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Hypermedia as a productivity tool for doctoral research

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This technical note illustrates a number of uses of a hypermedia tool that serve various dimensions of individual PhD study, such as organizing notes, generating literature reviews, performing experiments, analyzing results, publishing and presenting materials, and collaborating with supervisors and colleagues.

Keywords

scholarly hypermedia , graphical hypertext, semantic hypertext, transclusion, Compendium

Introduction

The authors, a doctoral student and his supervisor, use a hypermedia tool called Compendium as a centrepiece of day-to-day doctoral work. The student began working on a PhD as a part-time external student in October 2003. Compendium provides a number of capabilities and affordances that have made it well-suited for providing a personal ‘toolbelt’ (Sumner 1995) for both individual research and collaborations with supervisors and others. This technical note describes the role of Compendium in this doctoral work. It has been used in a variety of ways, as:

- a note-taking tool
- a literature review mechanism, providing ways to pull together ideas from the literature into analyses at various levels of granularity
- a publishing tool for posting analyses and notes on the Web in “native” hypertext format
- a presentation tool for formal seminars and supervisory meetings
- an experimentation medium for controlled experiments in participatory hypermedia construction, as well as qualitative analysis of those experiments
- a reference source for the preparation of papers and articles
- a collaborative discussion and argumentation environment for supervisory meetings.

We will describe each of these, highlighting the specifically hypertextual aspects, and providing some reflections on their effectiveness and limitations to date. We will also mention some implications for future tool and method support, and provide some reflections on the use of hypermedia as a personal productivity tool for PhD studies.

Background

The student, based in New York, started his PhD program at the Knowledge Media Institute (KMi), Open University, in October 2003, working on his research as a part-time distance PhD student at home during nights and weekends. The KMi supervisors are in the UK. His research concerns the role of artistry and expertise in the facilitation of participatory hypermedia construction, particularly in virtual collaboration.

Compendium's hypermedia functionality

Compendium is a hypermedia environment emphasizing visual maps of concepts joined by semantic links, with nodes appearing in multiple views via a transclusion mechanism. Each node can have a number of individual properties, such as "tags" indicating various metadata attributes (e.g. "citation", "action item", "open issue", etc.), customizable graphical icons, links to external documents, and publication metadata (see Figure 1). Compendium is implemented as a Java application communicating with a variety of data sources, such as MySQL and Derby databases, and interoperable with other tools via

XML and HTML exports, and Jabber messaging. The tool comprises a great deal of functionality not described here. It has been in development since 1998.¹

