

# Collective Intelligence for OER Sustainability

**Simon Buckingham Shum,\* Anna De Liddo\*\***

\* Senior Lecturer in Knowledge Media, Knowledge Media Institute, UK Open University.

\*\* Research Associate, Knowledge Media Institute, UK Open University.

## **Abstract**

To thrive, the Open Educational Resource (OER) movement, or a given initiative, must make sense of a complex, changing environment. Since “sustainability” is a desirable systemic capacity that our community should display, we consider a number of principles that sharpen the concept: *resilience, sensemaking and complexity*. We outline how these motivate the concept of *collective intelligence* (CI), we give examples of what *OER-CI* might look like, and we describe the emerging *Cohere* CI platform we are developing in response to these requirements.

## **Keywords**

sustainability, resilience, complex systems, collective intelligence

## **Tweet**

OER Collective Intelligence: rationale, principles, examples and tools

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# Introduction

The “sustainability challenge” for the OER movement quite naturally provokes debate around business models to cover the financial costs of OER operations. In this paper we approach sustainability from another angle (which may also lead to insights around business models, but this is not our immediate focus). The OER movement can be reasonably thought of as a community of inquiry, of innovation, of advocacy. If “the movement” can be thought of as an ecosystem, or a set of connected ecosystems, which must adapt to potential threats in the changing environment or die, then we can ask what capacities a sustainable ecosystem displays, and unpack the implications from there.

In this paper we outline a number of concepts that we find to be helpful when thinking about sustainability in relation to a community such as the OER movement. We then outline how they help to motivate the concept of “Collective Intelligence” (CI), and moreover, how they drive requirements for a socio-technical CI infrastructure that could support the OER community’s need to make sense of a complex, changing environment. We give examples of the heterogeneous nature that we expect “OER-CI” to take in order to reflect the diversity of stakeholders, and then describe a prototype tool called *Cohere* which seeks to reflect these requirements.

## Sustainability and Resilience

An internet search on *resilience* demonstrates the interest it is attracting in mainstream as well as academic science, with international institutes now devoted to the concept. A “system”, be it a learner, a team, a movement, a network (e.g. social; digital; conceptual), or a city/nation/planet, is considered to be not only sustainable, but resilient, if it has the capability to recover from stresses and shocks, and to adapt its evolution appropriately. Walker, *et al.* (2004) define resilience as “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks”. *Resilience thinking* is an emerging approach which generalizes resilience principles from ecology to socio/political and technological systems (e.g. Cascio, 2008; Folke, 2006; Saveri, 2009; Walker, 2008). In an OER context, it is noteworthy that it has also established itself in the learning sciences, as a disposition reflecting perseverance when stretched during learning beyond one’s intellectual and emotional ‘comfort zone’ (Carr & Claxton, 2002; Deakin Crick, *et al.* 2004) or when confronted by personal and social stressors, often due to poor socio-economic conditions (Roberts, 2009).

A key requirement in any complex adaptive system is a degree of self-awareness, through appropriate feedback loops. “Feedback” may be only low-level data signals when we are thinking about biological organisms or digital networks with no human in the loop. However, in a system concerned with higher order cognition such as a community of inquiry or an innovation network, we move from simple positive/negative feedback loops, to epistemic constructs such as ideas, questions, predictions, dilemmas and evidence, and emotional constructs such as surprise, reputation, hope and fear. In other words, feedback/self-awareness implies the *capacity to reflect*,

*learn and act effectively, both individually and collectively* — a working definition of Collective Intelligence (CI). This motivates, therefore, the proposal that good CI infrastructure (people+processes+technologies) is worth designing to advance the OER movement’s resilience. Some design principles for resilient systems are shown in Table 1, with possible translations into principles for an OER CI infrastructure.

If we elaborate the issue of feedback loops, for example, the OER design lifecycle typically ceases after “publication”. Comparatively few OERs are evaluated, and our current infrastructures have weak capacity to track and learn from what happens next. We do not close the design loop through to evaluation and evolution to better design processes and OERs. One objective is to facilitate feedback loops in order to pool evidence and aid discussion about its significance.

