Semantic Social Scaffolding for Capturing and Sharing Dissertation Experience

Vania Dimitrova, Lydia Lau, and Rebecca O'Rourke

Abstract—This paper presents a novel collaborative tool—AWESOME Dissertation Environment (ADE)—which facilitates student learning through semantic social scaffolding: a new approach to dissertation writing challenges. These challenges revolve around three issues: timing of support; collective intelligence, and sense making strategies in tension with the individual and individualized experience of researching, writing and supervising dissertations; and supporting students' transition from learning "about" to learning "how to" research and write dissertations. A social technical approach was adopted to meet the challenge of effectively integrating technology development and pedagogic practice to address these issues. A semantic wiki was tailored into a social writing environment capable of providing holistic support throughout the whole dissertation process. A trial of ADE with students and tutors in Fashion Design examines user acceptance and the connection between technology and practice. Based on the design, implementation, and user trialing of the ADE, broad implications for future TEL adopting social semantic web principles and tools are drawn, highlighting issues with 1) user-centric design and development, 2) tailoring, seeding and evolution of the community environment, and 3) divergent expectations and facilitation of user participation.

Index Terms—Community learning environments, academic writing, ill-structured domains, semantic markup, semantic wikis.

1 Introduction

A prospective research direction is emerging, which aims to build innovative technology-enhanced learning (TEL) environments by leveraging the new wave of social computing platforms to enable rich community experiences and social models of learning [31]. Recent developments in social semantic web (SSW)—semantic wikis, semantic blogs, or semantic social recommender systems—are emerging in the TEL arena [2], [3], [4], [14], [29], [32], [35]. There is a strong expectation that SSW will be part of the next generation TEL; creating new opportunities for collaboration and community-based learning.

Web 2.0 and social computing applications have mushroomed in recent years and it has become fashionable to attempt to deploy them in areas beyond leisure and entertainment such as learning [1], [31]. However, the educational community is sceptical; pointing out that social computing provides busy spaces but not necessarily effective learning spaces [1], e.g., too much time may be spent searching for information, uncritical reproduction of information, the knowledge is poorly structured, tacit knowledge can be buried in large textual resources with key concepts difficult to find and articulate. These issues are targeted by recent innovations in SSW which exploit ways to embed semantics in social computing platforms.

However, with any new technological innovation, such as SSW-based TEL, there is a significant gap between "technologies" and "learning practice." It is always a challenge to ensure that sound pedagogy is integrated into new technology and that the technology can be reshaped to capture pedagogic progress. Any novel SSW-based TEL solutions need to be 1) appropriately tailored to current teaching and learning practices, 2) accepted by the user communities, and 3) prepared for embedding in cultural and organizational settings. Underpinning all of this is the commitment to *pedagogy-led technical development* which follows sound user-centric methodologies.

Therefore, there is a pressing need for interdisciplinary, user-centric studies that examine how prospective SSW platforms can be *tailored to address important educational problems and needs*. Furthermore, it is crucial to identify *prospective domains* which can demonstrate the benefits of integrating social computing and semantics for existing teaching and learning practice.

Such a study is presented in this paper. Focusing on the challenge faced by higher education institutions—how dissertation writing is learned and taught—we illustrate a socio-technological approach aimed at closing the perceived gap between technological solutions and educational practice. Following a coevolutionary "development-in-use" approach and actively engaging the relevant user communities and stakeholders, we have created a novel technical platform for **semantic social scaffolding**, called AWESOME Dissertation Environment (ADE). It aims to harness experience sharing in a learning community by combining Web 2.0 principles and tools with semantically-enhanced features.

ADE was developed in the AWESOME[1] (Academic Writing Empowered by Social Online Mediated Environments) project funded by the United Kingdom's Joint Information Systems Committee[2] under its Users and

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Digital Object Identifier no. 10.1109/TLT.2010.42.

1. http://awesome.leeds.ac.uk.
2. http://www.jisc.ac.uk.

Innovation Programme. ADE is a *semantic wiki environment* tailored for semantic social scaffolding by providing a structure and vocabulary for participants to share and build upon their learning experiences in a specific domain of interest.