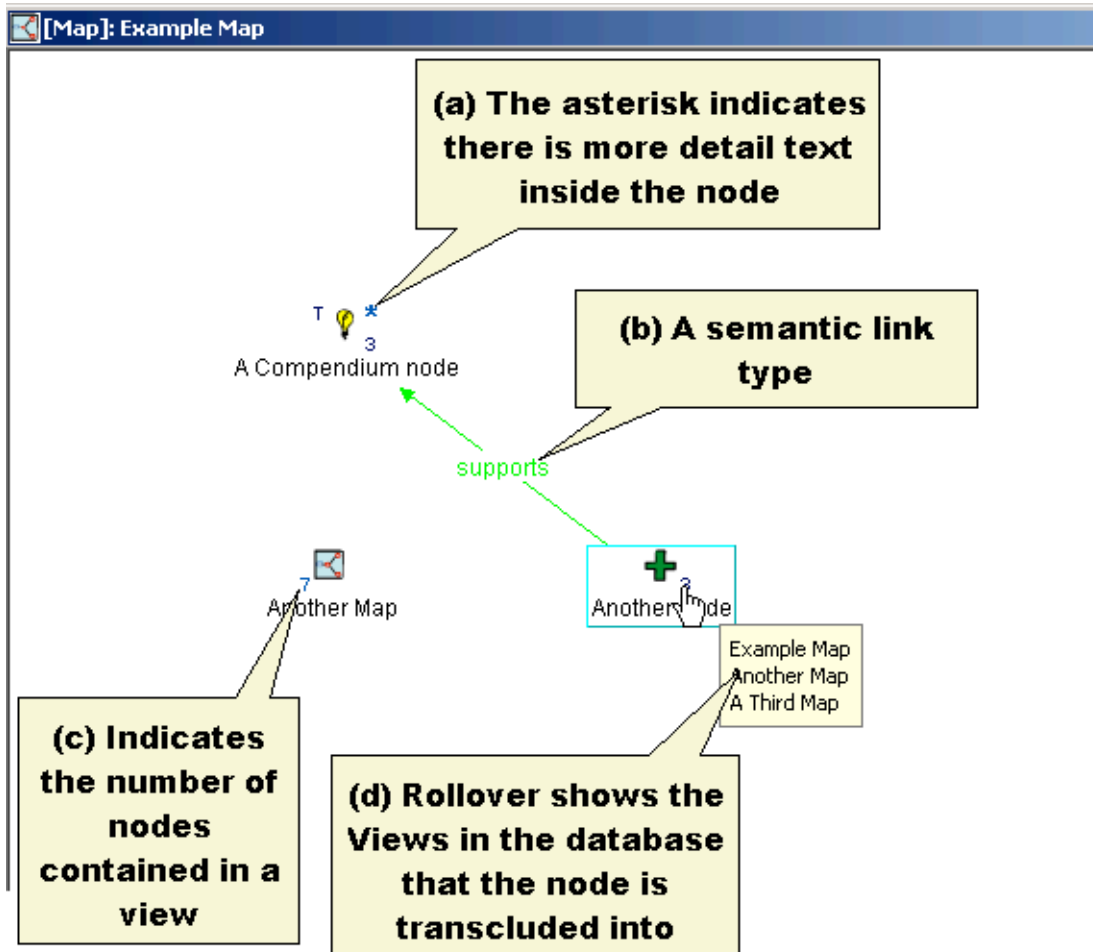


Figure 1: Example Compendium map illustrating some aspects of hypermedia functionality. (a) If an asterisk appears next to a node, there is more textual detail available. (b) Compendium supports a wide range of pre-supplied as well as user-defined semantic link types. (c) Nodes representing map and list views show how many nodes are contained within them. (d) Nodes display the number of views they are contained in, and rolling over the number displays a pop-up giving the titles of those views.

The three distinguishing features of Compendium, in comparison to other general concept mapping tools, are its visual notation, user interface, and hypermedia database. These have co-evolved over nearly 20 years of research and development in the field into a tool for meeting support and flexible information management.

- *Visual notation.* The IBIS notation (Issue-Based Information System) was developed by Horst Rittel (Kunz and Rittel 1970) to support collective deliberation over complex, multi-stakeholder “wicked” problems, as Rittel termed them. The graphical-IBIS (gIBIS) version was developed when hypertext tools

¹ Details of technical capabilities and case study applications can be found at www.CompendiumInstitute.org

were combined with large screen, graphical workstations in the late 1980s (Conklin and Begeman, 1988), to support the real time mapping of deliberations in meetings, and it is from this work that Compendium is directly descended. IBIS is used to visually map key issues, possible responses to these, and relevant arguments.

- *User interface.* Compendium's user interface is optimised for real time use in meetings, to capture and reflect back to participants (via a shared display) the structure of ideas as they emerge. The speed with which nodes can be created and linked makes it possible for the 'dialogue maps' to become time-based semantic annotations if the meeting is being recorded.
- *Hypermedia database.* Compendium maps are not 'flat' drawings, but views onto a relational database which can be rendered in multiple formats. A given node (e.g. representing an idea, argument, entity, or document) can appear and be updated in multiple views, and be assigned user-defined semantic tags, providing a flexible medium for managing connections between nodes across different contexts. Nodes can also link to any application document or URL which is dragged and dropped into a map, so an external document can be linked into one or more discussions and tracked – that is, given one or more meaningful contexts where it plays a role.

Note-taking

At this point in his studies, the student has read over 100 articles, books, and papers. His method has been to have the article open, either on paper or, as electronic text on the same computer running Compendium (both Microsoft Windows and Apple MacOSX are used). He peruses the texts and looks for salient ideas and quotations, which he then captures as nodes in Compendium for later reference, adding his own thoughts. He creates new maps for each article, which he annotates with the text's bibliographic information. If the paper is in electronic form, he highlights quotations and drags them into Compendium, where they form new nodes. Some article-maps will only contain a couple of nodes, while others can grow very large. For example, the map of notes from Schön's *The Reflective Practitioner* (1983) in Figure 2 contains 102 nodes. After a first pass through an article, he will often go back and perform various types of clean-up operations, such as correcting typos, breaking chapters or sections off into sub-trees, adding tags to individual concepts, or creating transclusions of the nodes into other views.