## Organizational Complexity and Sensemaking

Two additional fields inform our thinking about CI. First, *complexity science* is being applied specifically to organizational strategy and sensemaking. In a world where we are striving to make sense of overwhelming change and information overload, the OER movement could benefit from the insights that this work is developing. Secondly, *sensemaking* has emerged as a definable research field over the last 30 years, dating back to Doug Engelbart’s visionary 1960s work on the need for tools to “augment human intellect” in tackling “complex, urgent problems”, and Horst Rittel’s formative work in the 1970s on “wicked problems” (see Buckingham Shum, 2003, for a review). As noted in the call for a recent journal issue devoted to the subject (Pirolli & Russell, 2008), influential work has also “emerged quasi-independently in the fields of human-computer interaction (Russell, *et al.*, 1993), organizational science (Weick, 1995), and cognitive science (Klein, *et al.*, 2006).”

The work of Snowden and colleagues (e.g. Kurtz & Snowden, 2003; Snowden & Boone, 2007) is one approach to bringing together sensemaking and strategic thinking, distinguishing *known*, *knowable*, *complex* and *chaotic* problem spaces (Figure 1).

It may be instructive to reflect on which space we experience ourselves to be in, as OER researchers, practitioners, managers or advocates. Snowden *et al.* warn of the risks of confusing which space one is dealing with, since in their view, they have very different sustainability and resilience strategies. For instance, although there are OER success stories, are we ready to announce Best Practices yet, or do we run the risk of premature codification, freezing something that worked in one context for local reasons? How confident are we to predict successful outcomes of OER initiatives? It may well be that we are ourselves a complex adaptive system — in Snowden *et al.*’s view the default for non-trivial human activity systems.

Browning and Boudès (2005) provide a helpful review of the similarities and differences between Snowden’s and Weick’s work on sensemaking, with particular emphasis on the centrality that narrative/storytelling play in their proposals for how we manage complexity. Table 2 (left column) draws on the key features they and Hegel, *et al.* (2010) identify, while the right column suggests ways in which sensemaking infrastructure might be shaped in order to tackle some of the breakdowns in individual and personal sensemaking that are known to occur in complex domains.

# What do we mean by *OER-CI*?

We have introduced above some concepts with broad application to sensemaking and CI in any complex, knowledge-based system, but what form might this take specifically in the realm of OER? OER practitioners and researchers come from many intellectual traditions. What “counts” as legitimate evidence in order to make claims varies accordingly. Thus, we envisage pooling an evidence base that makes clear which of the following “evidence layers” underpin a particular OER or concept (Table 3).

The mere presence of evidence layers can provide an approximate cue to the level of validation a resource has received, but is not, of course, a guarantee of its suitability for a given context (content may be culture-specific; conclusions may be controversial; methodology flawed).

A community of inquiry is interested in claims and supporting evidence, but also in counter-claims and differing interpretations of the same evidence. While many projects are engaged in building collective intelligence, few know how to deal well with contested knowledge other than by enabling comments, threaded fora, blogs and wikis. While the low levels of structure in such tools creates very low entry thresholds for new users who want to post a comment, they provide correspondingly weak support for anyone who wants to know the current state of the evidence base or debate. This motivates the platform we are developing, as described next.

## Cohere: a prototype *OER-CI* platform

Elsewhere, we have detailed some of the core functionality in *Cohere*, the experimental CI platform we are developing in the OLnet Project (<http://cohere.open.ac.uk>). The design rationales presented there addressed the concerns of other communities (computational argumentation: Buckingham Shum, 2008; collective intelligence: De Liddo & Buckingham Shum 2010). In the remainder of this paper, we illustrate some of *Cohere*'s affordances with respect to the rationale introduced above, as a working prototype of a social-semantic platform tuned for inquiry, reflection and discourse.<sup>1</sup>

*Cohere* is based on three kinds of activity, which we use to organize this overview:

1. making thinking visible
2. connecting ideas in meaningful ways
3. providing services to analyze, visualize and track ideas

### Making thinking visible

In *Cohere*, users may annotate an OER or any other web resource directly through their browser by highlighting and adding annotations, which (if public) are immediately visible to anyone viewing that page who has installed *Cohere*'s sidebar (currently a Mozilla Firefox extension<sup>2</sup>). As with other web annotation tools (e.g. Diigo; Sidewiki), one can treat annotations simply as informal margin

notes or clippings, but in Cohere these can also become ‘first class’ entities that represent important “ideas” (such as a major *question* on which a project is working) around which a whole network of ideas can grow. Customizable icons signal what kinds of contribution analysts want to make with an annotation, such as a *prediction* or *data* (Figure 2).

