



Open Research Online

The Open University's repository of research publications and other research outputs

Designing Open Educational Resources through Knowledge Maps to enhance Meaningful learning

Journal Item

How to cite:

Okada, Alexandra and Connolly, Teresa (2008). Designing Open Educational Resources through Knowledge Maps to enhance Meaningful learning. *International Journal of Learning Technology*, 15(7) pp. 209–220.

For guidance on citations see [FAQs](#).

© [not recorded]

Version: [not recorded]

Link(s) to article on publisher's website:

<http://ijl.cgpublisher.com/product/pub.30/prod.1842>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk

Designing Open Educational Resources through Knowledge Maps to Enhance Meaningful Learning

Alexandra Okada, KMi - The Open University, United Kingdom
Teresa Connolly, The Open University, United Kingdom

Abstract: This paper demonstrates some pedagogical strategies for developing Open Educational Resources (OERs) using the knowledge mapping tool Compendium. It also describes applications of Knowledge Maps to facilitate meaningful learning by focusing on specific OER examples. The study centres on the OpenLearn project, a large scale online environment that makes a selection of higher education learning resources freely available via the internet. OpenLearn, which is supported by William and Flora Hewlett Foundation, was launched in October 2006 and in the two year period of its existence has released over 8,100 learning hours of the OU's distance learning resources for free access and modification by learners and educators under the Creative Commons license. OpenLearn also offers three knowledge media tools: Compendium (knowledge mapping software), MSG (instant messaging application with geolocation maps) and FM (web-based videoconferencing application). Compendium is a software tool for visual thinking, used to connect ideas, concepts, arguments, websites and documents. There are numerous examples of OERs that have been developed and delivered by institutions across the world, for example, MIT, Rice, Utah State, Core, Paris Tech, JOCW. They present a wide variety of learning materials in terms of styles as well as differing subject content. Many such offerings are based upon original lecture notes, hand-outs and other related papers used in face-to-face teaching. OpenLearn OERs, however, are reconstructed from original self study distance learning materials developed at the Open University and from a vast academic catalogue of materials. Samples of these "units" comprise a variety of formats: text, images, audio and video. In this study, our findings illustrate the benefits of sharing some OER content through knowledge maps, the possibility of condensing high volumes of information, accessing resources in a more attractive way, visualising connections between diverse learning materials, connecting new ideas to familiar references, organising thinking and gaining new insights into subject specific content.

Keywords: Open Educational Resources, Knowledge Maps, Meaningful Learning

Introduction

This paper sets out to demonstrate some pedagogical strategies for designing Open Educational Resources (OERs) through Knowledge Maps. This exploratory research focuses on the application and benefits of developing OERs using the knowledge mapping tool Compendium to enhance meaningful learning. The methodology of this investigation is based on two small-scale qualitative studies of two OERs designed with Compendium by the authors for the OpenLearn project developed by the Open University (OU) UK during 2007 and 2008.

OpenLearn is an open educational environment that makes a wide range of higher education learning resources freely available via the Internet. It also offers a number of knowledge technology tools available, including Compendium, to enhance and facilitate online learning. Initially funded by the William and Flora Hewlett Foundation, OpenLearn was launched in October 2006 and in the two year period of its existence it has released over 8,100 learning hours of transformed OU distance learning resources allowing free access and modification by learners and educators under the Creative Commons licence.

The majority of OpenLearn OER units are based upon the format and style of the original self-study distance learning materials, developed at the OU, and include their inherent pedagogy. However, Some of the original OU teaching materials, offered to OpenLearn as potential OER units, often included complex navigation. One of the greatest challenges during the process of developing OpenLearn OER units, therefore, was how to represent these materials in a meaningful and appropriate way taking into consideration that there is no tutorial intervention or support by Faculty for OpenLearn users – a learner or educator.

The thesis of this study is supported by the idea that knowledge mapping has a central role to play in weaving narrative connections between OERs for both learners and educators to share and debate interpretations and make meaning (Buckingham Shum and Okada, 2008). Additionally this work is currently framing the authors' pilot research in terms of how Compendium can be used by Learning Designers interested in developing OERs through knowledge maps to foster meaningful learning.

This paper also draws on the work of Ausubel (1963) and Novak et al (1998) who defined the principle of meaningful learning in terms of:

First, and in some ways most important, the *learner must choose* to seek ways to relate new concepts and propositions to existing relevant concepts and propositions she/he already knows. Second, the learner must *possess relevant concepts* and propositions with a sufficient degree of clarity and stability to anchor new, relevant concepts and propositions. Third, the material to be learned must be *potentially meaningful*; that is, it must be conceptually explicit and relatable to other ideas in the knowledge domain. (Cañas and Novak, 2008:27)

Specifically, the research questions of this study are as follows:

- What is the effect of designing OERs through knowledge maps, whose representation is different from the original materials?
- What are the challenges and benefits of OERs designed with Compendium for learners and educators?

Designing OERs in Compendium to Promote Meaningful Learning

Compendium is a free software tool for visual thinking, used to connect ideas, concepts, arguments, websites and documents. Users can install this software to create, share, upload and download knowledge maps in the OpenLearn environment or any VLE based on a Moodle platform.

The illustration in Figure 1 demonstrates how learners can create a learning pathway map in Compendium in order to reuse an OER during their studies. It also shows that knowledge mapping techniques can be used to solve a learning activity by raising questions (Figure 1: label 1), adding possible answers (Figure 1: label 2), and connect information from OpenLearn and also from FM-webconference (Figure 1: label 3).

