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# The Evidence Hub: Harnessing the Collective Intelligence of Communities to Build Evidence-Based Knowledge

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## ABSTRACT

Conventional document and discussion websites provide users with no help in assessing the quality or quantity of evidence behind any given idea. Besides, the very meaning of what evidence is may not be unequivocally defined within a community, and may require deep understanding, common ground and debate. An Evidence Hub is a tool to pool the community collective intelligence on what is evidence for an idea. It provides an infrastructure for debating and building evidence-based knowledge and practice. An Evidence Hub is best thought of as a filter onto other websites — a map that distills the most important issues, ideas and evidence from the noise by making clear why ideas and web resources may be worth further investigation. This paper describes the Evidence Hub concept and rationale, the breath of user engagement and the evolution of specific features, derived from our work with different community groups in the healthcare and educational sector.

## Author Keywords

Collective Intelligence, Online Deliberation, Evidence-Based Knowledge, Argumentation, Collaborative Knowledge Building, Social Media, Knowledge Mapping

## CONCEPTS AND RATIONALE

The Evidence Hub builds on research on Collective Intelligence [11] and Argumentation [16, 17], which have recently attracted active research on how technologies can help community action through social debate, in both the public and private sector [6, 8].

Collective Intelligence (CI) aims at developing novel ideas and technological solutions to exploit the power of the ‘collective’ [1] and move toward the development of intelligent online communities [10]. To cater for this CI tools should allow to capture online user knowledge, and to expose their thinking so that anyone can cleverly build on

and learn from it. An Evidence Hub is a Collective Intelligence tool in that it tunes specifically to meet the challenge of connecting the jigsaw pieces of individual experiences into bigger pictures.

At the same time an Evidence Hub is also an argumentation tool, because it puts *issues*, *ideas*, and *evidence* at the center of a reflective community of practice. These are the types of contributions that can be crowdsourced via the Hub. Since a harmonious ‘big picture’ does not always emerge in complex, contested fields (such as education, business or policy making), the Evidence Hub aims to show where people disagree and why. In this sense the Evidence Hub is a *Contested Collective Intelligence* tool [5] to build collective intelligence by structuring debate and arguments around controversial issues and competing worldviews.

The Evidence Hub descends from research on argumentation [16, 17], sensemaking [12] and intelligence analysis [9]. In particular, it strictly relates to that class of systems which uses a template-driven approach to mapping evidence [3, 13, 14, 7], and relies on disciplined mapping techniques to aid in critical thinking [15].

As other CCI technologies, such as Cohere [2, 4], the Evidence Hub provides collaborative web annotation features to support users to distill relevant ideas and evidence from Web documents. Then these lists of annotations can be connected and leveraged into meaningful arguments maps, thus providing a more structured online discussion interface to navigate and visualize the debate as network of ideas. Despite the success of the web annotation paradigm, people seems to struggle to make semantic connections by directly interacting with a network visualization. Moreover too many semantics produce often redundancy and content duplication. People interpret the same semantic in different ways, and therefore, the more semantics there are the more this bias affects content duplication. Building on those feedbacks we designed the Evidence Hub, as a CCI tool with a new simplified data model and an easier interface for connections making.

Unlike Cohere the Evidence Hub uses a simplified discourse ontology in which only specific types of content

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can be contributed, and only specific semantic connections are allowed between pairs of content's types (Figure 1).

### The Discourse Ecosystem Elements: A Simplified Data Model



Figure 1: The Building blocks of a Hub and how they connect.

Through the Evidence Hub people are called to contribute and debate on what is the evidence-based practice and research that can move the community forward. To do so users can:

- **Map the social ecosystem**— add People, Projects and Organizations and monitor their networks;
- **Map the discourse ecosystem** — add Issues, Solutions, Claims, Evidence and Resources to the debate (see Figure 1).

These are the core building blocks through which the community generates evidence-based knowledge; and the Evidence Hub is the place where this knowledge can be structured, explored, searched and visualized in many interesting ways. People can add their ideas, and interpretations by filling simple web forms, and see them instantly mapped into global argument maps. They can gradually cope with the information and visualization complexity of the debate by incrementally contributing in a linear, widget and network fashion. The Evidence Hub interface and user experience will be better described in the following sections by showing the different views.