Figure 3 shows a PhD student and a Researcher annotating an OER on Rice University’s Connexions, as part of a collaborative inquiry on climate change during the COP15 conference. Any of the annotated ideas (e.g. “*We cannot know the physical and ecological damage due to climate change*”) can have attached to it as backing evidence any number of ‘clips’ (text fragments) lifted from any number of websites. OERs are therefore linked not only by simple tags, but by more complex epistemic relationships.

## Connecting ideas in meaningful ways

Cohere provides a way to connect these nodes with meaningful relationships. The default set (Figure 4) can be edited by users to create a connection language that suits their interests.

As these are added, the Firefox sidebar displays connections between any ideas annotated on the website (Figure 5), now enabling navigation of OERs (or any website) by following paths/networks of meaningful relationships (recall that attached to each node there may be clips lifted from many sources).

## Analyzing, visualizing and tracking ideas

The larger web of connections (which may go many steps from a focal idea) can also be viewed graphically, e.g. in a self-organizing visualization (a Java applet, Figure 6).

This example shows the results of analysing the online discussion on open OER issues at the Hewlett Foundation Grantees meeting (March 2009, Monterey: <http://cloudworks.ac.uk/cloud/view/980>). Cohere was used to analyse the online discussion with a specific annotation schema which showed that issues were organized around five topics, shown in Figure 6: *Share-ability, Effectiveness, Participation, Sustainability and Scalability*.

As the web of user-generated annotations and connections grows, there is the need for tools to track patterns of specific interest, going beyond simply viewing the whole map. Users can engage in exploratory study by performing customized network searches, reducing the complexity of the graph to sets of connections of interest. In a large, multi-user context, users will want to monitor specific ideas, documents, people or topics without having to manually check. Agents can be set to monitor structured search results on sub-networks (that is to say specific semantic connections, to specific network depth on a focal idea). Figure 7 shows a “report” from an agent.

Finally, we are considering how we can crowdsource input to the evidence base from different OER communities, projects and websites. One approach is through the release of widgets (e.g. Google Gadgets) which the OER community can embed in diverse platforms. A user interface storyboard is at <http://cloudworks.ac.uk/cloud/view/3239>.

# Conclusions

We have argued that the broad topic of “sustainability” in the context of a given OER project, or the whole community, can be usefully sharpened through the conceptual lenses of *resilience* (ability to withstand and learn from shocks to the system), *complexity and sensemaking* (making sense, in and of, a complex adaptive system is difficult). These motivate the concept of a Collective Intelligence infrastructure (people+processes+technologies) to help the OER community sense and interpret changes in its environment, dialogue and debate strategy and courses of action, pool evidence, and reflect on successes and failures. It should be tuned to help address sensemaking breakdowns, and support the gradual layering of diverse forms of evidence around OERs, and epistemic constructs such as predictions, questions, problems and empirical findings.

A large scale analysis of >100 OER initiatives is currently in preparation by the OLnet Project, and will be published using Cohere. We invite the community to pool its collective intelligence to review and extend this seed next year.

