Using Knowledge Mapping to foster Open Sensemaking Communities

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The aim of this paper is to overview the ways in which knowledge mapping can be used to foster open sensemaking communities. First, we introduce the OpenLearn project, launched by the UK Open University. It is a large scale project that makes a selection of higher education learning resources freely available on the internet. OpenLearn integrates three knowledge media technologies: Compendium, Flashmeeting and MSG. Then, we analyse some examples which show how knowledge mapping techniques have been used to foster the open learning Community of Portuguese Language Countries CPLC by mapping knowledge, educational resources and virtual interactions. This study draws on multiple data sources: discussion forum, Compendium maps and FlashMeeting web videoconference. Through qualitative analysis, we examine the value of knowledge mapping as a mediating tool for sense making. The findings suggest that knowledge maps can be applied to promote collaborative learning and critical thinking.

1. Introduction
The project “OpenLearn” (http://openlearn.open.ac.uk), which was developed by the UK Open University and sponsored by William and Flora Hewlett Foundation, provides free online learning material and offers free knowledge media technologies for open learning (Jarman, 2005). Educators can reconstruct their own materials from existing open educational resources OER by downloading, editing, remixing and publishing courses under the Creative Commons license. Internet users can access OpenLearn courses called “units” and apply knowledge media tools to facilitate their learning in online communities.

These materials taken from OU-UK courses were designed originally for students paying for tutor- and peer-supported distance learning. Their original structure aims to promote critical reflection on the part of the learner. In an open learning context, however, learners do not have ready access to an expert tutor or cohort of peers, and may be drawing on diverse other OERs, blogs, wikis, newsfeeds and so forth, some of which may be superior, complementary, contradictory or of dubious authority. What support for managing this information ocean can we provide in the learning environment in which our OERs are embedded, in order to move learners towards knowledge construction and negotiation? Openlearners need intuitive, powerful tools to manage, share, analyse and track information, ideas, arguments and the connections between them.

The OpenLearn project consists of two virtual learning environments on the open source Moodle platform. First, LearningSpace <http://openlearn.open.ac.uk> is an area to access pedagogically-structured open educational resources., which are organized in units and areas of knowledge. Second, LabSpace <http://labspace.open.ac.uk> is an experimental zone and supports the dynamics of sharing, remixing and re-uploading OER in different languages. It hosts the same units published in LearningSpace, as well as remixed course versions and new learning materials.

There are three knowledge media tools, which are offered in both learning environments, Compendium (knowledge mapping software), MSG (instant messaging application with geolocation maps) and FlashMeeting (web-based video-conferencing application). After the first year of OpenLearn, there are more than 1.000.000 learners in 160 countries, over 1,000 FlashMeetings booked, 1314 Compendium Knowledge Map downloads and 17,000 MSG users.

Our specific concern within OpenLearn is to investigate support for what we call Open Sensemaking Communities [www.kmi.open.ac.uk/projects/osc - Buckingham Shum, 2005], a concept we are using to investigate the next step after publishing OERs, namely, designing for sensemaking: embedding OERs in an environment that supports end-users (both learners and educators) in engaging more deeply with the material and with each other in self-organising communities of interest. The focus on [sense][making] reflects our perspective on giving shape and form to
interpretations, and the individuals/communities articulating them, after Weick (1995): “Sensemaking is about such things as placement of items into frameworks, comprehending, redressing surprise, constructing meaning, interacting in pursuit of mutual understanding, and patterning.” (Weick, 1995, p.6)

We propose that a primary challenge is to assist self-organising learners and educators in assessing, extending and contesting OERs. This requires access not only to the text, but to the context (e.g. annotations, argumentation, and the people behind them). This rationale shapes the selection of the software tools that we are evolving, which are designed to make visible and manipulable the connections between ideas – knowledge web (Eisenstadt and Vicent, 1998), and between the people behind them. The focus of this paper is on mapping conceptual networks with Compendium, although we touch briefly on social networks at the end.