Our research aimed to better support dissertation students by applying insights from academic writing development research, which argues that learning is most effective when social and scaffolded [12], [19], [20]. The front-loaded delivery of critical information and guidance and predominantly individual learning encounters between students and their tutors/supervisors that characterizes dissertation writing is supplemented by the ADE. This makes effective use of an increasingly scarce commodity—research supervision by academic staff—and captures and models peer collaborative learning as successive cohorts of students engage with the complex processes of designing, preparing, and writing a dissertation.

ADE was instantiated and trialed in undergraduate and taught postgraduate programmes in Education, Fashion Design, Philosophy and Religious Studies, and Computer Science in United Kingdom universities. We focus here on the ADE trial in the **Fashion Design (FD) domain**. It provides insights into the applicability of semantic social scaffolding to a non-IT environment and allows us to examine the acceptability of ADE by users with no experience of using social computing in their dissertation writing practice.

The paper addresses the following **research questions**:

- **Q1**: *Which learning needs of current dissertation writing practice can be addressed with social semantic web TEL?*
- **Q2:** *How can a social semantic web platform be tailored to address learning and teaching issues in current dissertation writing practice?*

The significance of our work to the next generation of TEL systems and tools is three-fold:

- First, we bring an innovative approach, utilizing digital culture to scaffold learning, to address the persistent pedagogic challenge of how best to support students through dissertation writing.
- Second, we highlight the potential of SSW technologies by showing how semantic social scaffolding can utilize the power of collective intelligence for learning through sharing dissertation experiences.
- Finally, the underlying technological and pedagogical principles have wider applicability in a generic approach to other ill-defined domains.

The next section positions our research in the relevant literature and indicates its main contributions. Section 3 outlines the coevolutionary methodology followed in the AWESOME project which enabled us to engage with users and address the research questions discussed in this paper. In Section 4, we sketch the main characteristics of current dissertation writing practice, identify key problems, and derive design requirements for a SSW-based TEL solution. The concept of semantic social scaffolding is then introduced in Section 5, where we describe how the approach was used to tailor a semantic wiki in a novel dissertation writing community environment—ADE. Section 6 presents the findings from a user trial in Fashion Design. Section 7 discusses the findings and outlines broader implications for the next generation community-driven SSW-based learning environments.

2 Relevant Work

Innovations in technologies can empower, or hinder, learning, and teaching practices. User-centric methods for design and evaluation can provide a basis for a complex systems design of effective TEL ready for embedding in practice [8], [10], [28]. Iterative design and continuous user engagement are central to the success of large, multidisciplinary projects that create innovative means for collaboration and community learning, e.g., coevolutionary design of collaborative tools for knowledge maturing [32] and participatory design for creating technologies to support learning in communities of practice [7]. The work presented here contributes to the application of user-centric methodologies to the design of innovative SSW-based TEL for collaboration and community-based learning. Our novel contributions are 1) analysis of the role of semantics in shaping original pedagogy-led technologies to empower community learning and 2) trialing a SSW-based solution in a non-IT domain where social computing and semantics are new to practice.

Recent developments in the social semantic web are investigating the decentralized processes of collective intelligence, community-driven knowledge creation, and emergent semantics.[3] Semantic wikis, which combine both the flexibility of wiki-like dynamic content creation and the power of semantically-enriched content annotation and search, increasingly play an important role [27]. Semantic wikis are entering the educational arena and offer promising solutions for collaborative knowledge construction and learning in communities [13], [18], [32]. This paper contributes to research in SSW-based TEL by 1) exploring a new domain—dissertation writing—where semantic wikis can empower learning, 2) illustrating how to tailor a wiki to enable a novel pedagogy-led approach—semantic social scaffolding, and 3) drawing implications for the deployment of semantic wikis, and SSW in general, in learning and teaching practice.

Dissertation writing is an example of developing soft skills, which are fundamental in today's educational and societal climate, and receive increasing attention in TEL for ill-defined domains [21], [23]. Such domains are more challenging to support due to the lack of formal structure and the high complexity of tasks. Collaboration and peer support is a promising method to provide effective learning spaces for ill-defined domains [21]. The novel semantic social scaffolding approach presented here contributes to TEL for collaboration and community learning in ill-defined domains. The approach has been driven by, and tailored to, the needs of dissertation writing practice but can be applied in other domains, e.g., developing research skills or workplace learning, where capturing and sharing community experiences can empower the understanding of existing practices.

