Beyond Web 2.0… And Beyond the Semantic Web

Aurélien Bénel, Chao Zhou, Jean-Pierre Cahier

Chapter 1
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And Beyond the Semantic Web

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Abstract Initiated by Manuel Zacklad in 2003, the 'Socio-semantic Web' has recently seen important developments. Contrary to the Semantic Web, it is not interested in formal semantics but in semantics dependent on the human subject and on the semiotic substrate. Moreover, it aims at fostering people participation in knowledge work, such as Web 2.0 does for entertainment. In this trend, software design relies on three human and social phenomena:

- documents, because they are proofs of something else, not in the manner of a mathematical proof but more in line of evidence that is kept and that can be mobilized;
- interpretation, because the meaning of a document depends on its authors and readers;
- intersubjectivity, because the confrontation between conflicting interpretations allows to overcome subjectivity.

We illustrate our definition and design approach with descriptions of a course-material sharing platform and of a software enabling collaborative analysis.

Acknowledgements The authors are thankful to Kerralie Oeuvray and Dave Randall for their comments about a preliminary version of this article.

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1.1 Introduction

Tim O'Reilly, the famous technology book publisher, changed the life of many of us when he coined the name 'Web 2.0' (O'Reilly, 2005). Our research topics suddenly became society subjects debated on cultural radio programs[1] and, at the same time, became inappropriate marketing discourse according to several scientific reviewers. Indeed, Tim O'Reilly's first thoughts were economic, since it was about the resurrection of the Web after the bursting of the dot-com bubble. Some opponents of the concept do not think the term should be used since it is underpinned by no technological revolution. In contrast, we think there was a paradigm shift when several sites based on user-generated content became some of the most visited Web sites, and that massive adoption of that kind is worthy of researchers' attention.

As computer scientists working on CSCW, we are concerned with designing software for knowledge workers which would foster participation in much the same way as Web 2.0 currently does for entertainment. In saying this, we differ from researchers who think that the future of the Web is the 'Semantic Web' and who sometimes call it 'Web 3.0'. We do not see how "data processable by machine" (Berners-Lee et al, 2001) could be an improvement on the "wisdom of crowds" (O'Reilly, 2005). If semantics is important to improve Web 2.0, we think that we need a social semantics rather than a computational one.

In the first section, we will give a definition of what could be called a 'social semantic Web', as compared to the Web, the Semantic Web and Web 2.0. The second and third sections will illustrate this definition with, respectively, a course-material sharing platform and a collaborative document analysis software.

[1] In France, for example, a weekly program called 'Place de la toile' has been created in 2007 on France Culture on the time slot called 'Questions d'époque'.

1.2 Towards a Social Semantic Web

The term 'Socio-semantic Web' was coined by Manuel Zacklad (Zacklad et al, 2003) to express the view that there was another way to build a 'Semantic Web' than the computational way promoted by the World Wide Web Consortium. The main idea is to provide a digital medium for knowledge workers, where knowledge models are created and updated through cooperation and debate. The Socio-semantic Web can borrow concepts and technologies from both the Social Web and the Semantic Web, but combining them in a new way. In the following subsections, we will see why it is a 'web' and why it is both 'semantic' and 'social'.

1.2.1 A 'Web'

To define the 'Web', we shall analyze how the 'Mesh', an internal IT project from the CERN[2], invented in 1990 and prototyped in 1991, became a 'World Wide Web' of more than one trillion pages[3] [4].

Initially, the Mesh was created to solve the problem of the knowledge loss due to the high turnover in personnel in the organization. The transmission among staff was difficult since the documents and the data of a project were scattered among different servers with incompatible formats, data structures and protocols. To avoid that, Tim Berners-Lee proposed a distributed hypertext as a loose integration structure (Berners-Lee, 1989). It is reasonable to argue that the rapid success of the Web was due to its three core components (Jacobs and Walsh, 2004): URL, HTML and HTTP.

A URL (uniform resource locator) provides an easy way to identify a digital 'resource' anywhere in the world, may it be on the Web (independently of its format) or on other digital services (such as the older FTP and Gopher for files, NNTP for news, Prospero for directories, e-mail addresses, etc.).

HTML (hypertext markup language) makes it possible to structure a text both hierarchically (into headings, paragraphs, lists, tables, etc.), and with internal and external transverse links. With some technology (e.g. CGI), it is possible to generate a universal interface (a hypertext view) of an existing database. Moreover, having a formal network of informal nodes provides room for both computation and human interpretation. Because it is based on a URL, a link in a HTML document can point to a resource that is provided by a different community.