### STRUCTURING CONVERSATION BY INCREMENTAL STEPS

We follow an agile development approach and constantly engage with our end-user community to rework and improve the Evidence Hub interface. We add new features that respond to the most important users' requests. All these requests then feed back into a unique code base, which improves all the Hubs and enhance all our users communities. So far we developed a user experience which consists of four incremental levels of visual and functional complexity each represented by a different tab in the main data explore interface: the widget info view, the threaded chat view, the knowledge tree view and the knowledge graph view.

The first and easier view presented to the users as she land to the website is a linear view. The Hub shows lists of key challenges, issues, solutions and evidence organized in separate tabs. Then each element in a list can be explored in

four main ways. The first and simpler way is by exploring the “More Info” view. This is a widget view that shows a general description of the contribution, enriched by embedded images and videos. This view also allows social activities such as following, and adding connections to projects and organizations (Figure 2).



Figure 2. More Info view with social activities and connections

The second way to explore a contribution is by going to the “Chat view”. This is the view that provides a space for informal conversation. Each contribution has a Chat view to host a threaded discussion around that contribution (Figure 3).

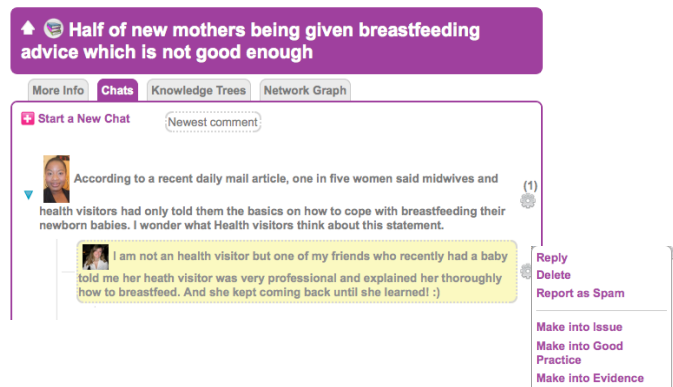


Figure 3. The “Chat” view for threaded informal discussion.

Each chat element can then be made into a more structured contribution to the “knowledge tree” with a simple right click menu, directly accessible from the Chat view(Figure 3). This mechanism allows the transition from informal conversation to more formal debate and knowledge building process, which will take place in the “knowledge tree view” (Figure 4).

The ‘knowledge tree’ shows the discourse building blocks of the Hub (key challenges, issues, solutions, research claims, evidence and resources) as a hierarchical indented structure. Users can build knowledge, by adding to the widgets on the left, and can explore the debate by looking at the knowledge tree on the right.

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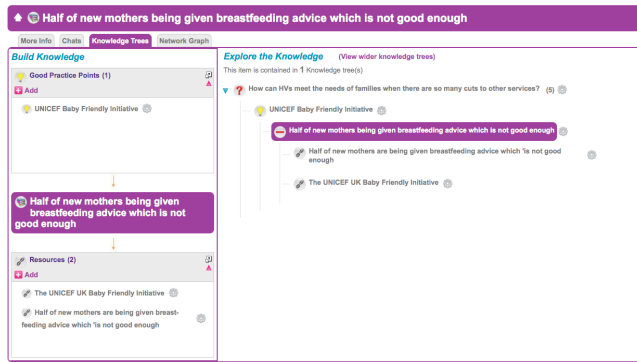


Figure 4.: The Knowledge Tree view for structured discussion.

Finally the ‘network graph’ provides an exploration interface, which is particularly appealing to some users. The Network Graph view shows the discourse network around a selected object (in yellow in Figure 5). This is generated by a dynamic and self-arranging graph Applet. It is difficult to say if users ‘like this view’ because it is dynamic and fun, or if there is a real advantage into showing a visual representation of the discourse data model. Preliminary evaluation suggests that it is a mix of these two factors – dynamicity and fun on one side and support to the understanding of the data model on the other - which makes the network visualization very interesting for many users.



Figure 5. The Network Graph view shows the discourse network around the selected object (in yellow).

## GEO-DELIBERATION

When issues and resources are spread around different geographical areas the spatial dimension of a debate may strongly affect the conversation. The Evidence Hub provides several geo-map visualizations of: people (users geo-locations) organization and projects (geo-location of social resources) and ideas (geo-map of the discourse elements - such as issues, solutions, evidence etc - deducted from the location of their authors). This geo maps can be also enriched with multimedia data (i.e. videos can be added as metadata to a contribution and can play directly inside a geo-map, Figure 6).

