electronics Engineers (IEEE), one of the leading organizations working on the standardization of Learning Objects (LO), defines a LO as "any entity digital or non-digital, that may be used for learning, education or training" (Learning Technology Standards Committee, 2002). Most authors consider the reusability of the LO as being a key characteristic. Daniel Rehak & Robin Mason (2003) define it as "a digitized entity which can be used, reused or referenced during technology supported learning."

A second key characteristic of a LO is its Metadata, descriptive tags that identify the LO, characterize it and makes it "searchable". A LO's metadata may include general course descriptive data, language, instructional content (type of resource, such as text, Web page, video, image, etc.), prerequisites, and educational level, among others.

Learning Object repositories would allow users to find relevant LOs for a course or topic by means of search engines looking through this metadata.

Unfortunately much of the effort placed on LOs has gone into defining a standard for the metadata, e.g. SCORM (ADL, 2010; Bohl, Scheuhase, Sengler, & Winand, 2002), and less effort on their usability and on what is a good LO. As a result, LO repositories are full of images, videos, PowerPoint presentations, etc, that are meant to be reusable but seldom are. They comply with all the characteristics of a LO, and have the full metadata description, but are of little use to an instructor looking for material to put together an online course.

Instructors preparing a new online course have three options: (a) search for a complete online course that has already been put together by another instructor on the particular subject and that is available for use, (b) develop all the online content, or (c) start searching for LOs as a means to putting together their own content. Using some other instructor's complete course has advantages and disadvantages, which we won't discuss here and should be obvious to the reader. Searching for LOs conveys two deficiencies of LOs: (a) their level of abstraction is too low, and (b) the experience gained from other instructors when using the LOs in their courses is lost.

To understand the low level of abstraction lets consider an example: an Introduction to Biology course. Practically all versions of this course include a chapter, module, or unit on cell biology. A search for LOs for cell biology within LO repositories (or on the Web) results in animations, interactive activities, videos of instructors lecturing on cell biology at other universities, texts, PowerPoint presentations, etc. As an example, a search at the Wisc-Online Web-based repository of LOs from the Wisconsin Technical College System ([www.wisc-online](http://www.wisc-online)) for "cell biology" resulted in three LOs within the Biology category: (1) Cell Division ("In this animated activity, learners examine the two major phases of cell division: mitosis and cytokinesis"), (2) The Plant Kingdom: An Introduction ("Learners read about the mutations that occurred in plants for the successful transition from an aquatic to a terrestrial existence. The classification of plants is based on these adaptive structures"), and (3) Leaves ("Learners read a general description of leaves and examine drawings and microscopic views. A matching exercise completes the learning object"). The North Carolina Learning Object Repository ([www.nclor.org](http://www.nclor.org)) also retrieved three LOs: (1) Plants and Animals, Partners in Pollination (PDF), (2) How Size Shapes Animals, and What the Limits Are (PDF document), and (3) American College of Cardiology and American Heart Association 2005 Guideline Update (Web page). Florida's The Orange grove repository (<http://florida.theorangegroove.org>) provided as results (1) an Animal Cell Puzzle, an interactive puzzle with versions for Biology Majors and Non-Biology Majors, (2) a Virtual Stem Cell Laboratory: Children's Hospital Boston Interactive Feature, which is an interactive laboratory at Children's Hospital Boston's website, (3) Immune Attack: An Educational Video Game, (4) a Biology textbook in PDF, and other less relevant LOs. The problem is: how does an instructor put together a course from such dissimilar material, without having to spend hours going through each of the LOs in detail?

The second deficiency is the lack of information on how these learning objects have been used or combined by Instructors in their courses. Was the Cell Division animated activity a good introduction material, or did it work better for the Instructor when used as remedial content? Where can an instructor find information on how LOs were put together by other instructors in a cohesive way to cover the Cell Biology unit? The LO repositories do not provide this information as LOs are too "atomic" in nature. The next level up of description is the complete course. We propose that an intermediate level is necessary.

### **3 Concept Maps as Course Organizers**

Ausubel (1963) introduced the principle of an advance organizer as a more general, abstract segment of instruction that is presented prior to more specific, more detailed instruction to serve as a kind of "cognitive bridge" between what the learner already knows and the new knowledge to be learned. Concept maps can serve as advance organizers, especially when they have at the top more general, more inclusive concepts that are likely to be familiar to the learners, followed by increasingly less general, more specific concepts and propositions lower in the concept map.