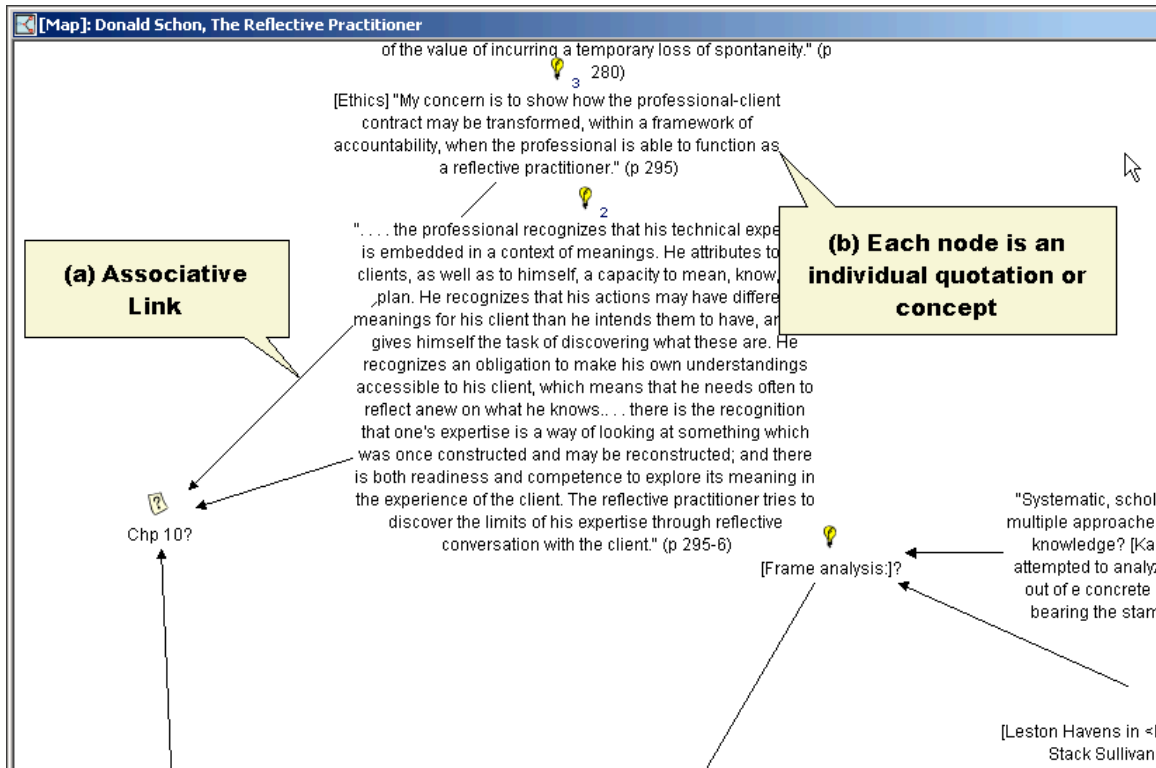


Figure 2: A portion of a note-taking map. Associative links show relationships between ideas (a). Each node represents an individual quotation or concept from the literature (b).

These activities have built up a repository of great depth and breadth. Visually reviewing the maps, or reading printouts of them, often helps to derive more insights from the literature. So far, however, the student has not found the act of taking notes in this manner to be “better” than taking notes on paper or index cards. There is something about the intangibility, the lack of marked-ness and inflection, to taking notes on the computer as compared to the crinkly feel of paper and the physical act of handwriting, that does not seem to impart all of the customary benefits of traditional paper note-taking. However, these deficiencies are more than outweighed by the benefits, which have to do with extraordinary flexibility and ease of reuse and incorporation of the notes into multiple and diverse artefacts.

Literature reviews

Notes on the atomic level are valuable, but more so when they are drawn together into new syntheses. To prepare literature reviews, the student reviews hundreds of individual notes in separate nodes, often spanning many maps, and uses Compendium to help organize the raw material into concept maps and outlines. For each, he creates a new map to serve as a précis of the original text (e.g. “Schön-Summary”), selecting nodes of particular interest from the original maps to transclude into the précis. Later, he can easily revisit each node in its original context (often gleaning some insight by simply seeing the surrounding nodes and links) by clicking on the node’s Views indicator (see Figure 1) and choosing from the list of contextual placements that appears. As he proceeds, he moves ideas around, creating new trees and associations as they occur, sometimes doing

wholesale rearrangements of large sections. At times, even these précis maps have grown too large. He then makes a third, yet more refined map, so that the number of ideas and quotations are few enough to serve as a detailed outline for the actual paper.