TEL solutions for writing development focus mainly on discrete aspects of the dissertation process, for example

3. http://socialsemanticweb.net.

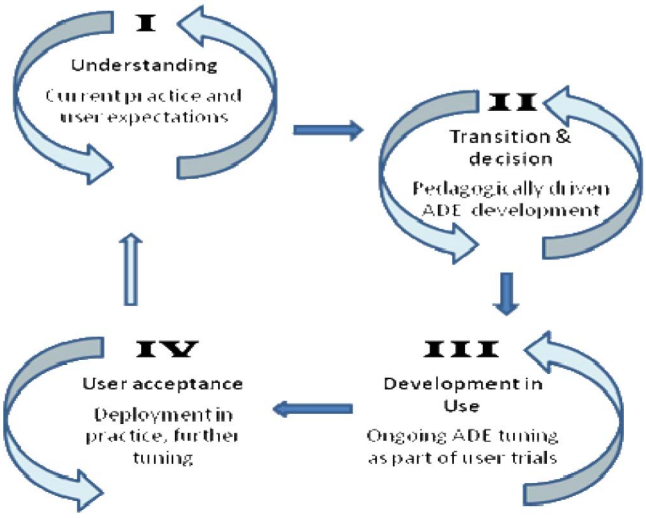


Fig. 1. AWESOME coevolutionary iterative methodology follows [8].

argumentation or research methods [22], [24], [33]. In contrast, we show that social computing can be exploited to provide the necessary holistic support throughout the whole dissertation process.

3 Socio-Technical Approach

AWESOME was an interdisciplinary project involving computer scientists, educationalist, staff developers, and academic writing experts across three United Kingdom universities.[4] The main goal was to develop technology that *put learning and learners first* and made a significant, *practical difference to dissertation students and their supervisors*.

The **methodology** followed in AWESOME had three distinct characteristics: 1) *user engagement* was a priority, both in the initial needs analysis and throughout the design and development stages, 2) *iterative and agile approaches* were adopted to develop genuine dialog with users and to respond flexibly to issues as the project developed, and 3) *pedagogy-led* technology design and development was adopted, with an emphasis on pedagogic underpinning and commitment to *technology in use*.

AWESOME adapted the stages of Fowler and Scott's Users and Innovation Development Model [8] (see Fig. 1).

Stage I was achieved by assembling a multidisciplinary team including experts in academic writing, education, and computing. A workshop was conducted to discuss the issues with a wide range of potential users, which identified a number of *champions* willing to contribute to the design and user trials in the next stages. An initial *understanding of the characteristics of current practice* was gained (see Section 4.1) to define the project scope.

In **Stage II**, a series of interviews with students and tutors was conducted to gain a deeper understanding of the key problems, and to identify which of them could be addressed with social computing (see Section 4.2). This led to the design of an *initial pedagogical model* of social scaffolding which was illustrated with a *proof of concept prototype* (see Section 5). Educationalists were involved in the creation of core *ontology for dissertation writing*, which mapped the main processes and provided the backbone for semantic social scaffolding (see Section 5.3). A decision was made to use Semantic MediaWiki[5] as the core platform. The prototype was well received by stakeholders, which led to successive tailoring of the ADE prototype into *instances* for different user communities.

In **Stage III,** two instances at the Leeds—for Education and Fashion Design—were *customized while being piloted and trialed with users*. The main activities involved interviewing selected tutors and students and collecting authentic samples to *seed* the instances. During this stage, the role of semantics to facilitate the social scaffolding became prominent and the concept of *semantic social scaffolding* (see Section 5) was shaped. Lessons learned were fed into further instances for the user communities at Coventry and Bangor universities.

During **Stage IV**, feedback was collected and analyzed from the user trials (part of which is given in Section 6) and from a meeting with partners and stakeholders. Two independent developments were pursued resulting from the feedback. First, we focused on *improving the usability* by simplifying the use of semantics. The new version was trialed with the United Kingdom Higher Education Academy Subject Center in Philosophy and Religious Studies. At the same time, we aimed to improve the benefits for students by *extending the pedagogical framework in the community space to the personal spaces* for each user. This resulted in developing personal bookmarking in ADE, which was used in an instance shaped for the School of Computing at the University of Leeds.