HTTP (hypertext transfer protocol) is the application protocol used between web clients and web servers. Just like FTP, it enables to create, retrieve and delete re-

[2] CERN: European Organization for Nuclear Research, Geneva.

[3] "We knew the web was big...", from `http://googleblog.blogspot.com/2008/07/we-knew-web-was-big.html` Official Google Blog.

[4] The 'deep Web', hidden into organizations intranets, is considered to be 500 times larger than the 'surface Web' indexed by Google.

sources on the server with requests named 'PUT', 'GET' and 'DELETE'. The main difference is that HTTP is 'stateless'. Because Web browsing cause the user to visit and quit a server without known patterns, each HTTP request must be processed independently, without any knowledge of the previous requests stored on the host.

Roy T. Fielding, who was one of the coauthors of the HTTP specification (Fielding, 1999), and was involved in the development of HTML and URIs, generalized the key factors of the Web success (Costello, 2002) for distributed network systems and named the resulting architectural style "Representational State Transfer" (REST) in his PhD thesis (Fielding, 2000). In the REST architectural style, every resource should have a unique, global identifier: the URI. Its state is modified through a universal set of operations called 'CRUD', (for "Create, Read, Update, and Delete") in the database community (Gregorio, 2004), the mapping of CRUD onto HTTP command is: POST, GET, PUT, and DELETE, respectively[5]. Another principle of a 'RESTful' design is to "link things together" (Tilkov, 2007), so that it is possible to navigate from one resource to another, simply by following the links.

In order to have a hypertext network as distributed, robust and versatile as the Web, we decided to define a RESTful protocol for the Socio-semantic Web (Zhou et al, 2006).

1.2.2 A Web Which Is 'Semantic'

Using a Web search engine reminds us that there is a huge difference between what can be stored and processed by a machine (character strings), and the meanings that people write, read, and look for. It reminds us powerfully that there is a semantic gap between the two.

In 2001, Tim Berners-Lee co-authored a Scientific American article announcing the 'Semantic Web' programme launch. His idea for bridging the semantic gap was to gradually turn the Web into 'well formed' data so that machines could 'understand' them and deduce responses to user queries (Berners-Lee et al, 2001). The World Wide Web Consortium (W3C), founded by Tim Berners-Lee after he left CERN, then began to develop Semantic Web technologies, following a roadmap humorously called 'the layer cake' (see Fig. 1.1). Layered architectures are indeed a very common way to build computer and network systems. Each layer is supposed to be built only on the layer below and to grow in complexity and specialization. Thus, the layers can be developed and standardized in relative independence.

First presented by Tim Berners-Lee at an XML conference (Berners-Lee, 2000), the cake is unsurprisingly built on Web technologies (Unicode and URI) and on XML (a tree serialization format). The next level is made from 'RDF', a directed graph model, and 'rdfschema' (also called RDFs), a 'vocabulary' aimed at using RDF to model classes and properties.

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[5] It is noteworthy that there are some common misunderstandings: ignoring PUT and DELETE, and using GET even to change the state of a resource.

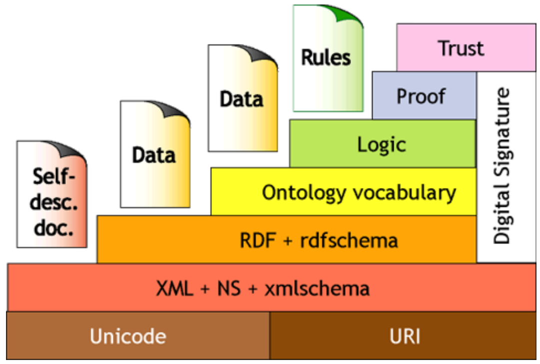

Fig. 1.1 The Semantic Web Architecture (Berners-Lee, 2000) - also known as the Semantic Web Layer Cake.

Those bottom layers have been standardized for years. Nevertheless, after more than 80000 research articles about the the 'Semantic Web' and 200000 about 'ontologies'[6], the feasibility of the upper layers still seems unclear. The 'Ontology vocabulary' is supposed to be a formal definition of the terminology used in a specific context. 'Logic' refers to the automatic inferences drawn from the statements given in the lower layers. As for 'proof' (explaining the courses of the logical reasoning) and 'trust' (users' trust in the data), no slide was dedicated to them in the original talk, and very little has been written on them in the Semantic Web literature.