2 Compendium: a language learning mapping tool

Compendium (http://www.compendiuminstitute.org) is a knowledge mapping software tool, which was initially developed by Verizon in 1993 and then by the Knowledge Media Institute at the Open University in the UK. Through Compendium, language learners can represent their thoughts, ideas and information. They can select and connect interesting resources and structure their knowledge of the content. Diverse mapping techniques can help learners to model problems, connect concepts and map arguments in discussions. This knowledge-mapping tool can be used as an individual or group tool to summarize discussions in forum, chats and web videoconference; to develop brainstorming activities to explore new ideas, organize key concepts from text and structure arguments to write essays. Figure 1 shows an example of Compendium task.

Compendium allows users to include any kind of files in the map, for example video, text, web pages, figures, tables, graphics and sound. Its key feature is its ability to categorize information through a set of different types of icons which represents questions, ideas, pros, cons, references, notes, decisions, lists and maps. The tool allows users to develop their own sets of icons and groups these using stencils.

Figure1 shows a map created by an OpenLearn user from the CPLC community also interested in Information Literacy. It illustrates how to use Compendium to organise ideas and arguments:

1. Drag and drop a question-icon \( \text{[question]} \) from the palette and type a question.
2. Create new nodes: 🌍 for answers, concepts or data; 🗣️ for arguments, choices or possibilities; 🤝 for supporting arguments; 🗫 for counterarguments. If you want to make connections, by clicking the right button of the mouse over the icon, drag the arrow and drop it onto the other icon.

3. Pictures, sites and documents from the web can be added into this map by dragging and dropping the media resource.

4. A number superimposed on a node (e.g. 2) means that it appears in more than one map. The same idea can play roles in multiple contexts and conversations which can be linked. When the mouse is over the number you will see all maps related to that node.

5. User-defined keyword tags [T] can be annotated onto nodes to help when searching for related material across multiple maps, and include comments [*].

Each icon in Compendium can be classified by keywords called “tags”. When the map contains a lot of information, users can search by tags and type of icons, which facilitates the constructions of new maps based on specific themes. Knowledge Maps are a very useful strategy to select, connect and share meaningful information from open sources available on the web. It is a way of integrating different viewpoints, interpretations, and meanings facilitating the process of sense making. (Bucking Shum, S. 2005, 2005a).

There are many free learning materials not only in the OpenLearn project but also in other open content initiatives developed by academic institutions indicated in the table below:

<table>
<thead>
<tr>
<th>Logo</th>
<th>open content initiatives</th>
<th>URL</th>
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<tbody>
<tr>
<td>🌍️</td>
<td>Carnegie Mellon’s Open Learning Initiative</td>
<td><a href="http://www.cmu.edu/oli/">http://www.cmu.edu/oli/</a></td>
</tr>
<tr>
<td>🍽️</td>
<td>CORE (China)</td>
<td><a href="http://www.core.org.cn/en/index.htm">http://www.core.org.cn/en/index.htm</a></td>
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<tr>
<td>🍽️</td>
<td>Japanese OCW Alliance (Japan)</td>
<td><a href="http://www.jocw.jp/">http://www.jocw.jp/</a></td>
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<tr>
<td>🍽️</td>
<td>MIT OpenCourseWare (USA)</td>
<td><a href="http://ocw.mit.edu/OcwWeb/">http://ocw.mit.edu/OcwWeb/</a></td>
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<td>🍽️</td>
<td>Open Learn – Learning Space</td>
<td><a href="http://openlearn.open.ac.uk/">http://openlearn.open.ac.uk/</a></td>
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<td>Open Learn –Labspace</td>
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<td>Osaka University Open Courseware</td>
<td><a href="http://ocw.osaka-u.ac.jp/index.php">http://ocw.osaka-u.ac.jp/index.php</a></td>
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<tr>
<td>🍽️</td>
<td>OU Open2.net (BBC)</td>
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<tr>
<td>🍽️</td>
<td>ParisTech OCW (France)</td>
<td><a href="http://graduateschool.paristech.org/">http://graduateschool.paristech.org/</a></td>
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<tr>
<td>🍽️</td>
<td>Physics Education Technology OER</td>
<td><a href="http://phet.colorado.edu/new/index.php">http://phet.colorado.edu/new/index.php</a></td>
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<tr>
<td>🍽️</td>
<td>Rice Connexions (USA)</td>
<td><a href="http://cnx.rice.edu/">http://cnx.rice.edu/</a></td>
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<td>🍽️</td>
<td>Sofia Open Content Initiative</td>
<td><a href="http://sofia.fhda.edu/">http://sofia.fhda.edu/</a></td>
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</table>