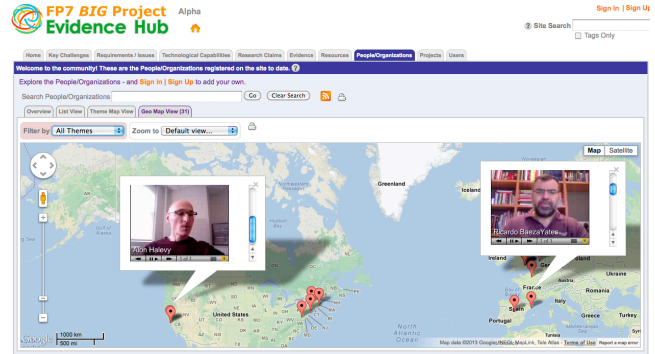


Figure 6: Embedded flash movies in the People/Organization Geo Map

## DISCOURSE AND SOCIAL ANALYTICS

As many CI tools the Evidence Hub takes the activity traces left by the user community to produce added value to the users, mainly by providing different types of analytics. For instance, discourse analytics show users’ attitude toward specific actions such as “comparing thinking” and “information brokering”.

### Compared Thinking

This analytic is a proxy for the degree to which a users connects her ideas — either her own, or those of others. These are rendered as follows, enabling the user, a peer, or a teacher/mentor to see the kinds of connections being made, and to jump into the more detailed context of those moves, if desired:

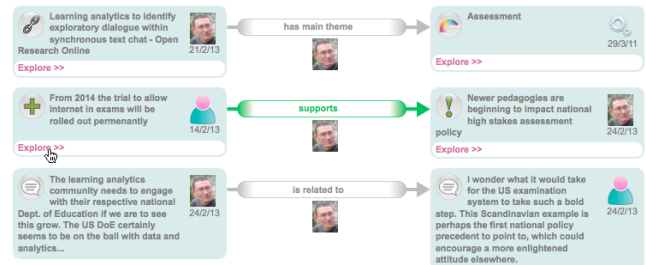
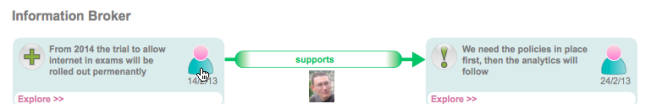


Figure 7: Compared thinking activities showed as triples

### Information broker

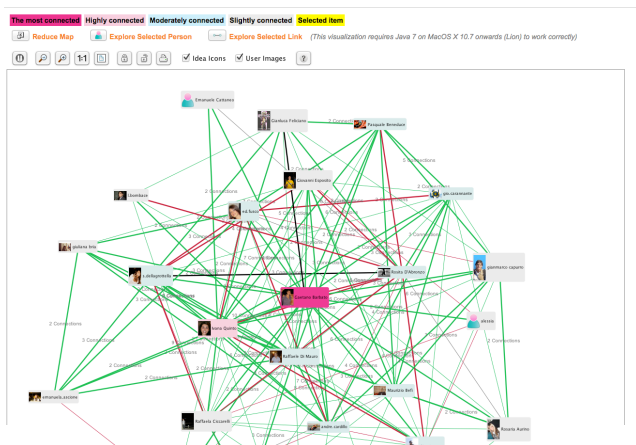
This measure shows the extent to which a user is able to forge meaningful new connections between the contributions of its peers. Arguably this is a more advanced kind of competence than connecting my own ideas and shows what users are playing the role of information brokers within the community.



**Figure 8: Information brokering activity for a user**

### Visual Analytics

The Evidence Hub also provides visual analytics on the social network. Nodes color shows the level of degree centrality of each node in the social network (node color shading from dark pink to grey for decreasing centrality). Links colors represent the agreement level between two users where red means high disagreement, green means prominent agreement and grey means mixed/neutral interaction. This visual analytics gives a quick overview not only of the level of connectedness of each user in the wider network but also provides feedback on the nature of the relationship between users (who agrees/disagrees with who).



### USER ENGAGEMENT

So far several Evidence Hubs have been built for different communities in the education and healthcare sectors. The full list of Evidence Hubs can be explored at evidence-hub.net. Several end users communities from the healthcare and education sectors have expressed interest in building an Evidence Hub.

#### Education

In the Educational sector we engaged with both international research networks (such as the Open Educational Resource - OER - movement) and local networks of educational practitioners (such as a network of teachers in the Milton Keynes council (UK)).

The OER Evidence Hub (ci.olnet.org) was built for the Open Educational Movement in order provide an environment to systematically interrogate the community on the state and future the Open Education research and practice.