The main difference between this approach and that of outlining software (or, for that matter, arranging physical index cards on a table) is the transclusions and the affordances they provide, as well as ease with which the student can share the arrangements of nodes and links, at any of their levels of refinement, in a variety of forms.

Experimentation and analysis medium

In February 2004, the student conducted a preliminary experiment using Compendium at the Open University. He assigned two teams (composed of faculty and graduate students) to extend a fictional hypertext story he'd created. The team members worked collaboratively. Each team grouped around a computer running Compendium, and in the course of 90 minutes authored their stories within the tool, adding text, illustrations, and navigation. They then presented the stories to the other team, projecting their Compendium maps and reading the text out loud while one of the team clicked through the various maps and nodes. As they worked and presented, the student observed the teams and took notes on paper. He also used screen-and-audio recording software to capture each team's work for later analysis. Following the presentations, he facilitated a debriefing session where all the participants reflected on the experience. As they spoke, he captured their comments in the live Compendium display, asking for validation to be sure he had transcribed or paraphrased correctly. Later, he used Compendium to analyze the videos, taking additional notes. He then grouped these with his observational notes and the debrief comments into categories and themes, and published the results as a Web document that was sent to participants for additional validation and reflections.

Several findings emerged from this experiment, both from the observations and from feedback from the participants. First, it was clear that the groups, with no experience in creating hypermedia fiction, were able to use the tool effectively to author and present a story, paving the way for later, more involved experiments. Second, the types of aesthetic choices and "dilemmatic" situations (Aakhus 2001) the participants had to make within the tight time constraints mirrored those we have observed on the part of expert facilitators using the software in other contexts. Third, each group showed a distinct character and style in both their choice of narrative elements and visual images, as well as their presentation methods, also correlating with observations of expert practitioners. Fourth, each group performed a similar range of (self-organized) tasks that could be grouped into distinct categories (illustrated in Figure 3), which will contribute to a descriptive model for such collaborative hypermedia authoring tasks that we are developing. Fifth, although both groups accomplished their story-making task within the time allotted and created stories that they and the other team enjoyed in the telling, they each reported some awkwardness with the experience, questioning -- though not rejecting -- the suitability of the tool as a narrative medium.

As with the other uses of Compendium described in this article, all of the materials -- the groups' stories, the video recordings, the notes and debrief comments, and the thematic

groupings -- were incorporated into the same Compendium database as the literature notes and other materials, available for later recall, review, and integration with subsequent work.