Table1. Open Content initiatives. More examples in http://www.hewlett.org/Programs/Education/OER

In order to learn about specific topics, teachers can remix the most interesting learning resources by selecting, ordering and sharing OER from different sources through maps. Then learners can visualize a meaningful sequence of different possibilities and navigate easily through different resources saving a reasonable amount of time. They can also download these maps and gather more language learning materials from various sources by dragging and dropping them onto Compendium, sequence them into their own learning path, and publish their maps helping their peers with new combinations.

A learning path map is similar to “my favorite list” or “del.icio.us” web application. It can combine easily a sequence of the most exciting web pages about language learning. However, this graphical representation is a more attractive and meaningful diagram (map) than a simple sequence of URLs (list). Moreover, it has the advantage of offering more possibilities: multiple sequences, extra information, personal comments represented by symbols and classified by categories.

There are many mapping techniques used to create maps, such as mind mapping, concept mapping, web mapping and dialogue mapping. Theses mapping techniques can be very useful for teachers while designing learning activities and for students to planning their tasks and answering questions while developing reading and writing skills. The next section will discuss further information on some mapping techniques analyzing some examples create by the CPLC community in the LabSpace.
3 Study Case

“Mapeando conhecimentos com aprendizagem aberta – CPLC” is a Community of OpenLearn users from Portuguese-Speaking Countries <http://labspace.open.ac.uk/course/view.php?id=1456> in the LabSpace. Its participants are educators and academic students whose interests focus on exploring knowledge media tools to facilitate collaborative learning. Based in different countries, they use FlashMeeting to meet online, learn together and create OER. Their discussions are focused on diverse open learning issues such as game based environments, knowledge media and social software. Compendium Knowledge Maps are created on e-democracy, thinking skills and information literacy. Through MSG, they can see who is online, ask questions and get answers quickly. By exchanging instant messages, they can discuss problems with tools, share additional information on the web, such as OER, knowledge maps, web videoconferences and papers’ URL about what they are studying.

3.1 Concept Mapping as a strategy for studying an OER together

Concept Mapping was developed by Novak in the 1970’s and based on Ausubel’s theory of meaningful learning. This constructivist approach emphasized that learning with understanding only takes place when new concepts are connected to what is already known. Concept maps externalize a learner’s current knowledge structure, helping them to see connections with new information, and make sense of it. (Novak, 1990)

This mapping technique is used to construct relationships between concepts. Learners can create concept maps to show important keywords from a webpage, explain their meaning, and connect them to other definitions from the internet and to familiar keywords representing their existing knowledge.

Concept Mapping can be used as a strategy to study online learning materials. Figure 3 shows an OpenLearn student from CPLC using Compendium to select key concepts from the OpenLearn Unit “Information Literacy” in the LabSpace and from other websites such as Wikipedia and flickr. By dragging and dropping the content into their maps, students can collect pieces of information that they consider relevant from different sources. They can represent their interpretation graphically by connecting their own comments, bringing arguments and raising new questions. They can identify concepts that they did not understand (e.g. what does it mean?) and also “recognize where there is information gap” (e.g. what competencies are they talking about?). By sharing a map within their communities, their fellows can browse it, see keypoints, access web resources, download it and add their contributions. They can also discuss about its content (questions, ideas and arguments) in a FlashMeeting, MSG or forum.

The Map below in figure 3 was created by another student, interested in “Media Literacy”. It shows interesting websites and offers complementary references related to “Information Literacy”.

Figure 2. Compendium’s user interface for linking issues, ideas and documents.
Through knowledge Cartography (Okada, Buckingham Shum & Sherborne, 2008), users can develop their ability to select information, visualize connections between different content and reconstruct them from different perspectives.

### 3.2 Web Mapping as a strategy for sharing Learning Path Maps

Another kind of representation is a Learning Path Map, a sequence of learning materials significant to a learner or as a set of resources for educators to attend their specific needs. A learning path map may offer an interesting group of reference nodes hyperlinked to activities or content from the OpenLearn OERs. It may represent an organised structure showing prerequisite knowledge, learning objectives and estimated study hours.