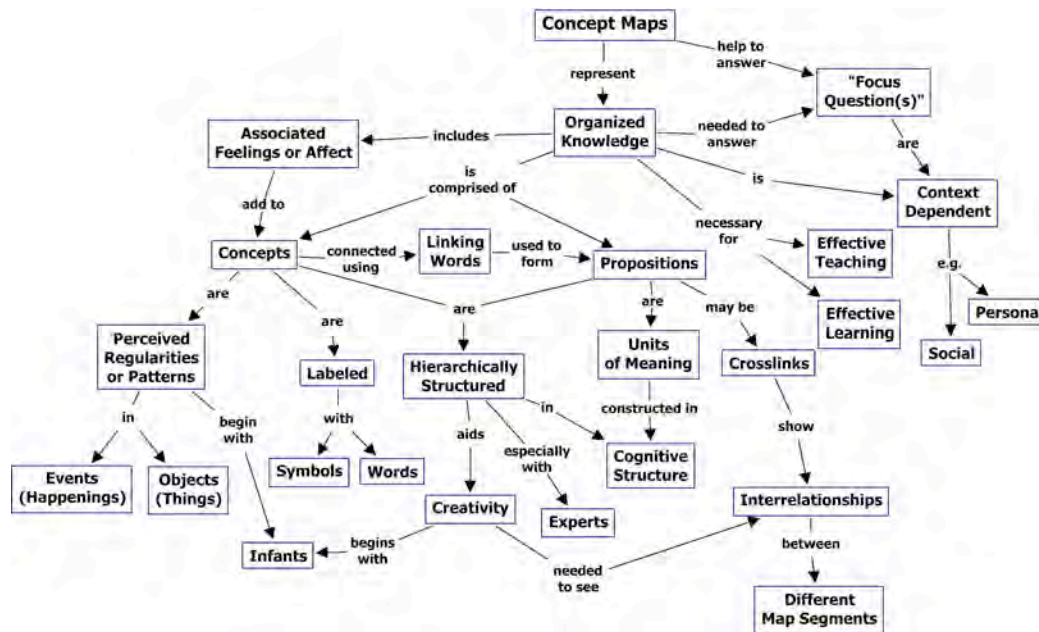


Figure 1. Concept map about concept maps (from Novak & Cañas, 2008).

Many authors have proposed and used concept maps as a means to organize course content (Basso & Margarita, 2004; Kumar & Saigal, 2005). We proposed LEO (Learning Environment Organizer) (Coffey & Cañas, 2003) as an example of how to extend concept maps to include prerequisite-type information between concepts, and links to LMS-type functionality to manage assignments and other such administrative functionalities. However, we've found that using a traditional concept map as a course organizer has a basic problem: the concept map describes the topic in a clear form, but does not explain what the student needs to do to *learn* and *understand* the topic. Observe the concept map in Figure 1, by Novak. It clearly explains what a concept map is. Now consider the learner that wants to *learn* what a concept map is. Even if we added links to resources, the Cmap in Figure 1 does not provide any guidance on how to proceed to *study* concept mapping.

#### 4 Itinerary: A Concept Map-based LO Organizer

An *Itinerary* is a concept map that guides the learner through a set of Learning Objects on the study of a topic. It is based on an instructor's experience teaching the topic, is easily adaptable and reusable, and provides a good building block for constructing courses. We expand on each of these characteristics.

##### a) *Itineraries are not descriptive concept maps*

Consider the Itinerary in Figure 2 and compare it with Figure 1. The concept map in Figure 2 is not "about concept maps". It doesn't attempt to describe what a concept map *is*, it attempts to guide or recommend the learner on how to go about learning about concept mapping and how to learn to build concept maps. Consider the concepts from Figure 2 "Understanding What is a Concept" and "Understanding what is a Focus Question". These concepts are not objects, they are events. Novak defines a concept as a perceived regularity in *events* or objects, or records of *events* or objects, designated by a label, as shown in Figure 1 (Novak & Gowin, 1984). Each of these could be considered a *competency* to be inline with the competency-based learning (Voorhees, 2001). The same can be said for most, if not all of the concepts in an Itinerary. Riesco *et al* (2008) have proposed using a concept map of competencies for curriculum design.