For François Rastier: "The recommendations of the W3C, reassuring enough when they are presented as being purely practical, are in fact designed to become standards"; "standards are established, and then given the status of theoretical models". François Rastier goes further: "By conveniently proclaiming the creation of Web Science in 2007, [Tim Berners-Lee] shrewdly avoids having scientific problems raised and debated outside the Semantic Web community, which is self- engendered and must therefore undergo only self-assessment". In particular: "the adoption of 'low- level' standards such as HTML, or Unicode, or even XML, in no way entails that languages of representation such as RDF or OWL should be adopted as standard, unless one merely seeks to yield easily to the attempt by the W3C to force through the 'Semantic Web' " (Rastier, to appear).

In contrast to the slow development of the Semantic Web, breakthroughs in Web search techniques were achieved through citation analysis (Google PageRank), directories (DMOZ, also used in Google), and tags. All of these technologies use simple structures created by human authors or readers; none uses content formalized by knowledge engineers. In order to have semantics dependent on the human subject and on the semiotic substrate, we decided to define a model allowing the users themselves to enrich documents with a model of their interpretation (Zacklad et al, 2003; Bénel et al, 2001; Zacklad et al, 2007).

[6] Source: Google Scholar on Feb. 2009

1.2.3 A Web Which Is semantic and 'Social'

The 'semantic Web', as suggested above, and although it is supposed to aim at 'trust', has very little interest in the social dimension of the 'Web'. Moreover, we can wonder what sort of 'trust' could be based on 'proof' and 'digital signatures'. Socially speaking, trust is precisely what is required when there is *no proof*. And, whilst a digital signature can effectively attest that data have not been modified by someone else other than the bearer of a digital key, it is far from being sufficient to provide trust. One might wonder, with François Rastier (Rastier, to appear), what exactly the political and economical program is underpinned by the Semantic Web.

Conversely, "harnessing collective intelligence" is one of the main features of what Tim O'Reilly called 'Web 2.0' (O'Reilly, 2005). Whether it comes from the 'scientific debate' (Bénel et al, 2001), the 'marketplace' (Cahier and Zacklad, 2002), or the 'wisdom of crowds' (Surowiecki, 2004), collective intelligence can arise from a shared place where contradictory viewpoints can be expressed. In Web 2.0, this can be achieved by allowing people evaluate a resource or a person, comment a blog post, edit a wiki discussion page, or tag a resource with a free keyword. These are situations where trust is needed, and can be socially constructed little by little. Web 2.0 tools usually try to aggregate the viewpoints into an average of marks, a 'cloud' of tags, or in a consensual wiki page. Because we are more interested in smaller communities, we focus on visualizations which preserve each actors' viewpoint (Zhou and Bénel, 2008).

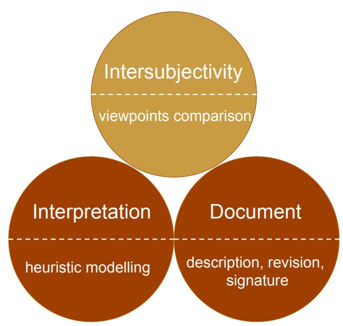

Fig. 1.2 The social semantic Web trefoil

Instead of being decomposed into layers, the Social Semantic Web relies on three human and social phenomena (see Fig. 1.2):

- documents, because they are *proofs* of something else, not in the manner of a mathematical proof but more in the line of a judicial proof; documents are a testimony to be kept, an evidence that can be mobilized;

- interpretation, because the meaning of a document depends on its authors and readers;
- intersubjectivity, because the confrontation between conflicting interpretations allows us overcome subjectivity (Bénel and Lejeune, to appear).

The Social Semantic Web can therefore be seen as the confluence of Knowledge Engineering and Computer Supported Cooperative Work. In the first research community we will examine, there has been a renewed interest in digital documents because of their semiotic richness, compared to formal models, as well as their ability to be hybridized with knowledge organization systems such as thesauri, topic maps and classification schemes (Pédauque, 2003; Bachimont, 2003). In the second research community, it is known that a lot of cooperative activities involves documents and categorizations, not as 'data' but as social and iterative constructs (Schmidt and Wagner, 2005; Israel, 2000). Hence actors need reflexive methods and tools to help them in carrying out self description (Herrmann et al, 2005), building maps cooperatively, expressing conflicts, comparing points of view, and assimilating or imitating conflicting interpretations (Salvador, 1997). For both research communities, focusing on user interpretation is a way to adopt a pragmatic approach to knowledge and to place emphasis on practices (Schoop et al, 2006; Park, 2008; Shum, 2006) To sum up, an increasing amount of research work in Knowledge Engineering and Computer Supported Cooperative Work permits us to think that a more semiotic and pragmatic Web could be possible. But because such a Web consists mainly of human and social phenomena (see Figure 1.2), and therefore cannot be built as such, we only aim at developping a structured writing *medium* (Goody, 1986; Bachimont, 2000) to let these phenomena happen...