It is important to stress that a thread that flowed throughout was the essential **linking of pedagogical and technological development** (i.e., stages III and IV). While the developers were seeking input from the users, we found that the users were also stimulated by the ADE demonstrator into exploring new ways of using the ADE for helping dissertation students. This coevolutionary approach echoed the end-user development and meta design as foundations for *cultures of participation* [9].

4 Dissertation Writing Practice and Social Computing

In order to build innovative TEL solutions that effectively support the practice and culture in a given community, it is necessary to understand the current practice: What the key problems are and which of these problems the target technology (in our case, semantic social web) can address. This was done during the first two stages of the AWESOME methodology, and is summarized below. The issues were identified by the communities AWESOME worked with, but many of them apply across higher education institutions not only in the United Kingdom but also in other countries.

4.1 Characteristics of the Current Practice

Through discussions with users and academic writing experts, and a review of relevant literature, we identified generic characteristics of the current dissertation writing practice.

4. AWESOME involved the Departments of Education, Computing, and Staff Development at the University of Leeds, the Center for Academic Writing at Coventry University, and the Department of Education and Lifelong Learning at the Bangor University.

5. http://semantic-mediawiki.org.

4.1.1 Individualistic Process

Irrespective of discipline (engineering, computing, and education) and level (undergraduate, masters, and doctoral), the expectation is that dissertation writing is an *independent piece of work* conducted by an individual with *some guidance from a supervisor*. In the communities we considered, joint student work was not promoted, i.e., collective experience was not part of the current dissertation practice. However, studies show the benefits of "multi-voiced" writers groups where students can support each other and work in collaboration [11]. However, this was not adopted in our target dissertation practice.

4.1.2 Complex Skills Set

Dissertation writing is characterized by the acquisition and deployment of a complex skill set including: 1) to research, acquire, and apply *subject-specific knowledge and disciplinary-specific practices* in methodologies/evaluation on a dissertation topic of their own choosing and 2) to develop and demonstrate *research skills*, such as critical analysis, critical reading, extended writing, and project management, which provides a foundation for a wide range of professional practices. Student starting points for this broad range of skills were highly varied, as was tutor experiences in helping students acquire these skills.

4.1.3 Loosely-Structured Process

Contrary to the common view in the dissertation support literature, (which considers the dissertation as a series of linear steps organized around over generalized rules) our analysis showed that dissertation writing was a *nonlinear process.* Students would usually go through the main dissertation steps in *several iterations*, in a seemingly *disconnected*, sometimes even chaotic, manner.

4.1.4 Institutional Support

Students are supported in their dissertation writing by a *range of institutional activities* providing knowledge through resources in specific intranets, classes, and/or text books, and supplemented with a tutor (supervisor) who passes on his/her tacit knowledge to students in one-to-one or small group meetings.

4.1.5 Informal Social Support

Students working on dissertations draw on a *pool of informal support*, often unacknowledged in the supervisory relationship and forms of institutional support. This can include family members and friends who have completed dissertations, peer support, examples and recommendations by chance encounters with other tutors. This information is passed on and received without checking its validity. Any misrepresentations which occur in these social exchanges are difficult to detect and correct and can have a negative impact on performance. It is, therefore, desirable to *channel this communication of experiences through explicit social processes*, so that their influence becomes visible and open to monitoring and debate.

In summary, it became clear that the current practice *focused on individual experiences, did not exploit social exchanges, and did not build on informal social interactions.* Hence, we felt that there was an opportunity for social computing technologies to create socially-driven learning spaces to foster and channel informal social support. Our hypothesis was that *social computing would have a complementary role to current practice*. To examine this hypothesis and to get a better idea of what, if any, role social computing could play in dissertation writing, we designed and developed a technological solution tailored to key problems in the current practice; and trialed this solution in representative domains.

4.2 Key Problems and Design Implications

This section presents the requirements analysis which looked at the key problems in current practice, as identified in our user needs survey, and derived design implications for the AWESOME Dissertation Environment.

4.2.1 Knowing "About" but Not Knowing "How"

Existing dissertation support was adequate to inform students about the principles of dissertation production, less good on introducing information about writing processes and exemplars of best practice, and weak in supporting student transition from *knowing about dissertations* to *knowing how to apply* this knowledge in practice. Traditional support follows the widely available "*how to*" guides which simplify the process of dissertation writing to a series of linear steps [15]. This is in sharp contrast with the nonlinearity of the students' dissertation journey in practice. As a result, students find it hard to relate "how to" guidance to their specific problems.