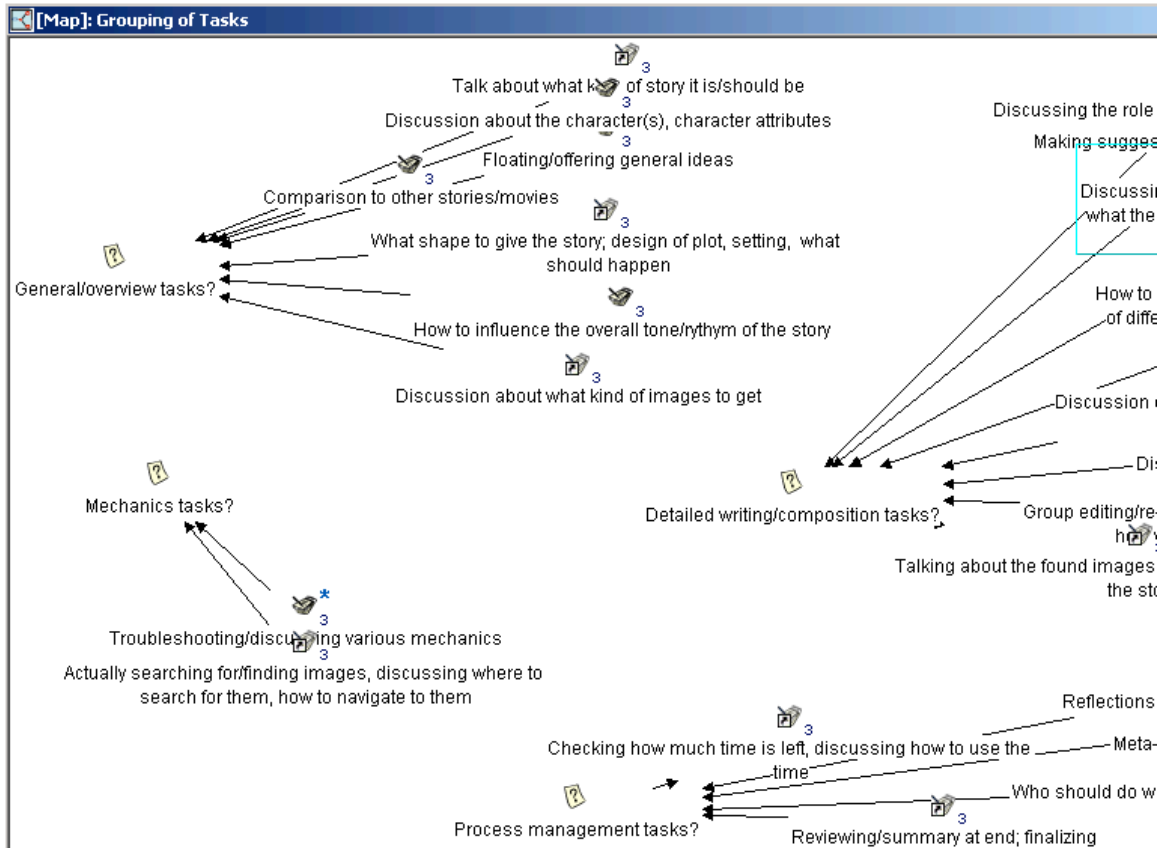


Figure 3: Portion of a map showing thematic grouping of observational notes from experiment. The groupings were validated with the participants.

Publishing tool

Compendium allows publishing on the web quickly and easily, in a variety of formats. The student uses Compendium to post works-in-progress, such as raw notes, as well as finished products, such as presentations and analyses, for others to browse, review, or comment on. This is done either in outline form, optionally including graphical node icons and "purple number" (granular addressability) references (see Figure 4), or as clickable image-maps that closely reflect the browsing experience within Compendium itself but don't require the user to install the software. We have also published XML versions of the maps for others to incorporate into their own Compendium databases.