1.3 Illustration in Education

The project named 'CogDoc' aims at providing a platform for sharing course materials (slides and audio/video records) among teachers and students from French speaking universities related to an international and interdisciplinary research group. A prototype was made at Troyes University of Technology with *Agorae*, a web space for topic map cooperative building (Zaher et al, 2006), and *Argos*, a web service implementing our protocol for community-driven organizations of knowledge (Zhou et al, 2006). In according with the socio-semantic Web approach, the prototype provided a space for documents, interpretation and intersubjectivity.

1.3.1 Document

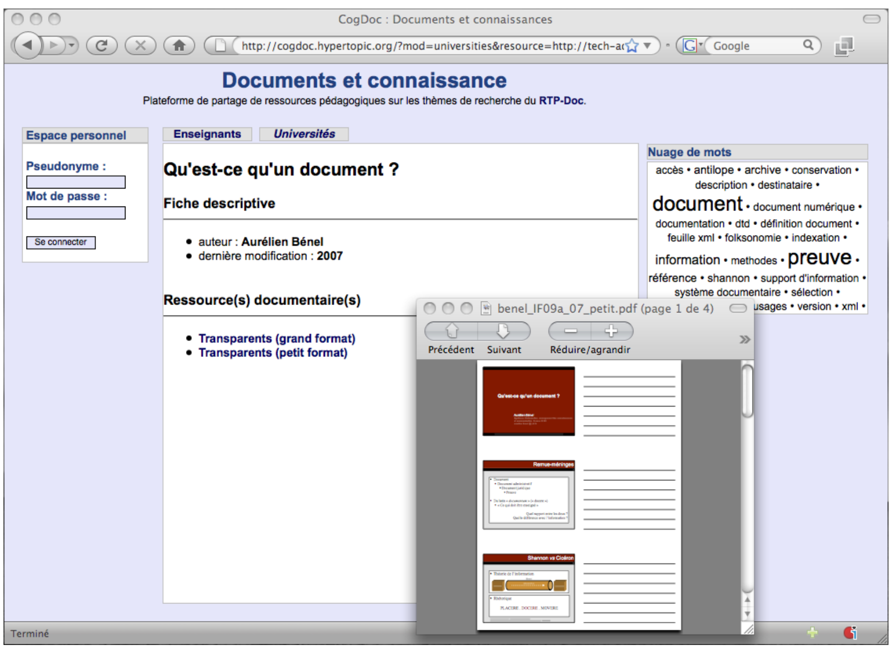

Fig. 1.3 A course lecture with its attributes and resources - Agorae screenshot

Two teachers have documented forty course lectures (see Fig. 1.3) with their corresponding slides (one version to be displayed, one to be annotated), exercises (if any), and description (title, author, date...).

Fig. 1.4 Primary classification scheme - **1** university, **2** major, **3** learning unit, **4** course lecture

Course lectures have been primarily classified according to their universities, majors and learning units. This catalogue made of pre-existing official topics can be browsed from a tab called ‘universities’ (see Fig. 1.4).

Fig. 1.5 Describing a course lecture with existing or new tags - Agorae screenshot

1.3.2 Interpretation

Once the teacher or student is logged in, any course lecture screen shows a panel for tagging (see Fig. 1.5). On the top of this panel is a drop-down list of viewpoints, related to this user. Within a selected viewpoint (see Fig. 1.5a), she is able to reuse tags assigned by someone else (see Fig. 1.5b) or to input her own tags (see Fig. 1.5c). Then, tags can be accessed through a personal tab and be used to browse one's personal collection of course lectures (see Fig. 1.6). Therefore, contrary to the primary classification scheme, tags are unstructured and uncontrolled terms chosen by the user for her own use. But the more the user reuses the tags on different lectures, the more she reveals intertextual links between them, and the more she organizes her knowledge of the field.