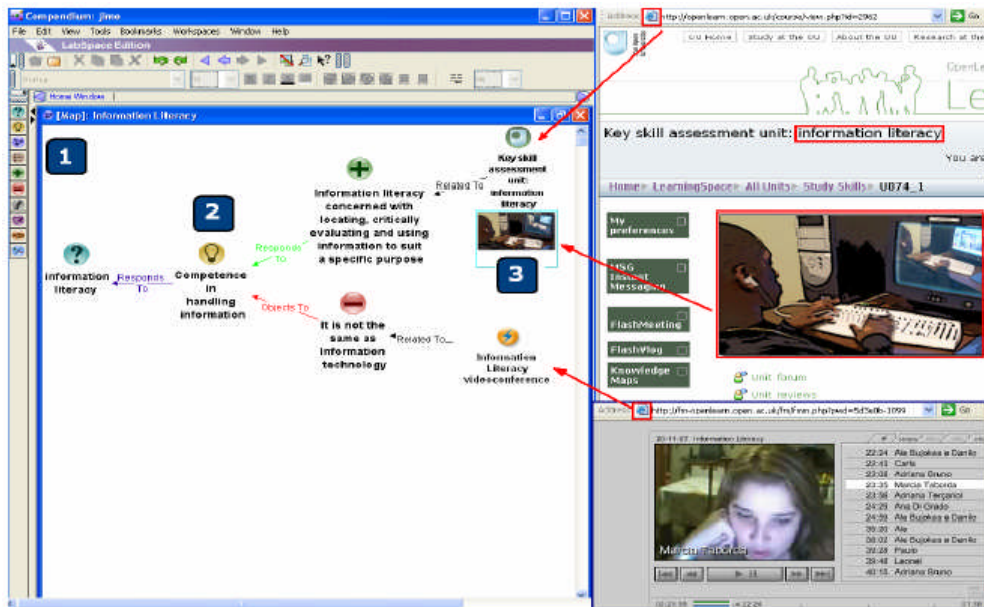


Figure 1: A Compendium Learning Pathway Map by CoLearn (2007)

Compendium gives learners and educators the facility to map learning paths, model problems and structure argumentation or discussions to enhance their visual thinking in order to make sense of what they are studying or designing. Figure 2 shows another example about how Compendium maps can be used as a visual authoring tool for the rapid (re)sequencing of learning resources - a form of high level “remixing” of open educational resources.

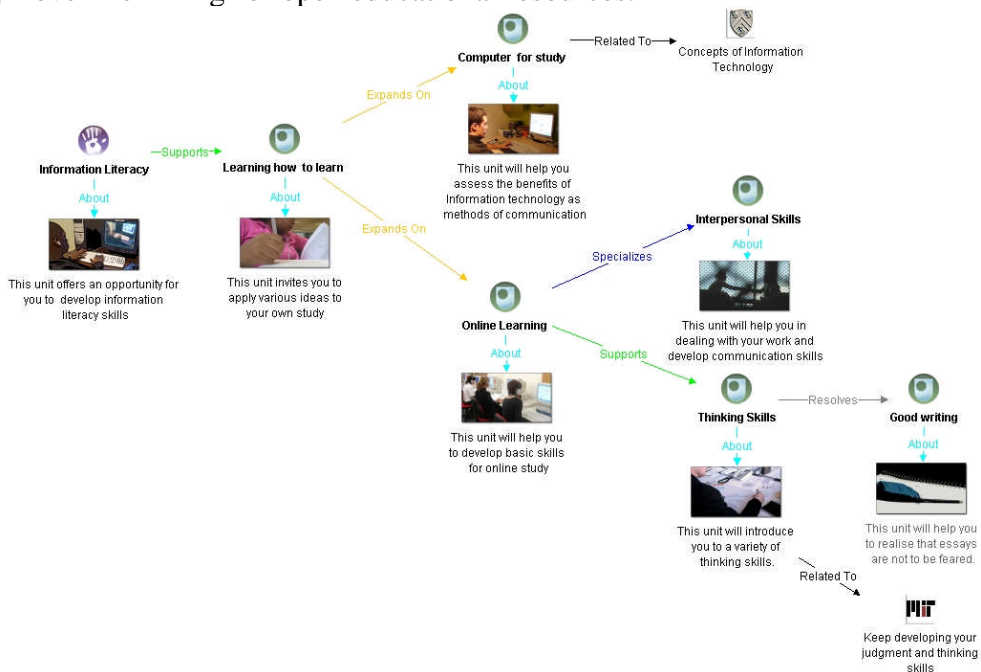


Figure 2: Compendium Map for Remixing OER by CoLearn (2007)

Schön (1987) defines designing as “a process of learning by doing”. A design-like practice is described as a process that it can be learned but it cannot be transmitted via instructions. Designing comprises reflection in action. Designing means a reflective practice experienced by teachers or learners when they are engaged in repeatedly back and forth between reflecting on and in acting.

Considering designing as a process of learning by mapping Novak (1998) argues that meaningful learning requires relevant prior knowledge, a novel problem solving and well-organised structure to connect existing knowledge with new concepts in order to creating meanings. He states that: “*The more we learn and organise knowledge in a given domain, the easier it is to acquire and use new knowledge in that domain.*”

Thus we suggest that by designing learning materials through knowledge mapping one can symbolise a process of representing graphically significant learning pathways in a specific context, based on clear objectives where a particular set of knowledge, understandings and skills can be developed by learners through reflecting in action.