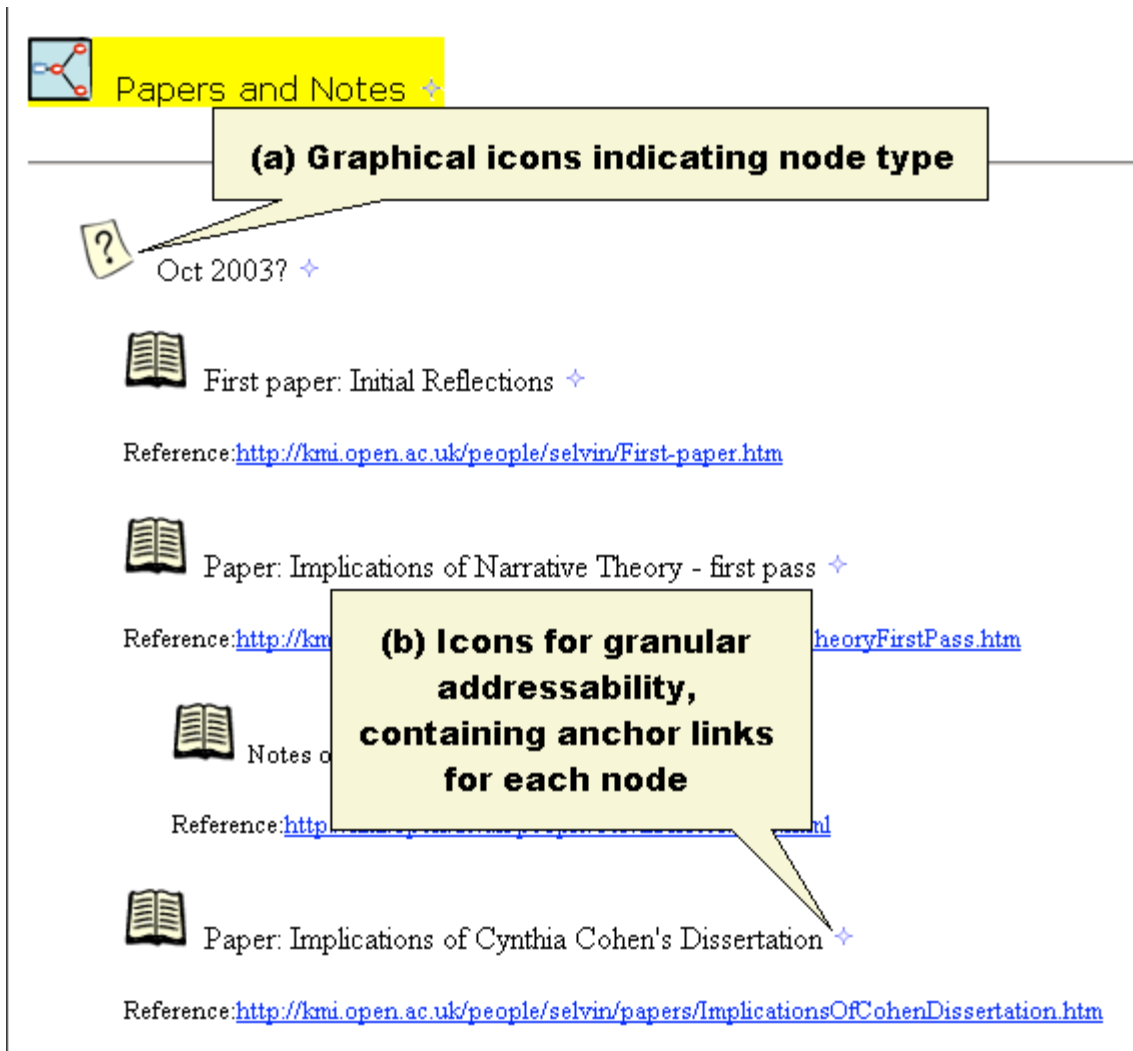


Figure 4: HTML Outline export, showing graphical icons (a) and 'purple number' icons (b) that contain the specific anchor link for that line of text

Presentation tool

Putting together presentations involves both creation of new materials and incorporating existing content. With Compendium these are both done in the same database. The student uses Compendium to do all the authoring for seminar presentations as well as for the delivery. An example from a progress report presentation appears in Figure 5. He assembles ideas and construct maps carefully, being sure not to overload each map with information (similarly to constructing slides in presentation software). For such maps it is useful to add more navigation capabilities than for less formal artifacts, such as maps of raw notes. This avoids excessive clicking and screen movements during the live event. Taking advantage of Compendium's facilities to add nodes rapidly in meeting situations, the student is able to integrate comments and questions directly into the same maps, linking them to the ideas in the presentation that they reference. Elements from presentations can be easily integrated into other artifacts. The transclusion capability

provides "traceability," so we can see where the same ideas have been incorporated into multiple contexts.