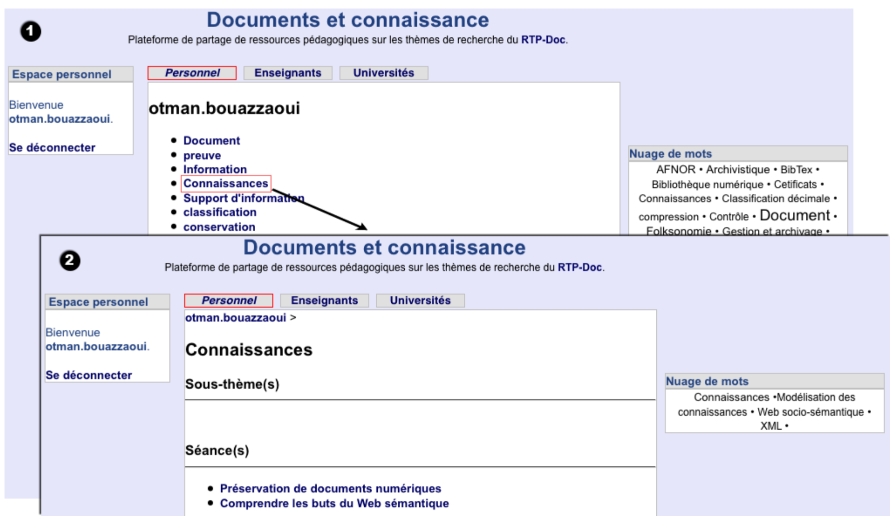

Fig. 1.6 Browsing one's tags - Agorae screenshot

1.3.3 Intersubjectivity

The hundreds of tags assigned by seventy students and teachers are dynamically aggregated into a tag cloud dependent on the page (see Fig. 1.3-1.4). To reduce misspelled or erroneous tags we filtered out tags used only once or twice from the cloud. Moreover, even if participants were incited to choose popular expressions as tags, and reuse them, the diversity was so important that we had to show only the eighty most frequent tags per cloud (and make them case insensitive).

The resulting emergent description of courses, majors and universities in term of learnt knowledge and know-how is quite interesting in what it affords:

- for students to choose a university or course, to revise for exams, to communicate ideas, to evaluate course sessions, to set milestones, to express opinions,
- for teachers to detect students misunderstandings, false interpretations or needs for discussion on certain topics,
- for university staff to validate courses passed by students in other universities, to match job opportunities with majors, or to change the organization of major or courses.

However, because education cannot be replaced by the 'wisdom of crowds', intersubjectivity is also featured in a more asymmetric and personal mode between teachers and students. Whilst the viewpoint of a teacher is public in order to be used as a reference (see Fig. 1.7), the viewpoint of a student can only be accessed by her teacher, so that the teacher can evaluate and grade what she understood.

Fig. 1.7 Accessing teachers' tags - Agorae screenshot

1.4 Illustration in Research

Our second case study is about the use by art historians[7] of *Porphyry* (Bénel et al, 2006), our collaborative document analysis software.

1.4.1 Documents

In this research project, the objects of study are Iron Age vases discovered in the excavations of the cemetary of Athens called ‘Kerameikos’. These artifacts are documented with photographs named according to their storage location and inventory identifier (see Fig. 1.8).

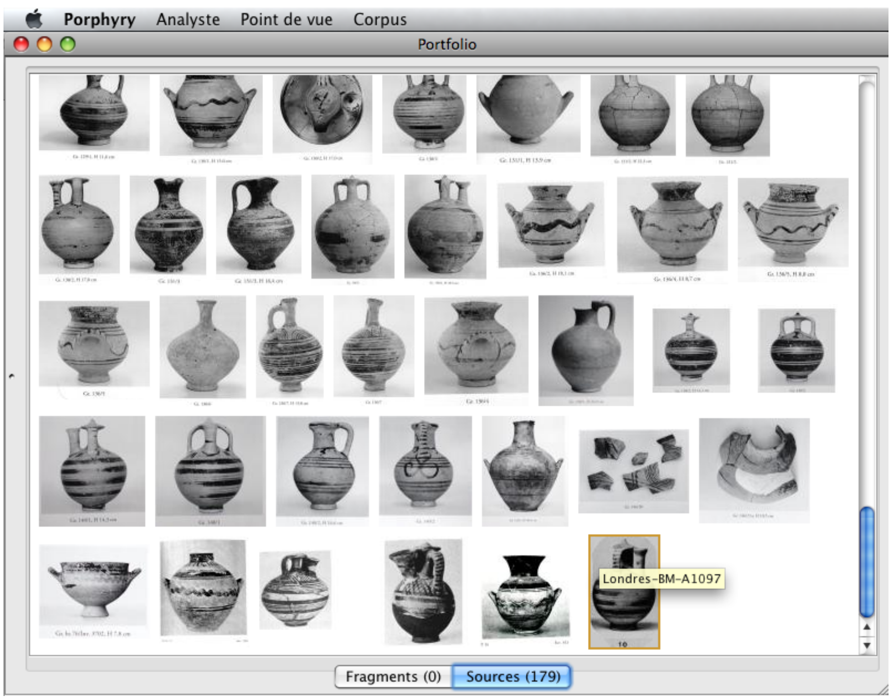

Fig. 1.8 Vases photographs named after their storage location and inventory identifier - Porphyry screenshot

[7] Pr. Jean-Marc Luce and his Master students (CRATA Laboratory, University of Toulouse II, France).