When teachers or learning designers are creating learning maps, they must consider that these trails are for learners navigating, making decisions and also designing by themselves their own learning journeys using learning maps that act as a guide. Teachers or learning designers, therefore, must create learning maps as clear, simple and as easy as possible for their students to visualise the content as well as understand how to use it effectively and efficiently.

The benefits and limitations of using knowledge maps for designing learning experiences derives from the ability to simplify and specify a set of knowledge to be represented in the map. This is one of the greatest challenges in such mapping. On the one hand, a map with a high degree of representation of knowledge may be helpful but at the same time complex or confusing. On the other hand a lack of details may make the representation clearer but may hinder orientation and understanding (Okada, 2006).

When designing a learning pathway, it is important to define key elements that must be represented in the resulting map. In this sense, the learning designer must be aware of issues such as:

‘What do I want the students to be able to do having completed this learning activity (a focus on learning outcomes)?’ ‘What tools and resources do I want to incorporate?’ ‘What are the particular characteristics of this group of learners?’ ‘How am I going to assess the activities?’ ‘What specific discipline issues or problem does this address?’ ‘How can I design the activity to promote: reflection, collaboration, application?’ (Conole, 2008:2000)

In order to use a learning path map as a guide, learners must also start their journey with some questions, such as:

“What is this map for? What am I trying to accomplish by using this map? What does this map show that I want to discover? What does this map show that I already know? What is missing in this map that I should include to make it clear? Is there anything that I could change in this map to make it more useful? What other situations and issues that this map can be useful for?” (Okada, 2008a)

When Knowledge mapping can be applied appropriately to the process of designing, it functions as an aid tool for both educators and learners to reflect in action, make sense of internet information, clarify reasoning and develop conceptual understanding (Okada, 2008b). The processing of mapping as a learning strategy helps users develop a permanent record of thinking, visualise key issues, get overviews indicating boundaries of current knowledge and make better decisions by ensuring that relevant considerations are taken into account (O’Brien, 2003).

In the context of open learning and OERs, it is important to consider that OER users may be looking for learning materials for different reasons such as life long learning, formal or informal learning, individual or, indeed, collaborative learning. Some of them may not have experience with graphical representations or multimedia materials. Diverse aspects must be taken into account during the learning designing process.

The “Elicit” approach for designing learning pathway maps may help educators/teachers and learners/students create significant maps that can be understood and used by others (Okada, 2008a). Eliciting is an important skill where learners are able to illustrate their interpretation by drawing out information from the map. A learning map must offer pathways for reflecting in action, which means trails in which learners can visualise, navigate and construct meaning through connections. These connections can already be established in the map or can be created by learners. In this case, learners must be able to access the learning maps and also be able to edit them using a knowledge-mapping tool. The following paragraphs outline some of these issues in more detail.

Table 1 shows the “elicit” principles for learning path maps (Okada, 2008a) in which in this current study was extended for OER maps.

The “elicit” process developed during OER design may, therefore, offer an individualised learning journey driven by the learner’s choices and needs. When learners can edit, update and share their OER maps their own journeys are more fully understood. Indeed the learning community can also share more meaningful learning and new ideas by experiencing a collective journey too.

Table 1: The “*Elicit*” Principles for Learning Path Maps Extended for OER Maps

Principles	Learning Path Maps for learners	OER Maps for learning designers
Explicit goals	Identifying clear goals to be achieved with the map is an initial step for the learning pathway. This start point can be a question or problem.	Making learning outcomes explicit in the map is the initial step for learners to understand what they can use it for and establish a clear goal to start their learning journey.
Learning activities	Choosing or including actions in the map based on goals and interests is a second step for facilitating navigation and for mapping update	Defining a set of learning activities in the map is the second step for guiding learners in their navigation to achieve their goals.
Interesting information	Highlighting or Recording relevant information in the map will be useful for connecting prior knowledge with new concepts	Organising and connecting interesting information will help learners identify what they already know and what they want to discover.
Clear clues and connections	Discovering or marking signs through icons, tags and details may be meaningful for widening, deepening and connecting new discoveries.	Structuring clear clues and connections without making the map confusing will add more value to it and enrich the learning journey by provoking curiosity and new discoveries by the learner.
Integrated overview	Getting the big picture in the map means be able to zoom out the map and visualise the connection among the most relevant points - familiar and unknown ones.	Offering a big picture of the main topics through a simple map interface will allow learners to see the key information initially and, through the pre-defined filtering or layering process, give them the opportunity to magnify or zoom into the areas that they want to explore.
Trail as a marked route with help	Visualising or tracing learning pathways means to explore, discover, and ascertain significant steps avoiding to get lost with orientation (help)	Suggesting a trail with key steps will help learners to feel more confident in exploring, discovering, and ascertaining different pathways without becoming lost. Tailored help facilities are a necessity here – giving clear examples of how, where and why certain routes are suggested as well as promoting the preferred trail.

Designing Compendium based OER Units

The following case studies outline how and why the Compendium mapping tool and the “elicit” framework has been used to deliver two specific OpenLearn OER map-based units.

Case Study 1: EPoCH OER Map – Making Connections & Creating Meaning

The first Compendium based example is an OpenLearn OER unit called Exploring Psychology’s Context and History (EPoCH). It is a psychology history timeline based on Compendium maps designed by Okada (2007). The original materials were offered to the OpenLearn project by the OU Faculty of Social Sciences. Knowledge maps were created to represent a substantial content-based CD based resource that portrays both biographical details of in excess of 100 psychologists as well as descriptions and links between psychology methods, contexts, perspectives and topics. Essentially EPoCH contains wide-ranging psychology based subject information including text, video, images and audio resources.