Design implications. *This can be addressed by an open wiki-like environment, which provides a broader content structure with details evolving over time. It should provide a flexible way of linking dynamic content to the broad structure (e.g., using an ontology as an anchor), and channeling the connection between dissertation guidelines and practical examples (e.g., enabling collective annotation of examples). It should also facilitate the discovery of content "on the fly" to help students map their specific experience to the generic steps and rules (e.g., enabling dynamic mashup of relevant content).*

4.2.2 Tutors Unaware of Student Problems

A common issue raised by both students and tutors was the time spent on individual supervision—perceived by students as "*never enough*" and by staff as cumulatively "*almost too much.*" It can be seen as time "wasted" going through the same issues time and again and answering similar questions for each student. Furthermore, the supervisory relationship reproduces that of an *expert-novice relationship*, where expertise in supervision and subject knowledge may often be less closely aligned with the students' topic, and where the number of students requiring supervision undermines the formation of all but functional relationships with their supervisor. This creates the situation of *supervisors not knowing what their students do not know*, especially if students lack the insight or confidence to ask for help in supervision sessions. This results in a structural mismatch between the process of giving information and getting support.

Design implications. *This can be addressed by providing a social environment to integrate peer and tutor support by channeling informal social exchanges, such as sharing of ideas, experiences, questions, and answers. There should be a flexible*

way to pull together current issues (e.g., by dynamically adding semantic markup to social exchange instances and using this markup to group issues), as well as to make such issues visible (e.g., by providing dynamically assembled overviews), hence improving awareness of issues among both tutors and students.

4.2.3 Students' Unfamiliarity with the Dissertation Genre

The dissertation as a genre—its *process, vocabulary, purpose, and staging*—is unfamiliar to many students [30]. They may not have acquired a deep enough understanding of the vocabulary and concepts commonly used by academics (e.g., be critical in the analysis, identify and address the audience appropriately; distinguish between method and methodology and so forth). This can be mapped to one of several models of cognitive development used in educational studies that show students operating with surface, rather than depth, understanding of knowledge, and process [25]. This results in students' inability to fully comprehend and follow the feedback they receive [20], [30].

Design implications. *This can be addressed with a social platform that facilitates learning-by-examples. Students should be provided with the means to ask for clarifications. Tutors can clarify expectations by sharing examples linked to dissertation discourse (e.g., by adding semantic markup). There should be an easy way to find examples and to see how they are connected to dissertation processes and vocabulary (e.g., using semantics to dynamically group examples).*

4.2.4 Inappropriate Timing of the Feedback to Students

Much of the information and guidance given to students is *front-loaded*—delivered prior to, or at the start of their dissertation studies—and needs *just-in-time reinforcement* throughout the process of completing the dissertation. Research is a form of practice—its skills are only fully comprehended in use and it is not until students begin to collect or analyze data, or carry out literature reviews, that they realize the limits of their comprehension of the task they are engaging in [34]. Students struggle to decontextualize feedback and translate it into actionable tasks in the dissertation process. From the tutors' standpoint, they reported finding it an attractive proposition to be able to reuse some of the advice given to different students, and the students welcomed more support outside the supervision sessions to make sense of the written information when they needed it.

Design implications. *This can be addressed by developing a growing body of knowledge aligned with the students' progress through the dissertation journey. It can be done by enabling evolving content (e.g., in a wiki- or blog-like style) and providing an appropriate anchor (e.g., in the form of ontology) to which new content can be linked. The anchor itself needs capability to grow, enabling new issues to be added (e.g., an evolving ontology). It should be possible to link content to demand (e.g., semantics can connect content to issues raised by students). There should be a way to synchronize the information available in a community space with the needs of individual students as they progress through their dissertations (e.g., maintaining a personal space linked to the community space).*

4.2.5 Affective Aspects

A significant finding in the user needs survey, was the degree of anxiety and loneliness which students reported as characteristic of their dissertation journey. This had a negative impact on their learning and manifested itself as lack of confidence, lack of understanding of key concepts, lack of awareness of expectation, and procrastination.