1.4.2 Interpretation

The selected vases are particularly important for the understanding of the history of ancient Greece, since they are supposed to be from a short period (called 'submycenaean') between the end of the Mycenaean civilization and the beginning of the Greek 'dark ages'. Indeed, invasions and external influences are supposed to have impacts on the styles the vases took, progressively making the forms simpler and the patterns more geometric.

A recent monograph analyzed features of each vase, and then gathered them into new coherent stylistic groups. In order to review this research work, Jean-Marc Luce used our software (see Fig. 1.9) to model "how [the author], himself, classified it"[8]: "I didn't follow his analysis, [nor] all his headings. I just retained the groups."[9].

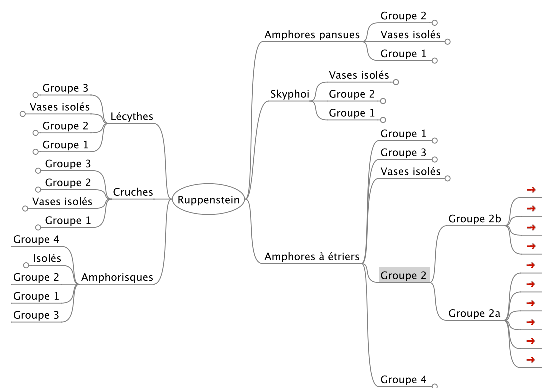

Fig. 1.9 Review of a researcher's hypotheses on stylistic groups - Porphyry export into Freemind

Then, in order to initiate Master students to research, he asked each of them to analyse the stylistic features of one type of vases (see Fig. 1.10):

> "The tool is interesting for several reasons: [...] it introduces them to ceramics study; [...] it teaches how to 'decorticate' and then recompose everything. When they do a dissertation on it they are 'driven', they are forced to do a rigorous work."[10]

Whether or not the tool really can structure the students, it seems that it is through dialoguing with their professor that they learn:

1. how to identify a feature on a vase;

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[8] "comment lui l'a classé"

[9] "Je n'ai pas suivi son analyse, toutes ses rubriques. J'ai juste mis les groupes."

[10] "L'outil est intéressant à plusieurs titres: [...] introduire à l'étude de la céramique, apprendre à tout décortiquer puis recomposer. Quand ils font leur mémoire dessus, ils sont cadrés. Ca les oblige à faire un travail rigoureux."

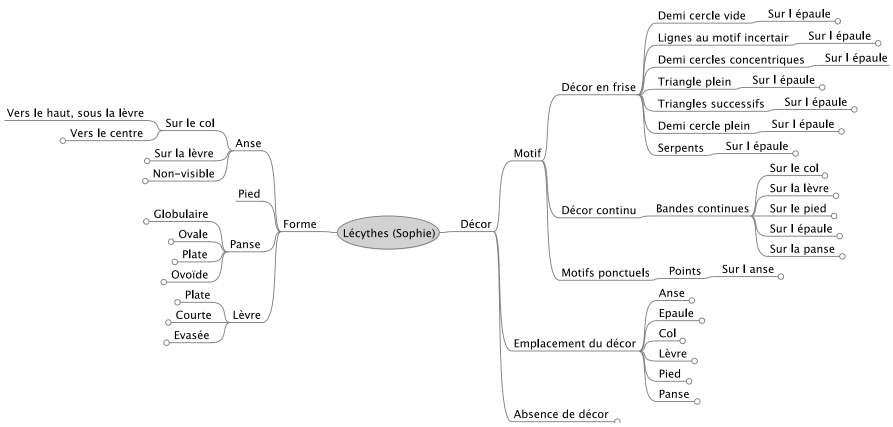

Fig. 1.10 Master student's analysis of stylistic features - Porphyry export into Freemind

Professor: "It is not a checker pattern. Zoom in."[11]

2. how to name a feature;

   Sophie: "I didn't know how to name it."
   Professor: "Generally, one says ..."[12]

3. how to build a group;

   Professor (to the observer): "That's what one learns: combining features to get groups as coherent as possible."
   Professor (to Sophie): "Your systems are fairly compatible, but not always coherent." [13]

4. how to interpret a group.