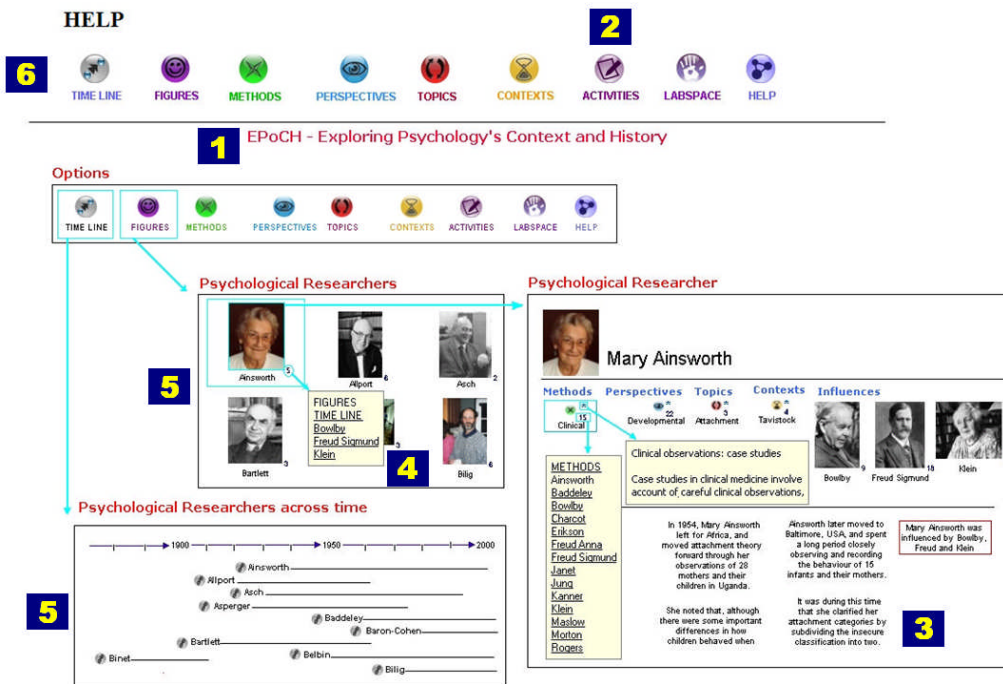


Figure 3: A Sample of the EPoCH Resources Presented using Compendium

Figure 3 shows the main principles applied to designing the EPoCH OER maps. The following text outlines how the Elicit framework was applied to the creation of the maps:

1. **Explicit goals:** the main goal of this OER is made explicit in it’s title: “Exploring psychology’s context and history” (see Figure 3, label 1).

2. **Learning activities:** were represented by the icon “activities” which can be accessed from any map through the menu bar (see Figure 3, label 2).
3. **Interesting information:** information about each psychologist can be accessed through different maps including photos, descriptions of life and work, categories for classifying approaches with some video and audio clips (see Figure 3, label 3).
4. **Clear clues and connections:** some clues were defined in this map by using icons to represent categories that classify and integrate similar approaches, numerals automatically generated by Compendium represent the number of times that the information appears in other maps as well as linking to the other maps (see Figure 3, label 4).
5. **Integrated overview:** demonstrated by the two first maps, the timeline and figures, that show all the psychologists classified by names with associated photos (see Figure 3, label 5).
6. **Trail as a marked route:** Learners can navigate through diverse hyperlinks, for example, using the icons or hypertext links in the yellow boxes (see Figure 3, label 4) containing associated details that allow them to access further information. The main trail, however, is a marked route and is available on each map through the menu bar at the top of every page (see Figure 3, label 6).

How have OpenLearn users been Learning with Epoch OER Map?

The EPoCH Unit has been one of the most popular OER units in OpenLearn both in terms of knowledge maps downloads and as an individual OER unit. Considering the five top Compendium-based OERs which OpenLearn users have been downloading Table 2 shows that EPoCH is the most popular. Two hundred and forty nine downloads means that the EPoCH OER unit and associated Compendium maps have been not only used for navigation, but also were copied from the OpenLearn for offline access and editing as we will now explore.

Course Description	Downloads
2850 EPOCH Psychology history timeline	249
1644 Extending and developing your thinking skills	15
1472 Studying the arts and humanities	14
1615 An introduction to business cultures	13
1526 Global warming	10
(...)	
<hr/>	
Total Map Downloads: 599	

Table 2: OpenLearn Compendium OER Unit Downloads (Jul 2007 – Jun 2008)

It is also possible to surmise that a greater number of users probably prefer to learn using knowledge maps not only by accessing this resource on the web browser, but by exploring and also at a later date making their own maps, which reinforces the meaningful learning context. There is some evidence, in the form of new EPoCH style Compendium maps, being uploaded to OpenLearn. Finally the higher number of downloads compared to other units, whose maps were created by users, indicates that the principles for designing maps may be relevant to learners when the intention is to share their maps for other learners experiencing a similar learning journey.