Design Implications. *This can be addressed by incorporating some Facebook-like features: Enabling students to share their moods and feelings about their dissertations (e.g., in their personal space) and dynamically assembling an overview with the feelings and problems in the community.*

The above design implications informed the creation of a new pedagogy-led approach that integrated collective intelligence in dissertation writing, as presented next.

5 ADE: Semantic Social Scaffolding

The requirements analysis justified the need for a collective environment to channel social exchanges at the appropriate time and scope in alignment with the students' progress through the dissertation. This is in line with insights from academic writing research suggesting that the most effective approaches to writing development are both social and scaffolded [11], [12]. This section presents a new approach to community-based learning that follows the design implications and was implemented by tailoring/extending an existing platform.

5.1 Scaffolding as a Pedagogical Practice

The concept of scaffolding in pedagogical practice is credited to Jerome Bruner and first emerged in a collaborative paper with David Wood [36]. It describes language acquisition through the informal learning between a mother and child. It was adopted within learning theory to explain staged and structured activities which assist novices—child or adult—to achieve something which they could not successfully complete unassisted. Both the concept and its practices have been refined over time, informing the critique of academic writing conventions as a "practice of mystery" [20] associated with the developing field of academic literacy. This has been highly influential in establishing the infrastructure of learning development and study skills support which are now ubiquitous. Scaffolding has also been a key concept for the emerging field of learning technology, and forms the basis of a comprehensive critical review by Roy Pea (2004). He stresses the social dimensions of learning scaffolds defining them as "*functions of processes that relate people to performance in activity systems over time.*" This suggests a dynamic rather than static system, in which the *collective intelligence* of those processes and performance are captured and made available for use and reuse. In developing the ADE we fore-grounded this social dimension of processes which scaffold learning.

5.2 Adding "Social" and "Semantic"

Students can enrich their learning of writing by *sharing ideas and experiences* and by *communicating their thoughts with others* on the various dissertation issues and problems encountered [19]. These *social exchanges* (e.g., sharing of examples, comments, questions, answers, and so forth) can

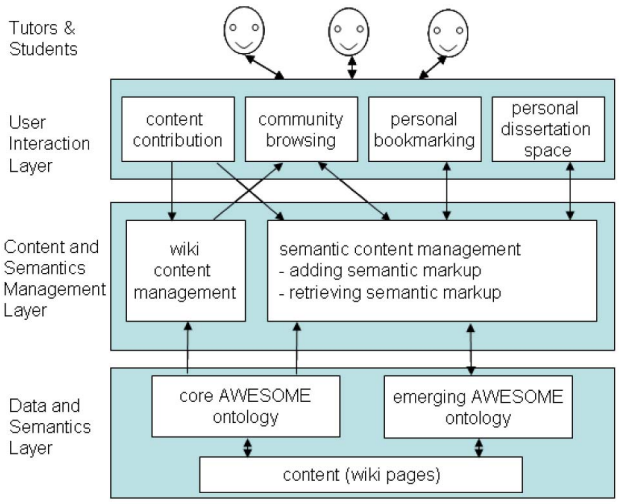


Fig. 2. The ADE architecture.

deepen the students' understanding of both the process and the research topic. This helps them connect and develop ideas, skills, and knowledge. A social computing environment captures complex and multiple authentic dimensions of planning, researching, and writing a dissertation. Simultaneously, the tenets of collective intelligence and active user engagement in creating and sharing content encourage social networking and peer support.

The key role of effective technological solutions is to put a structure, or "scaffold" [5], for channeling and focusing the social dimensions of learning. We propose a **semantic social scaffolding** approach, which *exploits semantics to channel and focus social exchanges among students and tutors*. A technological solution to this learning need performs a valuable social repository function. The key innovation is its *dynamic content* and the way in which its structure is based on an *ontology* which maps the complex process of designing, researching, and writing a dissertation. The semantic social scaffolding approach creates the potential for a deeper, active learning experience.

5.3 Implementation

ADE[6] extends a Semantic MediaWiki [17] to enable semantic social scaffolding in a dissertation writing community. ADE consists of three layers (Fig. 2): A *data and semantics layer* (which stores raw data—wiki pages—about dissertation experience and adds meaning by connecting content to ontological constructs), a *content and semantics management layer* (which deals with the adding and retrieval of semantic markup), and a *user interaction layer* (which implements the semantic social scaffolding interface). We present below the main ADE features that implement the semantic social scaffolding approach.