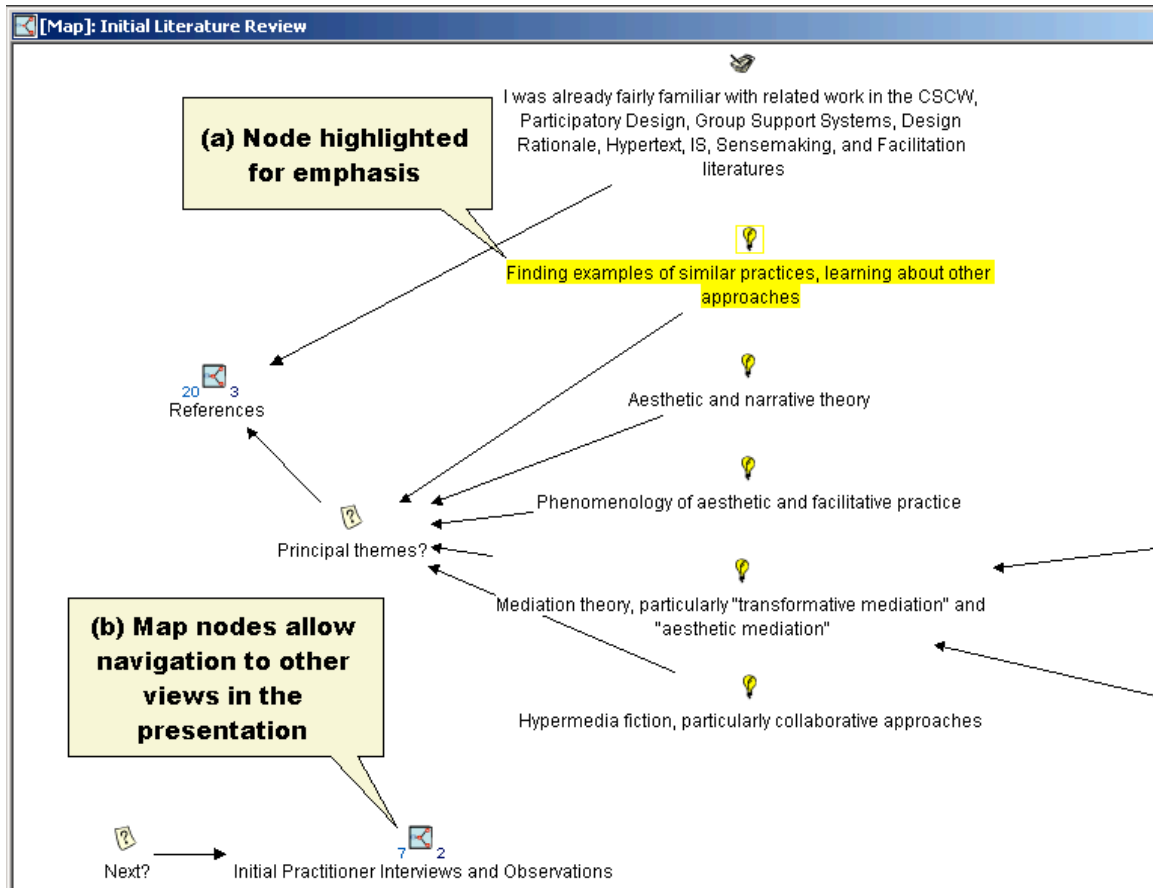


Figure 5: A map from a presentation, showing a node highlighted for emphasis (a). This map is the overview as well as the introduction; it contains map links to all the other maps in the presentation for easy navigation (b). Clicking on the indicator allows direct navigation to the other containing views.

Reference source

We have found that not all tasks involving the use of the data in the student's Compendium database are best performed sitting in front of a computer. For example, he found it somewhat difficult to prepare the literature review chapter of his first year report by assembling thematic maps directly within Compendium itself. Working within the software on individual maps, he wasn't able to create the kind of wide-ranging synthesis of all the literature he was after (although he had found this approach to be effective when dealing with smaller bodies of work). The task seemed to call for working on paper, physically surrounded by (tangible) textual notes. To achieve this, he generated outline exports of all the maps containing notes on the literature, and then printed them as one large document (containing almost 300 pages of material). He then worked in a more traditional mode, using index cards to take notes on the document and arranging them on a large table. When he needed more information on a particular quotation or idea, he would go back to the computer and locate the node in Compendium, examining its context, metadata, and transclusions to derive what he needed.

Collaborative discussion and argumentation environment

Compendium has helped add a new dimension to our supervisory meetings, which are nearly all carried out via occasional transatlantic telephone calls (as well as more frequent instant messaging and email contact). Especially in the first few months of the student's doctoral work, these meetings were carried out with the aid of a desktop-sharing tool, which would allow us to use Compendium as a live presentation medium as well as a way to capture the supervisors' comments and questions in real time. We would also pass control back and forth, so that when one party was speaking, the other could record the discussion on the same map. Figure 6 contains a screen shot from one of these sessions. At the moment this was captured, the student was in his home office in New York, recording the comments that the supervisors in the UK were making concerning one of his reports. We could also view each other via the FlashMeeting web video conferencing tool seen at upper right.²