##### b) *Itineraries provide flexible, alternative learning paths*

An Itinerary recommends or "advises" different paths to learning a topic. In Figure 2, the learner can decide to start the Itinerary by "Understanding What is a Concept", go directly into "Building Simple Concept Maps", or start by

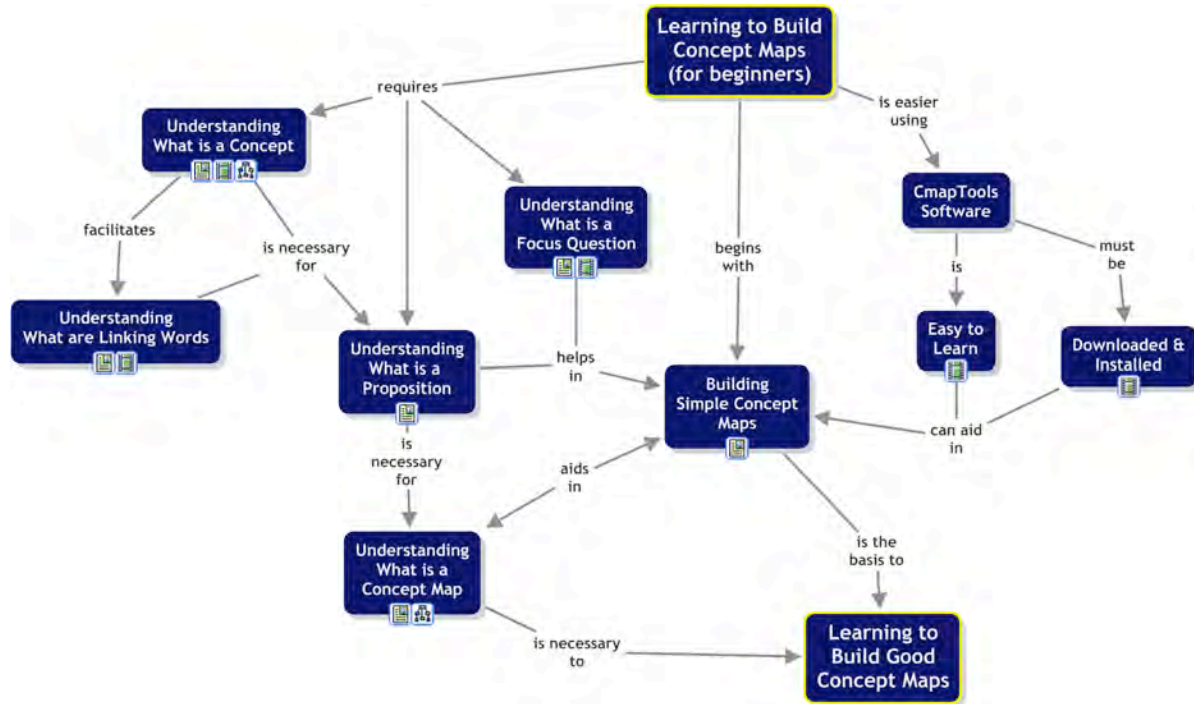


Figure 2. Itinerary on learning to build concept maps.

downloading and learning to use CmapTools. “Understanding What is a Concept” facilitates “Understanding What are Linking Words” and both are necessary for “Understanding What is a Proposition” – the learners are guided through the different competencies they need to achieve. Notice that the Itinerary recommends that “Understanding What is a Concept Map” aids in “Building Simple Concept Maps”, but also that “Building Simple Concept Maps” aids in “Understanding What is a Concept Map”. That is, these two competencies go hand-in-hand, and there is no clear sequential way to learn them: the more you practice concept mapping the better you understand what a concept map is, and the more you read about concept mapping the better maps you can build. Finally, all these competencies are the basis to “Learning to Build Good Concept Maps”, which is another Itinerary (in the Figure, Itineraries are recognized by their larger font. In the colored Cmap they have a yellow outline). Thus the learner has choices on which way to proceed through the Itinerary.

*c) Itineraries are built by instructors based on their experience*

The Itinerary in Figure 1 is based on this author’s experience after dozens of concept mapping workshops: some people like to get their “hands dirty” and start building concept maps immediately while others prefer to understand the theory behind Cmaps before they sit down to build their own. For this reason the root concept provides the implicit options to the learner: it states that Learning to Build Concept Maps requires an understanding of Concept, Proposition and Focus Question, but does not force the learner into going through these topics before starting to build concept maps. At the same time it mentions that it is easier to build Cmaps if you use software such as CmapTools, but it doesn’t require the use of the software.