#### Why an Evidence Hub

Open Education is a worldwide phenomenon aiming to impact and improve Education at all levels from grassroots local initiatives to higher national and international policy. It should be no surprise then how difficult it is to understand and keep pace with the challenges, success and

failures of Educational initiatives, projects, research, tools and practices. It is therefore even more difficult to try to develop an evidence-base of Open Educational effectiveness, and to identify the gaps in research and practice that still need to be explored to really push Open Education forward and enhance the impact it has on teaching and learning. An Evidence Hub calls upon a community to reflect on pragmatic questions such as:

- Where is the movement at?
- What are the challenges the movement still need to face?
- What are the potential solutions to those challenges?
- What is the evidence supporting those solutions?

From the research debate side a Hub also calls for researchers to reflect on:

- What is the evidence that Open Education has and will have a strong impact on transforming the way we teach and learn in the 21st century?
- What is the evidence that Open Education has and will have a strong impact on transforming the way we teach and learn in the 21st century?

To answer these questions we need a collective effort. We need answers that are built together by sharing knowledge resources, stories and insights on Open Education research and practice. We need collective intelligence in action and this is what an Evidence hub is for.

The OER Evidence Hub was launched in April 2011. At the moment, the Evidence Hub has about 150 signed up users, who have contributed to about 100 issues, 100 potential solutions, 130 research claims 250 Evidence, 600 Web Resources and 300 Projects and Organizations. In total over 1,500 user generated contributions have been shared through the OER Evidence Hub.

The story of the OER hub effectively describes the rationale and scope of a Hub that can be applied to many different communities of practice.

Another evidence Hub in the Educational sector is the “Ed-Futures Evidence Hub. This hub targets local Teachers and Educational Futures researchers in the Milton Keynes council area and aims at provide them with an environment for collaborative knowledge creation in which research insights can inform teaching practice and vice versa.

With much less users than the OER Hub this Evidence Hub had a very short life but it involved very active contributors. In fact only 20 users working along a 6 month period contributed 40 issues, 40 potential solutions, 20 research claims, 130 Evidence and 160 Web Resources, and 50 Projects and organizations; for a total of about 450 contributions. This Hub stopped to be active when the project finished, the reason for this may be mostly related to the absence of a practical goal as well as the active moderation of the project leaders.

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Two other examples Hubs in education are: “The Research By Children and Young People Evidence Hub” (<http://rcyp.evidence-hub.net/>) and the “Society for Learning Analytics Evidence Hub (Solar Hub <http://solar.evidence-hub.net/>). The Solar Hub has been used by students of a MOOC (Massive Open Online Courses) for collaborative knowledge-building (specifically evidence-building) around the course content and for self-reflection, supported by learning analytics that have been designed to provide information about users’ activity.

### Healthcare

In the healthcare sectors we engaged with Health Visitors from the UK NHS (National Health System) and the MHRA (centre of the Medicines and Healthcare Products Regulatory Agency).

In collaboration with CRIPACC (School of Health and Social work at the University of Hertfordshire) we developed the Health Visitors Community of Practice Evidence Hub (CoPHV hub). The main aim of the CoPHV hub is to develop evidence-based knowledge for the professional field of health visiting. This is a very complex professional domain in which often practice is more up to date than policy. Health visiting professionals therefore need to share good practice points of what works or not in the health visiting profession, and they need new ways to share and collaboratively build this very practical body of evidence-based knowledge. The goal of this hub is to build a health visiting online community of practice which can inform evidence-based policy and practice.

The CoPHV Hub was launched in September 2012 and it now counts over 100 users. User generated content contribution is starting to flourish thanks to the intensive user engagement effort put form the team at the University of Hertfordshire. So far about 80 issues have been contributed, 20 good practice points, 50 Evidence, 150 Web resources and 20 Organizations and Projects have been added to the Hub. The CoPHV evidence hub is not yet open to the public but just to selected Health Visiting Communities in two UK Counties.

Another example is the Evidence Hub for Medical Education (<http://onlinemeded.evidence-hub.net/>), which is still a work in progress and aims to connect, explore and debate efficacy of emerging online medical education practices.

### LANGUAGE CUSTOMABILITY OF THE BUILDING BLOCKS OF AN EVIDENCE HUB

The variety of end user communities targeted by the Evidence Hub has soon demanded high language customability. Each community has its own key themes and key challenges, its own way to talk about them, and more importantly each community needs to collect different types of evidence, and debate different types of contributions.