5.3.1 AWESOME Ontology

The ADE design is underpinned by an ontology developed together by academic writing experts and knowledge engineers and refined after user studies with ADE. The main purpose of the AWESOME ontology is to define the social scaffolding for dissertation writing in order to channel the social exchanges in ADE.

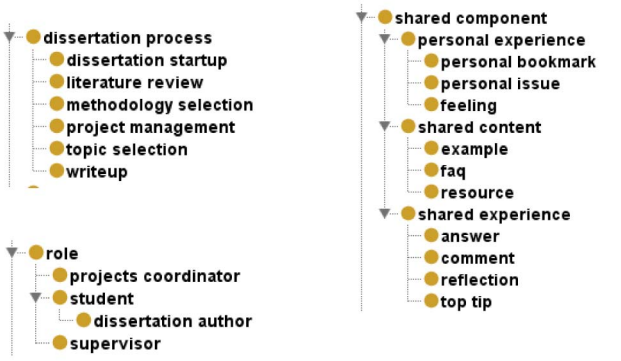


Fig. 3. Key ontology categories embedded in the ADE interface.

Fig. 4. The main menu from the ADE Fashion Design instance. The main block of links on the left corresponds to the subcategories of DISSERTATION PROCESS (e.g., "How to write clearly" relates to the category WRITEUP).

The AWESOME ontology includes classes (i.e., **categories** and **subcategories,** organized hierarchically) and characteristics (i.e., **properties).**[7] We present key examples from the Fashion Design instance to illustrate how the ontology underpins user interaction with the ADE.

Three key categories are presented in Fig. 3. Category DISSERTATION PROCESS consists of subcategories which define the key dissertation steps and are implemented as **main menu options** in ADE (Fig. 4).

Category SHARED COMPONENT, which is the backbone for **social scaffolding**, includes subcategories SHARED CONTENT (EXAMPLES, RESOURCES, FAQs), SHARED EXPERIENCE (COMMENTS, REFLECTIONS, ANSWERS, TOP TIPS), and PERSONAL EXPERIENCE (FEELINGS, ISSUSES, BOOKMARKS). In the ADE **community space**, users can contribute wiki pages with instances of SHARED CONTENT **(**examples, resources, or questions). Each wiki page is automatically associated with the corresponding dissertation process subcategory at the point of contribution. This is illustrated in Fig. 5 with a wiki page contributed in the area of "How to write clearly" from the main menu shown in Fig. 4. This page becomes an instance of an EXAMPLE for the category WRITEUP. Shared content is augmented with connections to shared experience by using

6. ADE can be accessed from http://awesome.leeds.ac.uk. Only one instance is public allowing browsing of the community content; public access to the other instances is disabled for data protection.