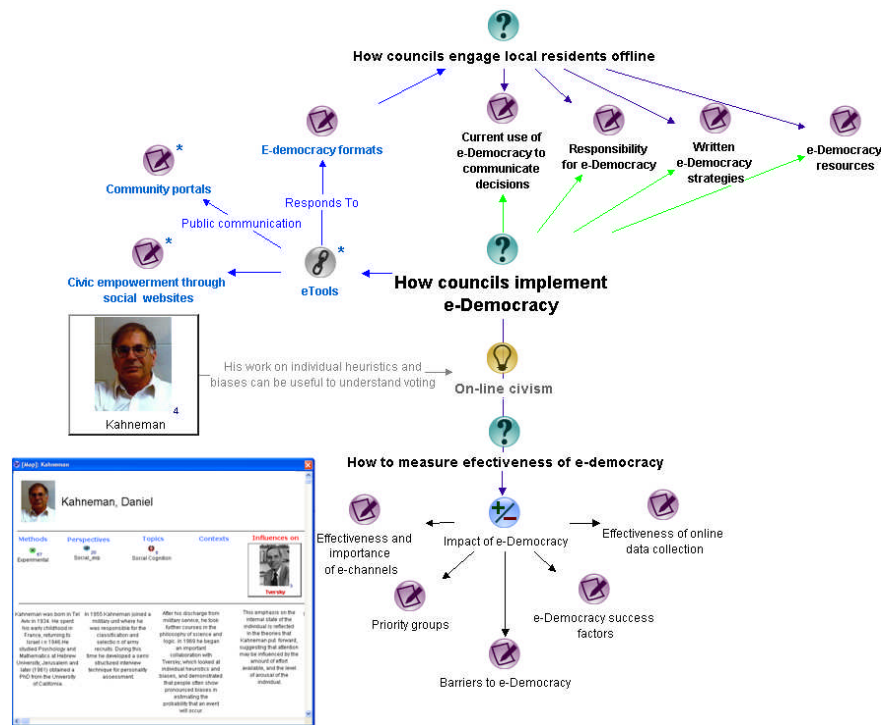


Figure 4: e-democracy Activity for Writing an Essay can be Organised

An example of this evidence can also be seen in Figure 4. It shows a Knowledge Map about e-democracy created by a social science lecturer who used EPoCH to collect some references. He developed this dialogue map (raising issues, posting responses and linking resources) in order to structure ideas for writing an essay related to e-democracy. His map shows three sessions: 1. “How councils engage local residents offline”, 2. How councils implement e-democracy and 3.”How to measure effectiveness of e-democracy”. These sessions, for example, might guide writers to organise their paragraphs. This map can also be downloaded by other educators and used with their students.

By contrast Figure 5 shows another example about OER maps in Education created by a teacher, from a secondary school, who again used EPoCH as a reference for creating a template. This teacher developed a web map about

important scholars and their contributions. Some key categories were selected (e.g. biography, work, knowledge and background) in order to classify their work.

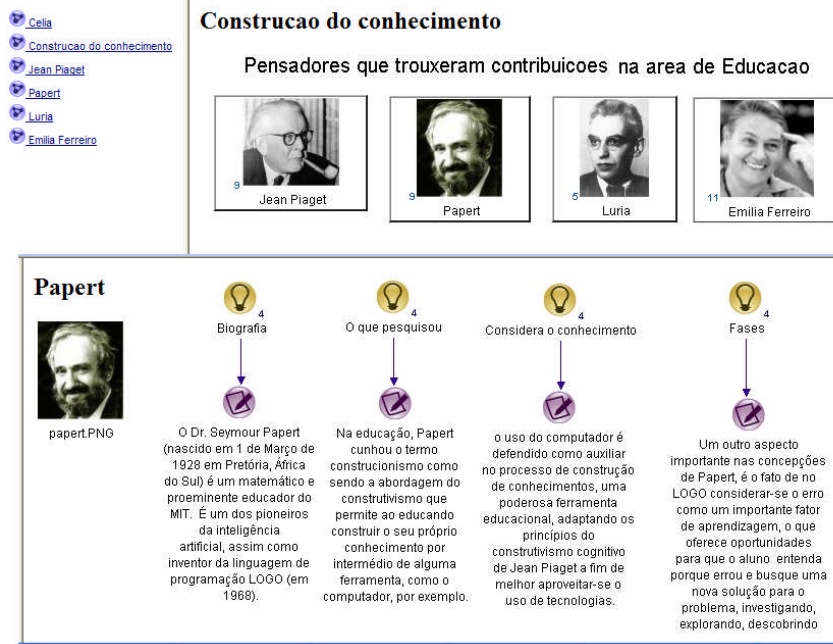


Figure 5: Compendium Map based on the EPoCH Template

The EPoCH template, therefore, can be seen to be very useful for similar type of subject area that lends itself to collaborative work and the collection of a wide variety of resources.

Case Study 2: Project Management OER map - a Problem Based Learning Scenario

The second example of applying Compendium to organise a potentially complex navigation of original OU teaching materials whilst delivering large amounts of subject-based information is based upon another OpenLearn OER unit called Project Management case studies. The resulting Compendium map (B713_PM) relates to the OpenLearn unit of the same name, and was designed by Connolly (2008). It will be available to view in late July 2008.

The original Project Management case study materials were supplied by the Open University Business School (OUBS) to the OpenLearn project in the form of a bespoke CD Rom containing the project management case study resources, along with extensive associated project management text-based teaching materials. The latter were originally delivered in a print form and comprised of five separate aspects of project management:

1. Preparing a project
2. Planning a project
3. Managing projects through people
4. Implementing a project
5. Completing a project.