   Professor: "The patterns are varied. [They were] made by hand. It is the most ancient phase."
   Sophie: "It's indeed what it seemed to me."[14]

1.4.3 Intersubjectivity

By comparing the viewpoints expressed in the new monograph and in an older one, the professor was able to guess that one of the innovations consisted in considering

[11] "Ce n'est pas un damier. Grossissez davantage."

[12] "Je ne savais pas comment l'appeler. – En général, on dit..."

[13] "C'est ce que l'on apprend : combiner les traits pour avoir des groupes aussi cohérents que possible. – Vos systèmes sont assez compatibles mais pas toujours très cohérents."

[14] "Les motifs sont diversifiés. C'est fait à la main. C'est la phase la plus ancienne. – C'est bien ce qu'il me semblait."

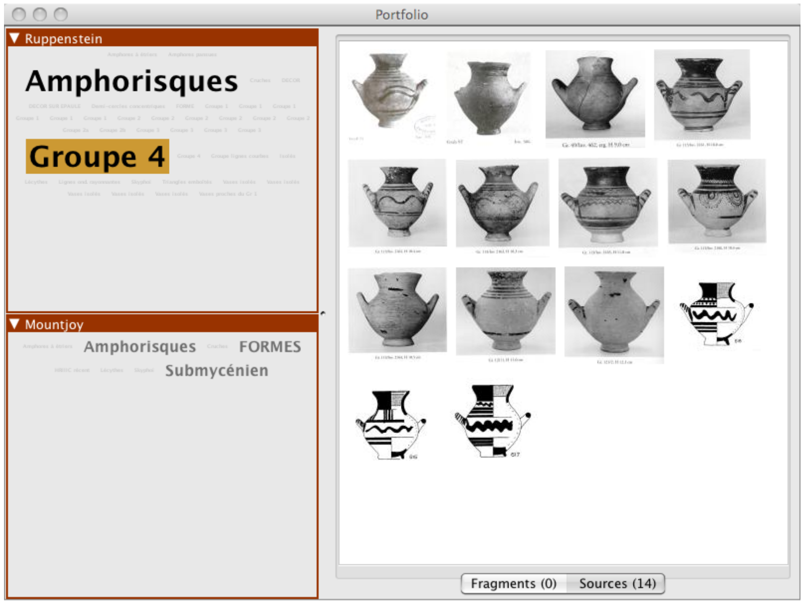

Fig. 1.11 Submycenaean or transition to the next style? - Porphyry screenshot

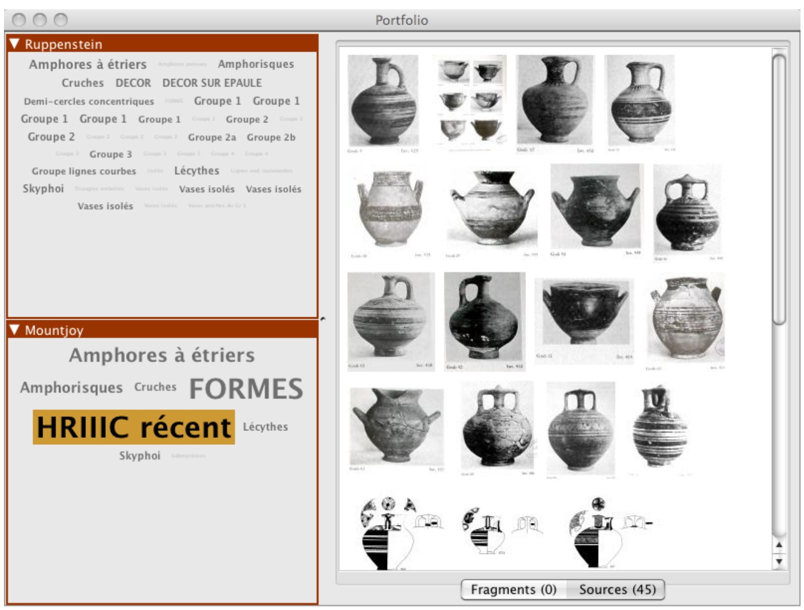

Fig. 1.12 End of mycenean or beginning of submycenean? - Porphyry screenshot

several vases (see Fig. 1.11) as belonging to a transitional phase towards a later period (‘groupe 4’) rather than being proper submycenaean. Another innovation consisted in considering vases (see Fig. 1.12), formerly tagged as from the end of the mycenean period (‘HRIIIC récent’), as now being in fact submycenean (‘groupe 1’, ‘groupe 2’).