# Acknowledgements

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## Figures and Tables

Resilience principle	Possible principle for OER CI infrastructure
<i>Diversity</i>	Diversity of participants and viewpoints: design for as wide a constituency as possible; do not lock participants into any worldview; support diversity, disagreement and quality debate
<i>Modularity</i>	Support loosely coupled applications/services and linked data, enabling interoperability and mashups with diverse end-user tools relevant to OER (e.g. Google Maps; GapMinder data visualization; YouTube movies; Wikis; Blogs).
<i>Practical experimentation with feedback loops</i>	Improve awareness of the existence, and success/failure of OER resources or ideas
<i>Trust/social capital</i>	Make use of appropriate measures of social capital, authority and reputation within the community

Table 1 - Principles from “resilience thinking” (Walker, 2008) and their possible implications for OER collective intelligence infrastructure

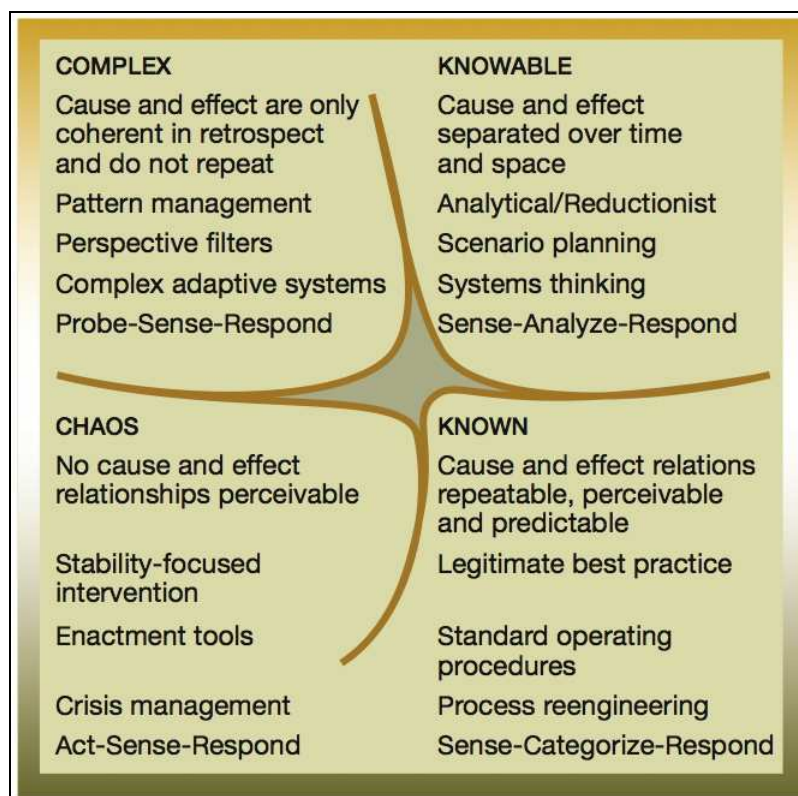


Figure 1 - The Cynefin sensemaking framework (Kurtz & Snowden, 2003)

<b>Sensemaking Phenomenon in Complex Domains</b>	<b>Sensemaking Infrastructure Opportunity</b>
<i>Dangers of entrained thinking from experts who fail to recognise a novel phenomenon</i>	Pay particular attention to exceptions Open up to diverse perspectives
<i>Complex systems only seem to make sense retrospectively: narrative is an appropriately complex form of knowledge sharing and reflection for such domains</i>	Stories and coherent pathways are important Reflection and overlaying of interpretation(s) is critical
<i>Patterns are emergent</i>	In addition to top-down, anticipated patterns, generate views bottom-up from the data to expose unexpected phenomena
<i>Many small signals can build over time into a significant force/change</i>	Enable individuals to highlight important events and meaningful connections, which are then aggregated
<i>Much of the relevant knowledge in complex emergent systems is tacit, shared through discourse, not formal codifications (Hegel, et al. 2010)</i>	Scaffold the formation of significant inter-personal, learning relationships, through which understanding can be negotiated flexibly

**Table 2 - Sensemaking phenomena in complex domains, and the potential roles that sensemaking infrastructure can play**



**Technical Reports on Design Principles:** Such principles may be of value to those making an OER selection decision (e.g. *the following pedagogical philosophy and disciplinary principles informed the OER design, here is the rationale behind the use of the particular multimedia presentation mode.*)

**Contexts of Use:** A description of the curricular locations where a particular OER might fit and the characteristics of the student population that would typically use the OER (e.g. *this introductory course in symbolic logic is a requirement for computer science majors. Students who take the course are usually sophomores and over half of them are philosophy majors.*)