These materials were originally developed by OUBS academics in conjunction with colleagues in the BBC as part of a practice-centred approach to management education (Fenton-O’Creevy, Knight and Margolis 2006) and fully integrated into the MBA programme of the OUBS. Both the teaching materials and the CD Rom case study resources had been carefully crafted to match the defined learning design and practice-centred pedagogy of the MBA programme (Fenton-O’Creevy, 2008 in press).

The Project Management OER, which was reconstructed with Compendium (Figure 6), comprises a set of maps that present an integrated overview (Figure 6, label 5) of seven offices of the fictitious company called *Y Call*. The main goal of this OER is to develop a business project using the *Y Call* resources that are made explicit in the first map’s description (Figure 6, label 1). Each office is, in fact, a map that presents a variety of interesting information (Figure 6, label 3): text, images, audio and video files. Additionally Learning activities (Figure 6, label 2) can be accessed in the associated Word-based workbooks. *Y Call*’s office maps offer learners and educators an opportunity to experience first-hand the issues that can arise from project management. They are encouraged to work through the various clues (Figure 6, label 4) useful for developing their business project by following a recommended trail (Figure 6, label 6) which has seven pre-defined stages.

Figure 6: A selection of the *Y Call* Compendium Map Case Study Resources

At each stage learners can explore a series of sources of information and they are asked to complete a set of tasks (found in the associated workbook) by using some project tools (figure 7). The information is presented as they might encounter it in a real organisation, in the form of memos, conversations, emails, telephone calls and so on. Within each stage there is no fixed order to encounter the information. One needs to look for it in the different office rooms and learners are encouraged to make their own sense of what is going on. There is short explanatory text to guide them through each stage of the project. Learners are expected to check the resources in each office, assess them and using the Workbook, attempt to answer the questions presented to them.

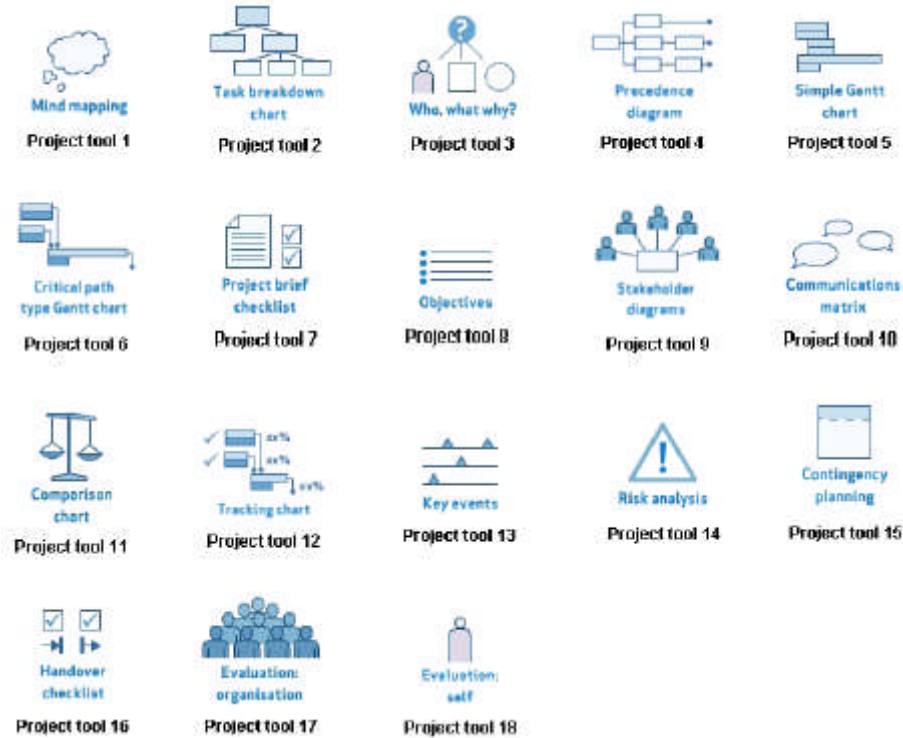


Figure 7: The Project Tools of Y Call Compendium Case Study Resources

What are the Benefits and Challenges of the Y Call Project Management Case Studies Compendium Maps from the Perspective of Learning Designers?

This second case study centred on the Y Call project management suite of Compendium maps, again presented as an OpenLearn OER unit. The unit and maps have not yet been published but draft versions were made available during a recent Computers and Learning Research Group (CALRG) research conference at the OU (Conolly and Okada, 2008). The authors invited those present to critique this method of mapping teaching resources and requested that they identify both the strengths and weaknesses of this approach through a focus group. Participants were asked to discuss from the perspective of learning designers by categorizing

the benefits and challenges of OER maps for either a learner or educators. As a result a number of observations were recorded, for example:

In my experience, the main benefit of knowledge mapping software for a learner is that he or she can make his own map in his/her own terms, and may well find someone else's map of the same conceptual area unintelligible -- i.e. it can work well as a tool for one's own sense-making, but not necessarily as a tool for transmitting knowledge to someone else. That's fine with me, since I see what I do not as transmitting knowledge but as supporting people in their own learning -- where their learning includes not only what the course team is trying to get across, but also their own creative and critical thinking in response. So in this view, assessment of the former is teacher-centred, and is about how accurately the course team (or its proxies) feels understood; assessment of the latter is student-centred, and is about how cogent an argument the learner can put together. (Zimmer June 2008)

It was also recognised that learners appreciate simplicity in terms of ease of navigation – less is more – and that learning pathways vary enormously between different types of learners often directly related to their previous experiences. Again this relates to the work of Ausubel (1963) and Novak (1978), mentioned earlier, whereby the learner chooses to seek seemingly familiar ways to relate new concepts and propositions to their existing knowledge.