![Learning Path Map diagram](image-url)
This technique known as Web Mapping was developed in response to the rapid growth of the internet. The huge number of websites and overflow of information can cause users to become lost in cyberspace. Web maps enable users to record their navigation using icons, hypertext and hyperlinks. Cartography tools permit selection of what is relevant in cyberspace, indexing and retrieving hypermedia web material (Dodge and Kitchin, 2000). Web Mapping is a useful technique to group and share important references from learning materials and from the web.

The map in figure 4 was created by an CPLC’s participant also interested in Information Literacy. It includes seven OpenLearn units and two additional OERs from MIT Open courseware and Connexions. These nine learning materials were organised in five levels (columns). Students can follow this sequence by starting with “Information Literacy” and then “Learning how to Learn”. Depending on their interests they can choose either “Computer for study”, or “Online Learning”. They can then study other units for Developing Skills, such as, “Interpersonal Skills”, “Thinking Skills” and “Good Writing”.

Compendium thus provides a visual authoring tool for the rapid (re)sequencing of learning resources, a form of high level “remixing” of the OU’s OERs. The learning path map provides learners and non-technical educators with a way to quickly drag and drop websites, documents and media clips into a map, link them and publish them.

3.3 Mind Mapping as a strategy for creating and solving Learning Activities

Mind Mapping was developed by Buzan around 1974 in the popular book “Use Your Head”. Thoughts are often difficult to represent in a linear order and initially appear without logical structure. Mind Mapping allows ideas to be represented non-linearly, using keywords, sentences and pictures in graphic form. The elements are connected by lines and arrows, with short descriptions.

Mind Mapping is a useful technique by which to generate new ideas, like brainstorming. Through mind maps, students can generate a large number of keywords as an initial step for solving a problem. This technique is helpful in developing creativity and learners can organize their initial ideas related to a subject to develop a project, write an essay or prepare a presentation.

Figure 5 shows a Mind Map about e-democracy created by a social science teacher from the CPLC community. This map can be downloaded by other educators and used with their students. Teachers can invite their colleagues to plan and share different kinds of learning activities such as exploring references from this map, comparing different theoretical approaches through concept maps, writing an essay through a mind map of key sentences structured by groups of paragraphs.

Figure 5. Compendium used for editing a web map created collaboratively using template
3.4 Knowledge Map templates as a strategy for literature review:
Users can create templates for organizing their maps collaboratively and a set of “tags” for classifications and new search processes. This is useful to group diverse elements in a map such as: text, figures, tables and graphics. Based on a template, students can add their ideas and upload their map using the same structure and system of tags.

Figure 6 shows a reference map created collaboratively by five researchers using the same template for literature review. This map presents twenty three references about “critical thinking, knowledge media tools and OpenLearn”. Compendium users who download this map to add new contributions can see the documents organised by color, icons, titles and two groups of tags kind of document and keywords. In this template:

- color shows who selected the reference (e.g. blue, Beto; pink, Nely; black, Ale;...)
- icons represent the kind of document e.g. article, journal paper, chapter or book.
- titles gives information about the content of the documents in the map
- the first group of tags “Type” indicate the quantity of each kind of document; e.g. (3) articles, (1) chapter and (10) papers.
- the second group “Topic” indicate the quantity of references categorized by keywords; e.g. (7) references about collaborative learning; (2) information literacy and (8), critical thinking.