*d) Itineraries organize LOs*

The icons underneath the concepts in Figure 2 indicate that there are resources relevant to the particular concept linked to it. For example, the concept “Understanding What is a Concept” has three icons: the one on the left indicates a link to a resource whose content is “text+images”, in this case a link to a document that explains what a “concept” is. The icon on the right links a concept map about “concepts”, and the icon in the middle links a video interview where Novak talks about “concepts”. These are all LOs. It is up to the learners to decide in what order they view these LOs – probably depending on particular learning styles. All icons underneath the other concepts in

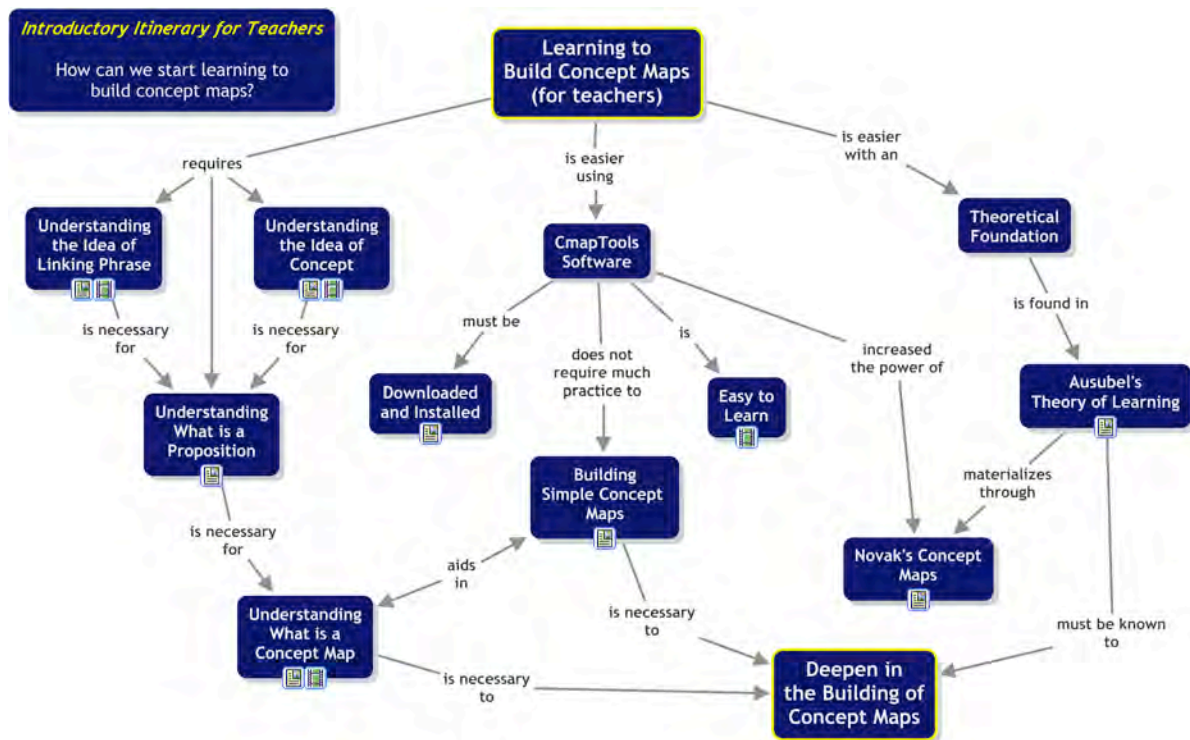


Figure 3. Itinerary on learning to build concept map, specifically for Teachers (by N. Miller).

the itinerary are links to a variety of LOs. The Itinerary is thus a guide for the learner on how to study the topic (Learning to Build Concept Maps) through links to a set of LOs.