Another colleague also commented how the use of Compendium as an enabling tool, to bring together different types of information (text, images, audio, video) from a range of subject areas, could also be beneficial when working in multi-disciplinary groups. Additionally she described how the opportunity of OpenLearn developing the OER based Compendium maps had enabled a collaborative project to be created and shared amongst a wide variety of end users. Indeed it was also recognised that the Compendium map-based template idea of both EPoCH, and the Y Call case study, layout could be adapted to suit other subject content.

The authors have also consulted with one of the OUBS academics who helped to develop the original Y Call project management case study materials. This not only gave an insight into the previously adopted practice-based approach to management education (described earlier) but also illustrated how the presentation of the newly developed Compendium maps aligned with the commissioning academic's idea of a so-called 'learning journey' (Fenton-O'Creevy, 2008). Indeed developing the Y Call project management case study materials and transforming them as OERs also offered a much wider audience the possible experience of both using the materials and potentially adapting them for their own further use too.

Thus in respect of the Y Call project management case studies developments the Compendium map contents offer equally important opportunities for the learner or educator: an opportunity to experience (structured) real world problem solving whilst at the same time being guided through the case study through a series of questions and tasks. It is acknowledged, however, that this is not a new

idea in itself (it dates back to Socrates!) but that its presentation and delivery method: the Compendium map is the innovative development.

Discussion

Looking more closely at the key research questions posed earlier, it is now important to examine the emerging solutions and possible developments that have come to light from our research, case studies and focus groups. Firstly we posed the question: What is the effect of designing OERs through knowledge maps, whose representation is different from the original materials? It appears that in both of our case studies the OER Compendium maps help learners or educators elicit sensemaking and the possibility of designing or creating their own learning pathways. One of the main features of OERs designed with Compendium is that maps offer small pieces of information, connections and clues such as icons, tags and details with flexible and editable structure. Any web user is able to access the OER maps; and then, visualise, choose and interpret these small pieces of information in any order based on their own needs.

Additionally the content of an OER map shows different, dynamic, pathways instead of the familiar linear sequence of related text, video or audio. Graphical representations also offer diverse levels of extra information, in which users can associate different resources, by visualising their classifications through tags or groups through numbers of maps that have the same category. All these different semantic levels may help users to interpret each piece of information and construct meanings.

OER maps designed with Compendium can be useful to promote:

- **Authorship:** Through this software tool, users are able to create and recreate new OER units
- **Learning by mapping:** Learners with Compendium are able not only to navigate within maps but also can visually record/map their own learning pathways
- **Learning Meaningfully:** By visualising and constructing connections with familiar knowledge and new concepts, learners are able to elicit increased or reinforced understanding

Our second question focussed on: what are the challenges and benefits of OERs designed through knowledge maps for learners and educators? We have already outlined some of the responses from a recent research conference and now further develop this idea in relation to the literature. Sherborne (2008), for example, identifies and describes four reasons to design curriculum through concept maps. We would argue that his approach can be adapted and also applied to design OER through knowledge maps, namely that:

- OER maps offer a big picture for thinking and understanding. As Sherborne(2008:195) suggests “*the focus needs to be on the big ideas rather than the detailed knowledge*”. Additionally OER maps seem naturally suited to this style of thinking, by representing only the most

important concepts and their interrelationships. By contrast, long documents make it all too easy to lose focus on the key objectives.” This is proven by OpenLearn users who have pointed out that OER maps are useful for the *“Integration of ideas - relationships among different OERs with the one view you can see all integrated (Claire, Jun 2008)”* suggesting that an overview or big picture is immensely helpful.

- OER maps promote the philosophy of constructivism, in which learners are able to scaffold their understanding through *“a network of interconnected ideas rather than isolated information”* (Sherborne, 2008:195). Furthermore OpenLearn users have also identified that OER maps can be used to *“enable different routes through materials, and improve meaningful learning (scaffolding)”* (Li, Jun 2008)
- OER maps allow shared visualisation, in which the design can be constructed by or bring benefit for many learners together. There are different interpretations of maps and the contrasting ways of learning can also be discussed and shared. Once again OpenLearn users have commented that they have found that OER maps are useful for: *“Sharing and constructing maps collectively . . . observing other people who are looking at same map and sharing different points of view among learners”* (Ann, Jun 2008)
- OER maps may reduce the ‘cognitive load’ inherent in the complex area of the learning process design. *“They relieve the mind of the task of organising the most important factors.”* (Sherborne, 2008:196). OpenLearn users have confirmed this idea when commenting on the collaborative nature of the Compendium tool and the development of OER units that cross subject or Faculty boundaries so seamlessly. Presenting the high level information as simple maps using relevant visual icons filters the often complex processes and relationships that can sometimes over-complicate academic projects.

Equally it is important to recognise some of the challenges emerging in this project: Sherborne (2008), for example, pointed out in his work: that learners and educators may be more used to communicating through text. Thus to challenge the learner/educator way of thinking can often take time and persistence. The initial findings of our research, however, indicate that the majority of people using Compendium OER units for the first time find the principle of simple map templates easy to understand and many discover navigating the maps is intuitive rather than a barrier to their learning and exploration of a particular subject area. There seems to be a sense of discovery, a need to see the “sights” or perceived important parts of the Compendium maps and this often mimics the learning journey in terms of travelling around the maps looking for clues, hints and signposts.