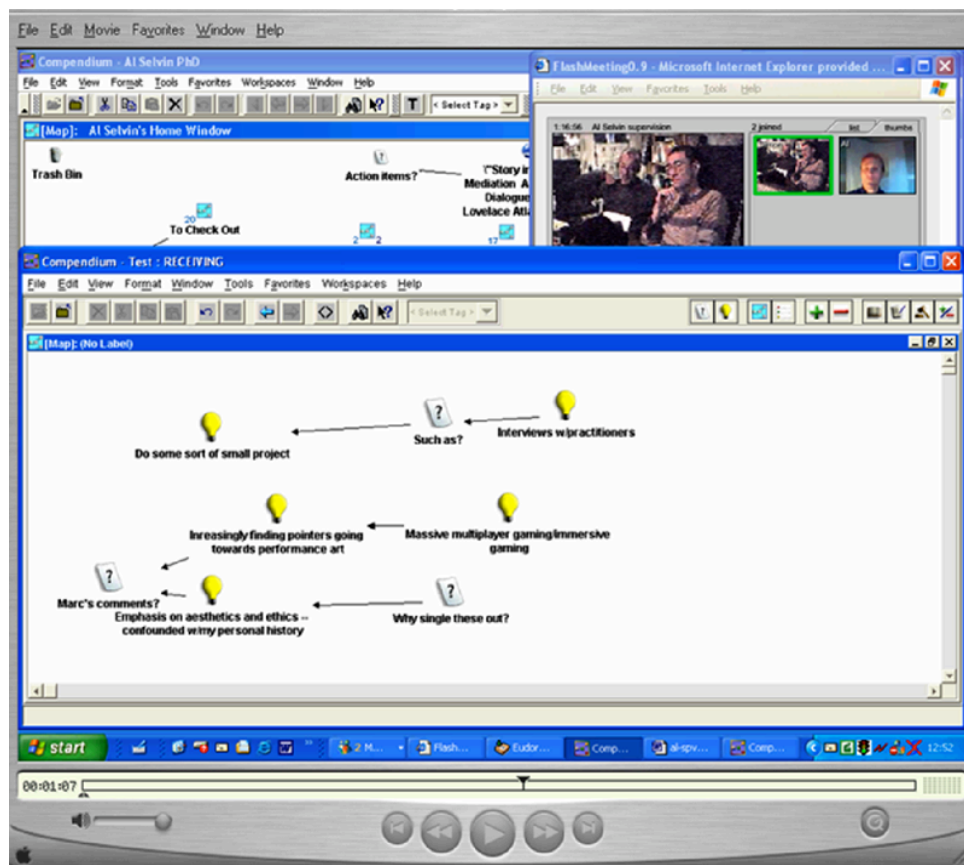


Figure 6: Screen capture of a UK/US supervisory meeting, showing video insert of supervisors watching live Compendium mapping of the discussion. The whole session appears in a video window as it was also recorded using a screen+voice capture utility, resulting in a replayable movie which can be 'skimmed' using the Compendium nodes to locate specific points in the meeting (e.g. when a particular issue was raised). Compendium-based meeting replay has since been developed into a more sophisticated meeting replay environment.³

² FlashMeeting, Knowledge Media Institute, Open University: www.FlashMeeting.com

³ For Compendium-enhanced meeting replay, see the *CoAKTinG* Project: www.actors.org/coacting and the *Memetic* Project: www.memetic-vre.net

Summary and conclusions

This article has described the diverse uses we are making of the Compendium hypermedia tool for the day-to-day work of doctoral research, a form of longitudinal action research which is helping to drive the tool's development as a research vehicle. We have been able to take advantage of many of the specifically hypertextual aspects of the tool, such as typed nodes and links, transclusions, annotations, semantic metadata (tags) and others, to perform a wide variety of tasks. More importantly, there is an aggregation effect: the more the database is used, the more material can be related to other material, adding layers of insight and reference. The student's Compendium PhD database now contains 2763 nodes organized in 193 maps. When printed, this comprises more than 1000 pages of material. We have been able to make use of the tool and approach for tasks as diverse as note-taking, literature analysis, artistic exploration, participatory experiments, qualitative analysis, presentation, web publishing, and a wide variety of other information management tasks. It remains a central part of the student's work.

Despite these benefits, it is not, of course, a panacea for all tasks. There are a number of tasks that still feel more amenable when performed with more conventional means. As an individual productivity tool for doctoral research, Compendium seems most suited to activities that involve creating and relating ideas together. These can be unstructured, very granular activities such as taking notes and brainstorming, or highly structured pursuits such as constructing analyses, presentations, and other artifacts. But it has so far seemed less tractable for activities that involve thinking through a subject in a narrative manner -- essentially, writing. Other papers in this special issue (Kolb and Nakakoji *et al.*) consider in more depth the ways in which hypermedia functionality can assist this creative and analytic process.

For example, when creating textual syntheses of large bodies of material, we still find that sitting down with pen, paper, and index cards is the most generative mode for such work. This may simply be a matter of personal habit, preference and style. Thinking, reading and writing hypertextually is a very recent art, essentially a new form of literacy, and it is difficult to overcome the "naturalness" that decades of experience in conventional writing have accumulated. As we saw in the experiment referred to earlier, however, creating narrative syntheses in hypermedia, while it may feel somewhat unnatural, is quite possible and can lead to kinds of innovation, insight and creativity that conventional means may not foster. Future work and reflection, as well as wider adoption of hypermedia tools for day-to-day doctoral work, will better illuminate these matters. We plan to continue the use of Compendium for this student's doctoral work and learn from our experiences, as well as to encourage others to begin to incorporate the approach in their own studies.

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