e) *Itineraries are reusable*

The original version of the Itinerary in Figure 1 constructed by Cañas included concepts such “Understanding the Theoretical Foundation” which linked to documents on the theory that sustains concept mapping. Comments from several instructors whose students are not studying to be teachers indicated that when they worked with concept maps they were not interested in covering the theoretical foundations, so the author removed those concepts so the Itinerary would have as broad use as possible. However, when Norma Miller (2010) created a new Itinerary, based on that in Figure 2, she decided to introduce the theoretical foundation as an important component, as is shown in Figure 3. The Itinerary in Figure 3 “reuses” the Itinerary in Figure 2, but has some important modifications. First, it adds the new concepts mentioned above. Second, although not apparent in the Figure, she used new LOs to explain Concept, Linking Phrase, Proposition, Concept Map, and Building Simple Concept Maps that go less in-depth than those linked in the Itinerary in Figure 2. She dropped the concept maps linked to a couple of concepts, but reused the rest of the LOs. The LOs linked to the concepts on “Ausubel’s Theory of Learning” and “Novak’s Concept Maps” were “reused”, Cañas and Novak had developed them for another itinerary on “Using Concept Maps in the Classroom” (not shown). Its important to make note of the difference the effort needed on the part of an Instructor between searching for LOs in a repository to build a unit on learning to build concept maps, and starting from an existing Itinerary that can be adapted and complemented to suit the Instructor needs.<sup>1</sup>

f) *Itineraries as building blocks for course*

The Itineraries in Figure 2 and 3 are not complete “courses”. However, Learning to Build Concept Maps is a unit, module or chapter in many courses. With a few Itineraries like those in Figures 2 & 3 it would be quite easy for

<sup>1</sup> The authors have accidentally found while using the search tool in Cmapppers.net, an Itinerary stored in a CmapServer in Colombia that reuses the Itinerary in Figure 3 with some of the links to LOs changed.

Instructors to pick the one that is more appropriate for their needs, and adapt them if necessary. If this could be done for each of the units of a course, setting up an online course would be much easier than what is available today through Object Repositories.

### g) *Itinerary of Itineraries*

As was mentioned above, LMS enforce linear, sequential courses, mimicking the traditional classroom organization. Beyond serving as the building block for courses, the Itinerary can well be used as the course organizer. That is, the course syllabus becomes an Itinerary that links to Itineraries for each of the units or modules in the course. This way, flexible, nonlinear courses can be created that break the tradition of linearity and little flexibility that continues to exist despite the options for flexibility that technology offers.

## 5 Cmappers.Learn

Cmappers.Learn is the section of the Cmappers website (www.cmappers.net) open for everybody to learn about concept maps and concept mapping. The site consists of a collection of LOs, organized through a set of Itineraries. Figure 4 shows the front Web page for the site, with the list of Itineraries on the left and the list of LOs on the right. The first itinerary in the list corresponds to that in Figure 2. The second Itinerary listed shows how to use the site itself. The site is available in English, Spanish, Portuguese and Italian. If an Itinerary is available in the language the user chooses to display the site, it is displayed in that language. Figure 5 shows the Spanish version of the Itinerary from Figure 2, together with an additional feature of Cmappers.Learn: if users “obtains” an Itinerary, it is added to their Learning Center. When navigating through an Itinerary from the Learning Center, an option will display the thumbnails of the linked LOs right above the Itinerary, and users can mark those LOs that they have completed.

Cmappers.Learn is available free to anybody interested in learning about concept mapping and its uses. Registration is done through Windows Live, and there are about 2,500 users currently registered. The site does not