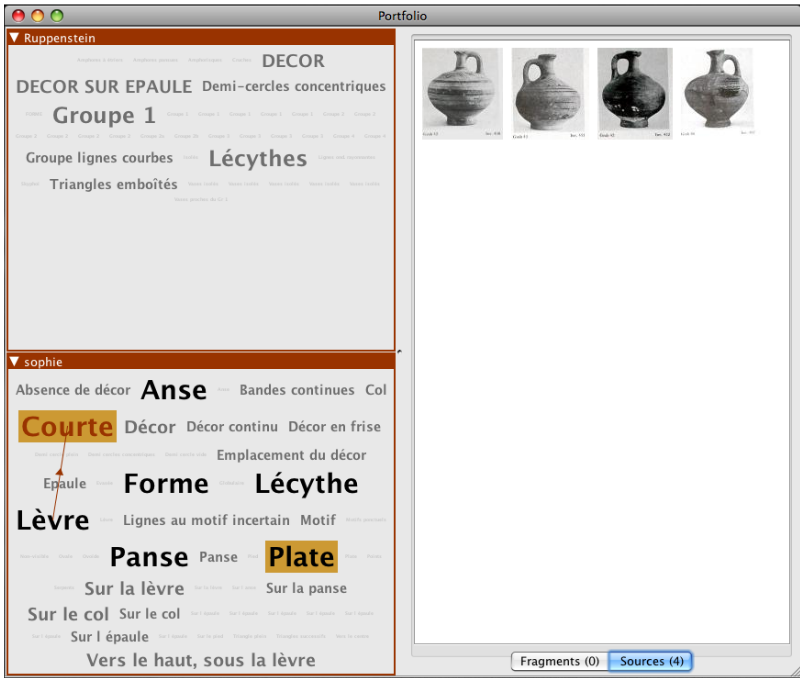

Fig. 1.13 Do your stylistic features define a group? - Porphyry screenshot

Another use of viewpoints comparison was to confront Master students’ interpretation and those of senior researchers. Even if the analysis by Sophie was incomplete and perfectible, the vases she described as having a flat paunch (‘panse plate’) and a short lip (‘lèvre courte’) appeared to be exactly what the specialist considered to be the oldest group (see Fig. 1.13). Moreover, she successfully identified features (oval paunch, flat lip, triangles or circles patterns) which were sufficient criteria to assign a vase to the more recent group. Indeed, as a Master student, comparing one’s viewpoint with those of senior researchers should not be seen just as a way to get correct answers, but as a way to take part in the sense-making process followed by specialists, a way to get involved in the ‘on-going science’.

1.5 Conclusion

This paper introduced the 'Socio-semantic Web' as as an alternative to the Semantic Web and Web 2.0. In contrast to the Semantic Web, it is not interested in formal semantics, but in semantics dependent on the human subject and on the semiotic substrate. Similarly to what Web 2.0 does for entertainment, it aims at fostering people's participation in knowledge work. In this trend, software design relies on three human and social phenomena:

- documents, because they are proofs of something else, not in the manner of a mathematical proof but more in the line of evidence to be kept and mobilized;
- interpretation, because the meaning of a document depends on its authors and readers;
- intersubjectivity, because the confrontation between conflicting interpretations allows to overcome subjectivity.

Software prototypes complying with this approach have been tested within different domains[15] (archaeology, sociology, civil society, engineering...). In this paper, we focused on two iconic sense-making activities: education and research. In the first illustration, by fostering the intersubjective description of content by students and teachers, a simple course-material sharing platform has been turned into a digital space for collaborative knowledge building. In the second illustration, researchers and Master students were able to model and compare their own hypotheses to established ones, thus enabling them to envisage scientific debates.

As illustrated by the applications, the main contribution of the Social Semantic Web would be the introduction of 'viewpoints', consciously managed by actors. This would emphasize hyper-singular knowledge, micro-communities of practice, theories comparison and competition. Whilst this trend is not free of risks, it nevertheless brings great opportunities for discovering new forms of collective intelligence on the Web. Divergent viewpoints on shared items could be indeed a trade-off between unrealistic extremes: positivism and relativism, tyranny and anarchy, dogmatic discourse and chaotic din.

[15] See our community wiki: `http://www.hypertopic.org/`

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