Whereas communities of researchers need to contribute and debate ‘research claims’, other communities, targeting more practice than research, need to collect and debate “good practice points (like the CoPHV hub). In the same way mixed community of researchers and practitioners need to debate both research claims and practical solution so that research and practice can inform each other (as the OER Hub or the Ed-Future Hub).

Issues of language and communication are key factors for community engagement and building common ground. In order to accommodate these issues the Evidence Hub has been designed as a customizable platform, in which each community can choose how to name and use the building blocks of the Hub.

### CONCLUSION

In this paper we have described the Evidence Hub concepts and rationale. We have summarized the main features of the Hub and explained how they serve specific end-user communities needs.

The Evidence Hub is a *contested collective intelligence* tool for communities to gather and debate evidence for ideas and solutions to specific community issues. The Evidence Hub builds on research on CI and argumentation and provides an environment in which, by filling simple web forms, users can add their evidence, arguments and interpretations, and see them instantly mapped within a global knowledge base.

By aggregating and connecting single contributions the Evidence Hub provides a collective picture of what is the evidence for different ideas, which have been shared by an online community. This collective picture can be explored in form of a simple textual interface (as list of organizations, claims, evidences, issues, resources) or in a more visual way as a knowledge tree, or a network map.

The platform allows different users to build progressively and collaboratively on the same content, thus facilitating collaborative knowledge production and discovery.

Moreover the system provides analytics on users activities. This means, for example, that if a user has made a claim, shared some evidence or a piece of data, these will show up in his personal profile, together with analytics on his activities. Eventually these analytics will be used to provide contextual recommendations.

The system also allows users to easily add evidence or present counter-evidence to other people's claims, thus triggering conversations and knowledge sharing between people who tackle similar issues.

Finally the Evidence Hub allows users to visualize, explore and be part of a social network of contributors. Visual analytics on this network allows grasping the social dynamics that are emerging from the debate (such as who

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are the key players and who is agreeing/disagreeing with who, Figure 9).

Results our research and of users engagement with the Evidence Hubs has confirmed that a pervasive challenge for building CI platforms is balancing a critical tension. This concerns the tradeoff between the need to structure and curate contributions from many people, in order to maximise the signal-to-noise-ratio and more advanced CI services (e.g. queries that no website can answer at present: What is the most strongly evidence-based proposal? Which research has had most real world impact?) — versus permitting people to make contributions with very little useful indexing or structure (the bias in most social web platforms), which is easier because it requires less reflection or learning how the site is structured. It is fair to conclude that we have made some progress with respect to this challenge, but it is a very tough problem, and far from solved.

To date we cannot claim to have built a large, actively contributing user community. Rather like Wikipedia, the majority of data from diverse sources has been entered by a small percentage of editor/champions (but since our overall numbers are far lower than Wikipedia, the numbers are also small). In the early stages of a new CI site, it is inevitable that the burden falls on the project champions to populate the site in order to demonstrate the concept with meaningful examples. An open research question is whether higher level CI (ie. not just aggregating low level data such as clicks and ratings, but issues, solutions and evidence) can be structured by ‘normal people’ (rather than structured data enthusiasts such as those who built freebase.com), or whether the skills of curation and mapping will remain the preserve of a minority, with the majority of contributors submitting relatively conventional freeform texts with a few tags.

#### FUTURE RESEARCH

Future research will be devoted to develop more sophisticated analytics to provide specific added value services to the users. Some example services would be:

**Reporting System:** *What is the state of the debate and how can we summarize the main issues, arguments, conflicts, resources etc?* A customizable reporting interface should make easier for people to focus on specific aspects of the debate and filter out the noise. Each of these aspects would have single crafted analytics.

**Discourse analytics:** *What had been said? What do we know and what we need to know?* Discourse analytics will aim to spot similarities, and identify gaps and hobs in the deliberation process (i.e., pointing at where people may need to contribute, or where popular topics are debated, etc.). Discourse analytics will provide useful visualizations to represent the state of a debate, and will be used to gather

feedback and inform self and collective awareness of the deliberation space.

**Geo-Deliberation Analytics:** *Who are the people close to me who think like me? What are the places where similar ideas to mine have been supported more? What are the places where the solution I proposed would fail, and why?* When people’s ideas and resources are spread across different geographical locations, deliberation needs to be concerned with the “spatial” dimension of the debate. It is important to understand the reciprocal influence of spatial and conceptual locations of both people and their ideas. To this aim we will craft specific social and discourse analytics to support a better understanding, and a more complex reasoning, of geo-deliberation issues.

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