**Anecdote:** Stories perhaps using text/images/video from the field that can help build understanding, even though they may lack hard evidence or conclusions (e.g. *we've just completed the first trial of this OER and it has not met our hopes — but we have some clues as to why, which we're chasing up.*)

**Comparative Review:** Analytical comparisons of OER materials aimed to identify strengths and weaknesses in terms of learning resources, technical requirements, and content coverage and treatment (e.g. *we have classified these OER in terms of their technical requirements and how these match to assistive and mobile technologies.*)

**Portraits:** Illustrations of OER in use similar to what Lawrence-Lightfoot calls *portraits*, that is, qualitative accounts of “the complexity, dynamics, and subtlety of human experience and organizational life” (e.g. *we followed, videotaped, and questioned a user over a specific chunk of time and across multiple settings and present here some unintended side effects of simple design, sequencing, and formatting decisions.*)

**Case study – anecdotal with informal evidence:** Partial descriptions and data that would benefit from further analysis and discussion (e.g. *we have the following screencasts and interview MP3s that we're happy to share because we need help to analyze them.*)

**Case study – structured research methodology and data analysis:** Reports about a particular situation supported by analysis that draws conclusions (e.g. *this article/website tracks a cohort of trainee teachers for 3 months, as they sought to apply OER, video analysis using Grounded Theory leads us to propose three key factors that influence their success.*)

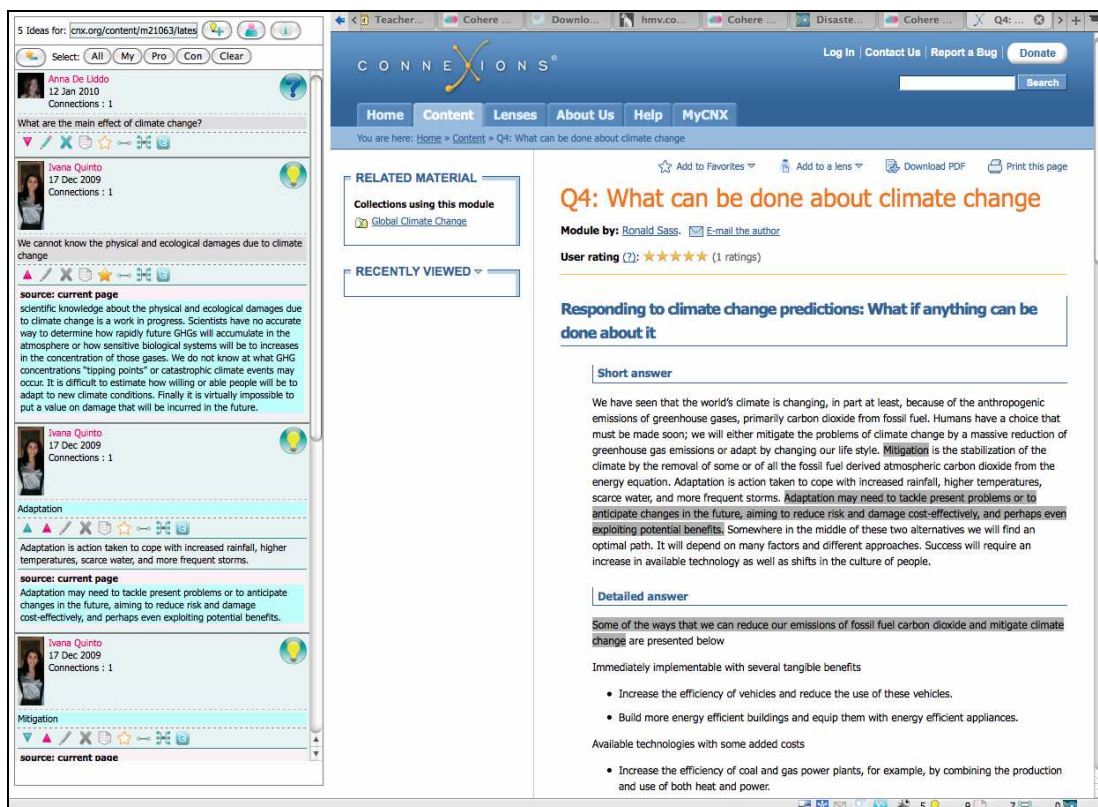
**Controlled experiment:** Supported comparative studies with qualitative and/or quantitative data (e.g. *48 undergraduate chemistry students grouped by ability and cognitive style used the ChemTutor OER to complete Module X, statistical analysis combined with think-aloud protocols supports the hypothesis, based on Learning Theory Y, that higher ability students would benefit most.*)