It is acknowledged, however, that some learners and educators may prefer an instructional rather than constructivist approach. We are not all visual learners.

Some learners/educators prefer and continue to place great value upon extensive textual contents. It is likely that these users will make little or no use of OER maps for their learning. Responses from the recent CALRG conference confirm this supposition:” . . . *the map needs to fit what the learner needs to learn*”. *“Learners often face challenges. They externalise what they think. They may or may not be familiar with the (mapping) tool. They may have to draw first in order to explore their thinking processes”*. (John, Jun 2008)

Conclusion

Our work has encompassed a variety of methods that have identified some pedagogical strategies for developing OERs using Compendium – a knowledge mapping tool. We have also analysed some particular applications where Knowledge Maps have enhanced meaningful learning by focusing on specific OER examples. This pilot research centred on the OpenLearn project, a large scale online environment that makes a selection of higher education learning resources freely available via the internet.

Through two small-scale qualitative studies, this exploratory investigation has analysed two OERs designed with knowledge maps by the authors. Our findings illustrate the benefits of sharing some OER content through knowledge maps, the possibility of condensing high volumes of information, accessing resources in a more attractive way, visualising connections between diverse learning materials, connecting new ideas to familiar references, organising thinking and gaining new insights into subject specific content.

Findings in this study present evidence for the benefit of OER designed through knowledge maps for both educator and learners. This study shows three main reasons for disseminating the wider use of OER designed by maps: fostering learning designing authorship, promoting learning by mapping and meaningful learning

OER designed through Knowledge Maps is a timely project mainly due to the rapid development of the OER movement and open source tools. Further research will allow us to identify how practitioners can develop different techniques for designing OER through maps, in addition to understanding how new OER maps can be useful for large numbers of learners. This investigation will help us identify more examples of good practice and also analyse how the “elicit” design principles for OER maps can be better applied in different contexts.

Acknowledgements

We would like to thank the following people for their contributions and discussions in support of our work: Patrick McAndrew, OpenLearn Research Director; Simon Buckingham-Shum, Coordinator of OpenLearn sense making technologies; Michelle Bachler, Developer of Compendium and those who attended both our recent Compendium based workshops and conference presentations.

References

- Ausubel, D. *The psychology of meaningful verbal learning*. New York: Grune and Stratton, 1963.
- Canas A. and Novak J. Concept mapping using Cmap tools to enhance meaningful learning. In: Okada, A.; Buckingham Shum,S & Sherborne,T. *Knowledge Cartography: software tools and mapping techniques*, London: Springer, 2008.
- Colearn. *Community of Research on Collaborative Learning and Educational Technologies* <http://colearn.open.ac.uk> OpenLearn Project, 2008.
- Connolly, T. *Compendium Project Management* http://labspace.open.ac.uk/file.php/2623/kmap/1214820298/B713_PM%20Case%20study%20materials%202.html. July, 2008.
- Connolly T. and Okada, A. *Workshop: Developing OER through Knowledge maps to enhance meaningful learning* (CALRG) 2008 18th-19th Open University Milton Keynes. June, 2008.
- Conole G. Using Compendium as a tool to support the design of learning activities . In: Okada, A.; Buckingham Shum,S & Sherborne,T. *Knowledge Cartography: software tools and mapping techniques*, London: Springer, 2008.
- Fenton-O’Creevy, M. *A dialectical approach to practice based learning*. Symposium on ‘Towards a pedagogy of practice’, Academy of Management Conference, Atlanta, USA. August, 2006.
- Novak, J. D. *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations*. Mahwah, NJ: Lawrence Erlbaum Associates, 1998.
- Okada, A. Cartografia Investigativa - Interfaces epistemológicas comunicacionais para mapear conhecimento em projetos de pesquisa. *Doctoral Thesis*. São Paulo: Programa de Pós-graduação em Educação: Currículo. Pontifícia Universidade Católica de São Paulo. Abril, 2006.
- Okada A. *Compendium Maps - Exploring Psychology’s Context and History* http://openlearn.open.ac.uk/file.php/2850/knowledge_maps/1183374514/epoch.html. July, 2007.
- Okada, A. Eliciting critical thinking with inquiry maps. In: Torres, P. & Marriott,R *Handbook of Research on Collaborative Learning using Concept Mapping*. London: IGI group, 2008a, forthcoming.
- Okada, A. Scaffolding School Pupils’ Scientific Argumentation with Evidence-Based Dialogue Maps. In: Okada, A.; Buckingham Shum,S & Sherborne,T. *Knowledge Cartography: software tools and mapping techniques*. London:Springer, 2008b.
- O’Brien, P. *Using Science to Develop Thinking Skills at Key Stage 3*. NACE/Fulton Publication, 2003.

Schön, D. *Educating the Reflective Practitioner*. San Francisco: Jossey-Bass, 1987.

Simon Buckingham Shum and Alexandra Okada. Knowledge Cartography for Open Sensemaking Communities. *Journal of Interactive Media in Education*. <http://jime.open.ac.uk/2008/10/>. May, 2008.

Sherborne, A. Mapping the curriculum: how concept maps can improve the effectiveness of course development. . In: Okada, A.; Buckingham Shum,S & Sherborne,T. *Knowledge Cartography: software tools and mapping techniques*. London: Springer, 2008.