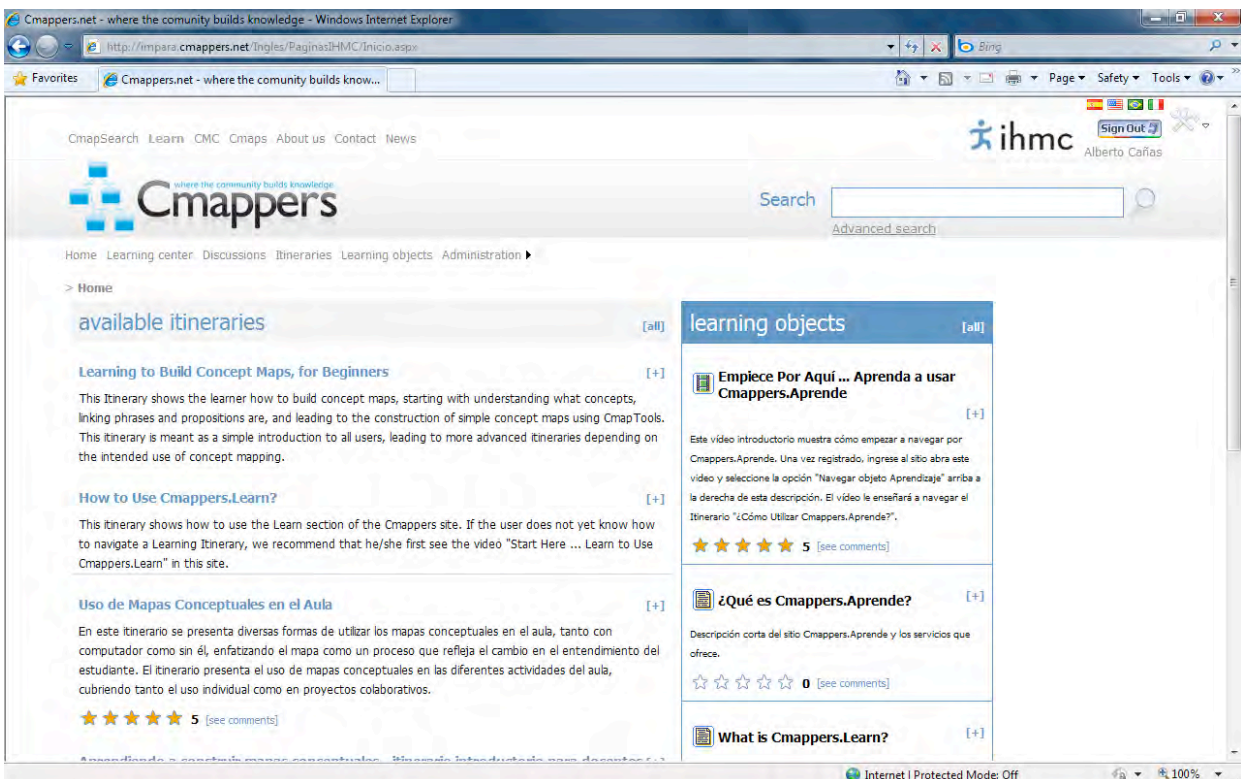


Figure 4. The Cmappers.Learn site consists of a set of Itineraries that organize a larger set of Learning Objects on concept maps and concept mapping. It is part of the Cmappers.net site (www.cmappers.net).

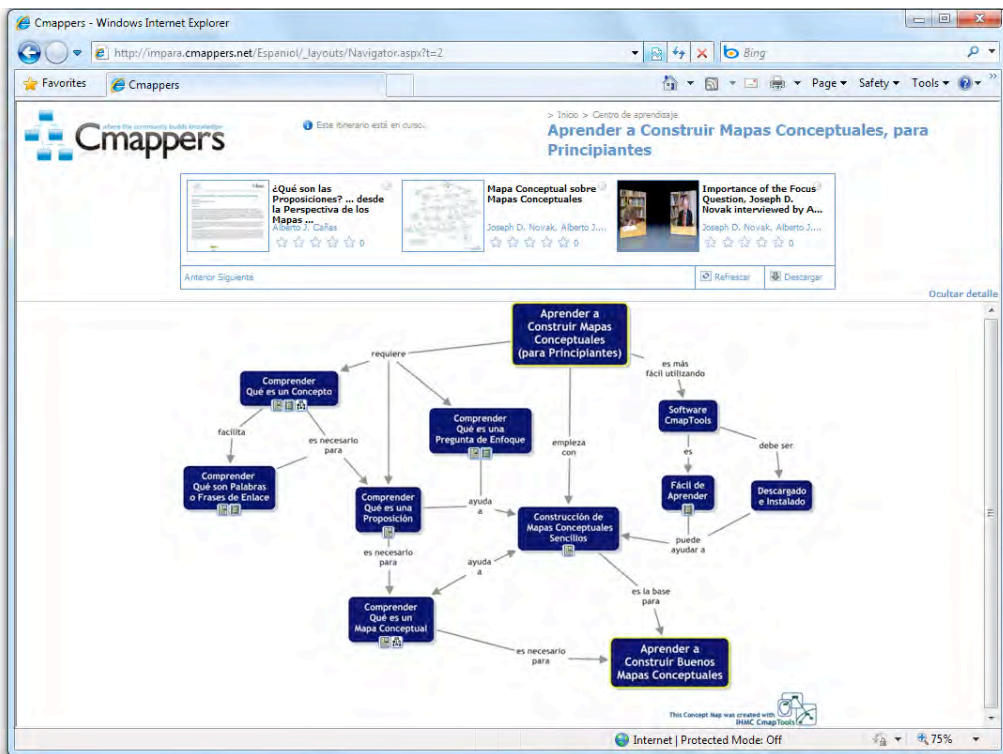


Figure 5. The Itinerary from Figure 2 shown in its Spanish version at the Cmappers.Learn site together with the option of listing the thumbnails of the LOs above the Itinerary.

include any courses, provide any evaluation or certify the students. Learners are free to navigate through the Itineraries at their own leisure. Instructors interested in having their students learn about concept mapping can point them to the site and its existing Itineraries, or can reuse and adapt one of the exiting Itineraries. We invite the Cmappers community to contribute LOs and Itineraries on different uses of concept mapping to the site (Cañas & Novak, 2008).