**Learning Analysis Studies:** Provide a detailed picture of the experience that students are likely to go through, and constitute a resource for iterative design improvement (e.g. *we examined the data log files and can articulate how students benefit from the different components and instructional devices that make up this OER such as explanatory text, built-in videos, animated illustrations, self-assessment, learning by doing applets, and virtual labs.*)

**Table 3 - Heterogeneous layers of OER Collective Intelligence**

 Prediction	edit   delete	 Assumption	edit   delete
 Pro	edit   delete	 Con	edit   delete
 Question	edit   delete	 Data	edit   delete
 Scenario	edit   delete	 Idea	default
 Software	edit   delete	 Method	edit   delete
 Theory	edit   delete	 Opinion	edit   delete

Figure 2 - Default ways to classify an annotation in Cohere



The screenshot shows a web browser window displaying the Cohere platform. The page title is "Q4: What can be done about climate change". The interface includes a navigation menu with options like Home, Content, Lenses, About Us, Help, and MyCNX. The main content area features a "Short answer" and a "Detailed answer" section. Annotations are visible on the left side, with users like Anna De Liddo and Ivana Quinto providing input. The annotations include text about climate change and related concepts like "Adaptation" and "Mitigation".

Figure 3 - Collaborative Web annotation of an OER in Cohere

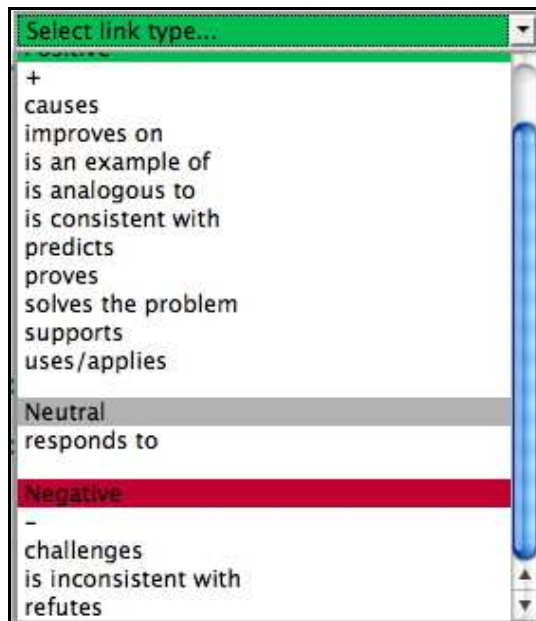


Figure 4 - Default, customizable links for connecting ideas

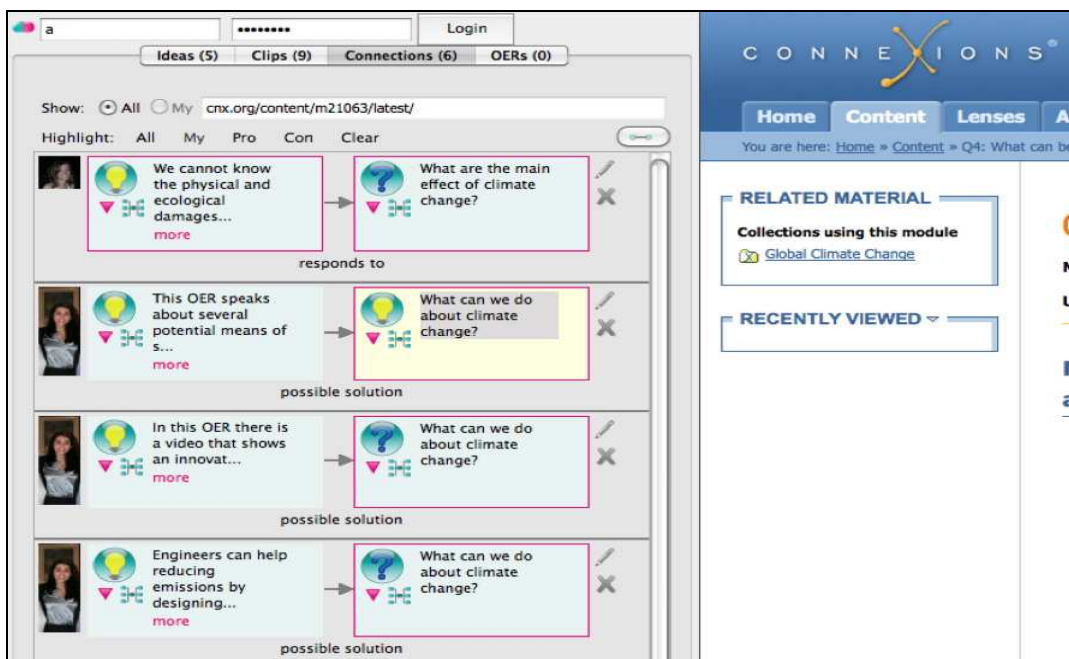


Figure 5 - Connected ideas annotated onto an OER

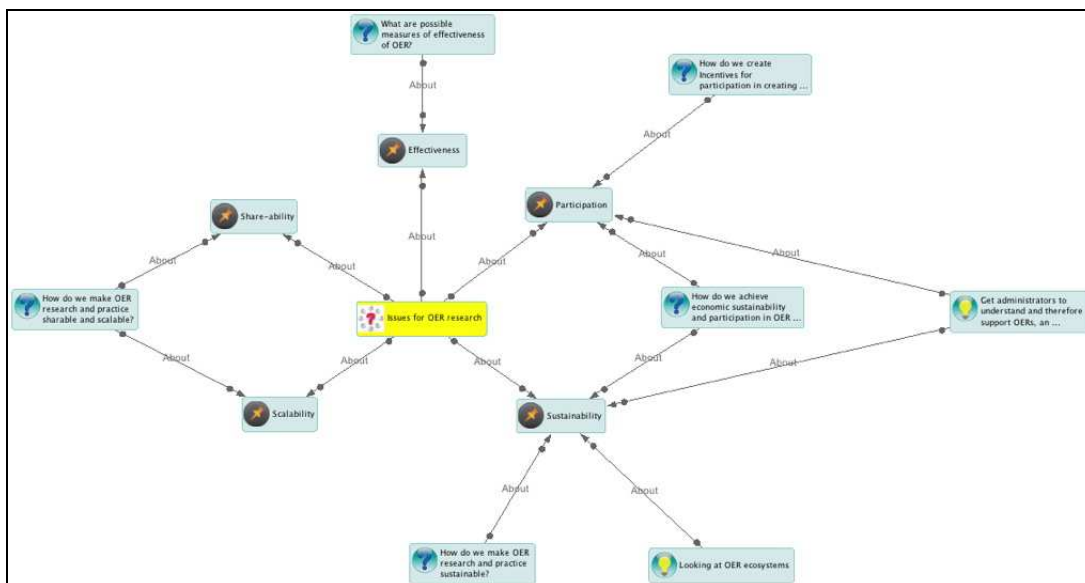


Figure 6 - Issues for the OER research field clustered around emerging themes

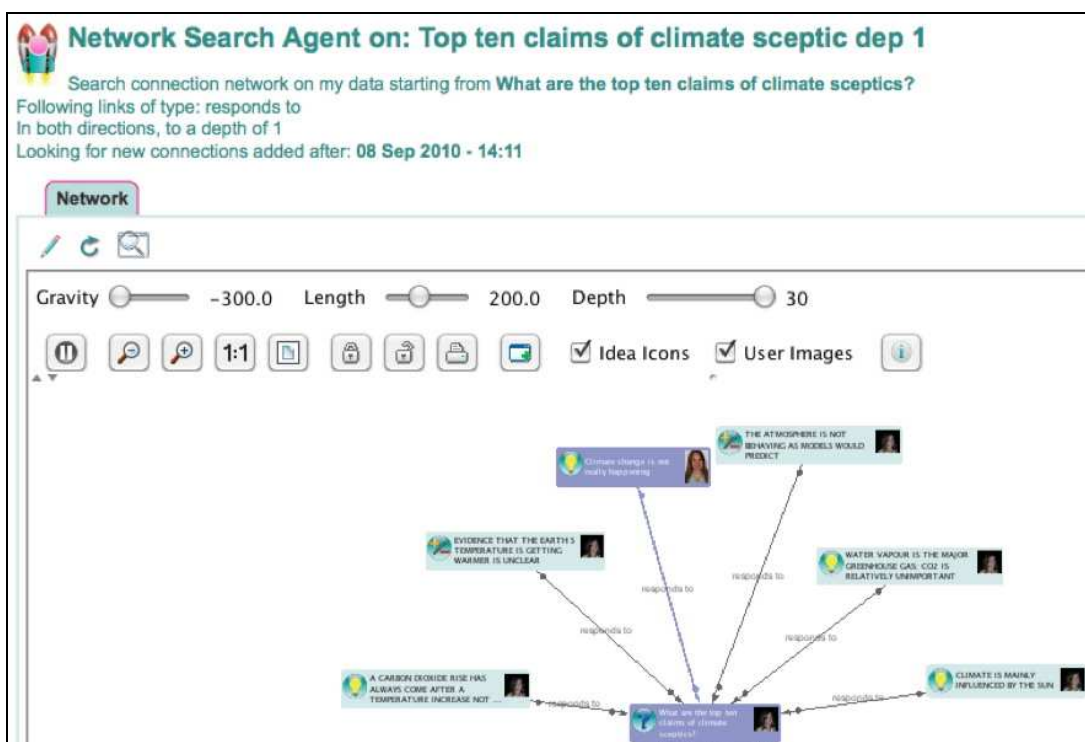


Figure 7 - An agent set to watch the network for connection types of interest, highlights nodes to signal new connections since the last check

# Notes

1. See the OLnet Project workshop on *Online Deliberation: Emerging Technologies* for examples of other structured deliberation tools: <http://olnet.org/odet2010>
2. Cohere's Mozilla Jetpack extension was one of the winning finalists in the Jetpack for Learning Design Challenge sponsored by Mozilla Foundation/MacArthur Foundation: <https://wiki.mozilla.org/Education/Projects/JetpackForLearning/Profiles>.

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## About the authors

### Simon Buckingham Shum

Senior Lecturer in Knowledge Media, Knowledge Media Institute, UK Open University.

Simon Buckingham Shum is a Senior Lecturer in Knowledge Media at the UK Open University's Knowledge Media Institute, where he leads the Hypermedia Discourse Group. He brings a human-centered computing perspective to the