3.5 Dialogue Mapping to summarize web videoconferencing
Dialogue mapping was developed by Conklin (2006) to solve wicked problems and share an understanding of these during discussion. It is also derived from the Issue-based Information System (IBIS) developed by Rittel in the 1970s to solve ill-structured problems. IBIS is a rhetorical grammar with three core elements: issues, positions and arguments all of which can be rendered as textual outlines and graphical maps that grow with the conversation. Dialogue Mapping is a sensemaking strategy useful for structuring reasoning based on questions, statements, pros, cons and conclusions. Dialogue maps can be applied to prepare and present a set of arguments, develop a logical line of reasoning and facilitate critical thinking. Learners can create these maps with Compendium to organize argumentation in face to face meetings and online conversations such as discussion forum, web videoconference, chat, or from texts and video clips. Dialogue maps can contain any kind of resource such as video, pictures, audio, graphs, text, forum or webconference. Figure 8 is an example of a dialogue map created to summarize a webvideoconferencing in FlashMeeting.
These maps can enhance the understanding of the event, as they include temporal and conceptual connections amongst all event elements, such as who attended the meeting and who spoke when (Figure 7), the URLs visited and the whiteboard images or interactions (Figure 8). All these elements are nodes linked in a knowledge map (Figure 9), which can be used to assist the replay users in structuring, acquiring and reconstructing the knowledge transferred during the discussions and argumentations in the meeting. The nodes are actually links back to the original replay as well; therefore a way of traversing the replay through different categories of indexed timestamps.

Knowledge Mapping indicates a new way to interact and construct knowledge collaboratively from individual learners to social groups (Aigrain, 2003) and from global networks to local communities (Anderson, 2007). Some messages posted by CPLC users in the LabSpace discussion forum point out diverse contributions of knowledge maps to foster open sensemaking communities. Knowledge Mapping can be a pedagogical strategy to support learners and educators in open learning. Compendium can be used to:

- Build new learning objects, leaving them open for sharing, reuse and remixing:
  
  “A knowledge map is a meaningful interface for sharing learning objects classified by icons, tags and titles. When people construct the map’s structure or template together, then the process of sharing, remixing and reuse open educational resources becomes easier.” Dana, 13/08/2007

- Manage personal or group information by dragging and dropping in any document or website (a form of ‘visual e-portfolio’);
“Knowledge Map block in Moodle is a useful resource for collaborative learning; users can contribute by adding more components in their colleagues’ maps and the community is able to see improvements by accessing previous versions of that map”. Jose, 14/12/2007

- Manage knowledge and learning by charting questions, ideas, and arguments as they arise;
  “After navigating in the reference map my key question is how could we use the Moodle’s resources to support our reflection about knowledge mapping? See my map above, (...) I would like to discuss 2 aspects: how to improve the templates and our reflection about critical thinking.” Lila, 12/08/2007

- Share learning pathway maps over resources; to work through revision question templates;
  “Wow! Our maps are very interesting! We started with a small bibliography map, which expanded with new references... Then... people developed reading maps, and we have now a research map... Should we select a key issue based on the integration of our questions? Should we identify interesting concepts (for everyone) to go deep in our research?” Beto, 17/08/2007

- Browse or construct knowledge maps associated with learning resources and literatures, or dialogue maps which add value to online meetings;
  “It is easier, more attractive and meaningful to navigate in a web videoconference using a knowledge maps. Dialogue Maps can be used to provide a global picture of a online discussion in FlashMeeting” Paulo 12/12/2007

- Build knowledge facing difficulties and developing critical thinking.
  “My difficulty was to identify information about the analysis. The methodology of research is not clear. It seems more a descriptive paper showing the potential of cmaps applied to writing, than a proper research. I could not find maps about students, their improvements, benefits, difficulties and limitations. There is no evidence for some claims and there are arguments without strong connections... This exercise of mapping the reading is interesting because we can identify visually the structure and parts that are missing in the text.” Lila, 17/08/2007

6. Conclusion and Future Research

During its first one year of existence, the OpenLearn project has engaged a critical mass of over 15,000 knowledge technologies users and , taking advantage of the OER to learn at their pace and time. So far, the knowledge media tools have been proved useful to help users connect with other open learners with similar interests and participate in online communities of practice. In an open learning environment, desktop videoconferencing with FlashMeeting has also been used to discuss knowledge maps. Compendium has been applied to study, remix and develop OER. Several of these resources produced in FlashMeeting and Compendium have been reused worldwide by individuals from different corners of the world.

Our future research focuses on how students and educators can disseminate knowledge mapping as open sensemaking tools to foster their social learning networks and contribute to the open learning resources movement by developing their learning materials and new pedagogical strategies. Open Educational Resources, knowledge media tools and open sensemaking communities are essential to promote open learning mainly if OpenLearners can take part in this collaborative process of critical thinking and collective construction of knowledge.

References