## 6 Conclusions

We propose the use of the Itinerary, a concept map that guides the learner through the different activities and competencies needed to learn a topic, as a means of organizing LOs based on the experience of Instructors. The Itinerary provides a level of abstraction that is more manageable by Instructors creating online courses than LOs, and provides better reusability of LOs and the Itineraries themselves. Itineraries are used as the means to organize LOs at the Cmappers.Learn site, enabling thousands of users to learn about concept mapping and its applications.

## 7 Acknowledgements

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## 8 References

- ADL. (2010). SCORM 2004 4th Edition Version 1.1 Overview. Retrieved August 19, 2010, from <http://www.adlnet.gov/Technologies/scorm/SCORMSDocuments/2004%204th%20Edition/Overview.aspx>
- Ausubel, D. P. (1963). *The Psychology of Meaningful Verbal Learning*. New York: Grune and Stratton.
- Basso, S., & Margarita, S. (2004). *Teaching By Doing with Concept Maps: Integrating Plone and CmapTools*. Paper presented at the Concept Maps: Theory, Methodology, Technology. Proc. of the First Int. Conference on Concept Mapping, Pamplona, Spain.

- Bohl, O., Scheuhase, J., Sengler, R., & Winand, U. (2002). *The Sharable Content Object Reference Model (SCORM) - a Critical Review*.
- Cañas, A. J., & Novak, J. D. (2008). Next Step: Consolidating the Cmappers Community. In A. J. Cañas, P. Reiska, M. Åhlberg & J. D. Novak (Eds.), *Concept Mapping: Connecting Educators. Proceedings of the Third International Conference on Concept Mapping*. Tallinn, Estonia: Tallinn University.
- Coffey, J. W., & Cañas, A. J. (2003). LEO: A Learning Environment Organizer to Support Computer-Mediated Instruction. *Journal for Educational Technology*, 31(3), 275-290.
- Kumar, A., & Saigal, R. (2005). *Visual Understanding Environment*. Paper presented at the Proceedings of the 5th ACM/IEEE-CS Joint Conference on Digital Libraries, Denver, Colorado.
- Learning Technology Standards Committee. (2002). *Draft Standard for Learning Object Metadata* (No. IEEE Standard 1484.12.1-2002). New York: Institute of Electrical and Electronics Engineers.
- Miller, N. (2010). Personal Communication.
- Novak, J. D., & Cañas, A. J. (2008). *The Theory Underlying Concept Maps and How to Construct Them* (Technical Report No. IHMC CmapTools 2006-01 Rev 01-2008). Pensacola, FL: Institute for Human and Machine Cognition.
- Novak, J. D., & Gowin, D. B. (1984). *Learning How to Learn*. New York, NY: Cambridge University Press.
- Rehak, D. R., & Mason, R. (2003). Engaging with the Learning Object Economy. In A. Littlejohn (Ed.), *Reusing Online Resources: A Sustainable Approach to E-Learning* (pp. 22-30). London: Kogan Page.
- Riesco, M., Fondón, M. D., & Álvarez, D. (2008). Designing Degrees: Generating Concepts Maps for the Description of Relationships between Subjects. In A. J. Cañas, P. Reiska, M. K. Åhlberg & J. D. Novak (Eds.), *Concept Mapping: Connecting Educators. Proc. of the Third Int. Conference on Concept Mapping*. Tallinn, Estonia & Helsinki, Finland: Tallinn University.
- Siegler, M. G. (2010, August 19). Bill Gates: In Five Years The Best Education Will Come From The Web. <http://techcrunch.com/2010/08/06/bill-gates-education/>
- Voorhees, R. A. (2001). Competency-Based Learning Modes: A Necessary Future. *New Directions for Institutional Research, Summer 2001*(110), 5-13.