challenge of building collective intelligence and the sensemaking capacity that 21st-century citizenship requires, from childhood onwards. His research is reflected in the books *Visualizing Argumentation* and *Knowledge Cartography*. <http://people.kmi.open.ac.uk/sbs>.

OLnet: Open Learning Network Project  
Knowledge Media Institute  
The Open University  
Milton Keynes, MK7 6AA  
United Kingdom  
[S.Buckingham.Shum@open.ac.uk](mailto:S.Buckingham.Shum@open.ac.uk)

### Anna De Liddo

Research Associate, Knowledge Media Institute, UK Open University.

Anna De Liddo is a Research Associate at the UK Open University's Knowledge Media Institute, where she works on the Open Learning Network project ([olnet.org](http://olnet.org)), focusing on the design and development of a Collective Intelligence infrastructure to enhance collaborative learning in Open Education. She gained her PhD at Polytechnic of Bari, investigating ICT for Participatory Planning and Deliberation, after which she held a postdoctoral position at the Open University evaluating human-centred computing tools to tackle Climate Change. <http://people.kmi.open.ac.uk/anna>.

OLnet: Open Learning Network Project  
Knowledge Media Institute  
The Open University  
Milton Keynes, MK7 6AA  
United Kingdom  
[A.DeLiddo@open.ac.uk](mailto:A.DeLiddo@open.ac.uk)



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