7. Categories, subcategories, and properties are part of the Semantic MediaWiki terminology.

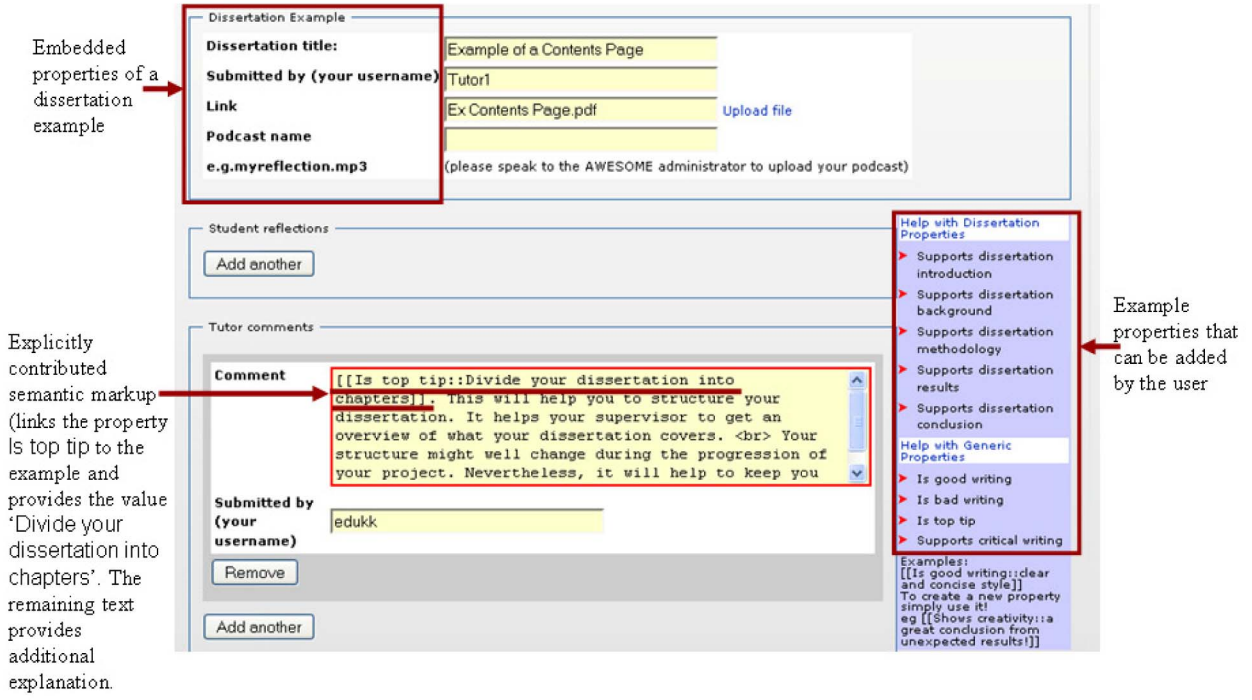


Fig. 5. Example semantic form for entering an example and adding semantic markup. This wiki page is linked to the category WRITEUP and annotated with properties (embedded or user defined). A similar form is used for contributing a resource or asking a question.

corresponding properties. For instance, every EXAMPLE includes the properties as comment to attach relevant user COMMENTS, or is top tip to indicate relevant user TOP TIPS (Fig. 5 illustrates properties associated with a dissertation example). Additional properties, such as has author, has title, has link, are included to add a brief description of shared content and experience.

The subcategory PERSONAL EXPERIENCE (Fig. 3) is used to structure the **user personal spaces**, where users can add instances of their feelings (messages on one's mood), share any personal issues (comments associated with one's dissertations), and collect personal bookmarks (links to wiki pages with shared content from the community space).

Category ROLE includes STUDENT, SUPERVISOR, and PROJECT COORDINATOR (Fig. 3). Roles are used to manage access, e.g., supervisors and project coordinator can edit every contribution, while students can make changes only to their own contributions.

5.3.2 Role of Core and Emerging Ontologies

The AWESOME ontology includes two parts:

- **Core Ontology** comprising *predefined categories and properties*. It underpins the ADE interface, and is used for adding/retrieval of content or semantic markup in the semantic content management layer (see below).
- **Emerging Ontology** comprising user-contributed *instances of categories*, user-defined *new categories and properties*, and *triples* with properties defining binary relationships between a semantic entity (a wiki page or a category) and another data entity or value.

It needs to be pointed out that the separation of core and emerging ontologies exists only at the conceptual level as Semantic MediaWiki links content to one ontology ("special pages" in Semantic MediaWiki can be used to browse the implemented ontology). However, the distinction between the core and the emerging ontology enables us to make the generic semantic social scaffolding aspects more explicit in the core part, allowing the evolving understanding or disciplinary-specific dissertation writing aspects to be captured in the emerging part.

This distinction is a result of the need for ADE to be tailored for different user studies. It became apparent that the creation of a new ADE instance requires adaptation to a particular domain and its dissertation practices. Examining the ontology, we identified parts that could be preserved (from both the user interaction and the semantic content management layers of an ADE instance) and others that would need changing. Consequently, generic (core) ontology for semantic social scaffolding was derived and encoded in OWL.[8] It is available from the AWESOME website[9] and can be used as a basis for instantiating ADE in different domains (e.g., we used it to create a Computing instance).

After ADE is instantiated, the user contributions expand the ontology with category instances (links to wiki pages) and triples connecting semantic objects (categories or instances) to values by using properties. This expanded ontology is what we call an emerging ontology; it is specific to each instance of the ADE and grows with the use of the environment. Differences between ADE instances relate to discipline-specific discourse and epistemology [34]. They are articulated as differences in the sets of properties associated with core categories, diverse values linked to specific content via properties, and different instances of shared components (e.g., user contributed examples).

8. http://www.w3.org/TR/owl-ref.
9. http://awesome.leeds.ac.uk/demos.php.

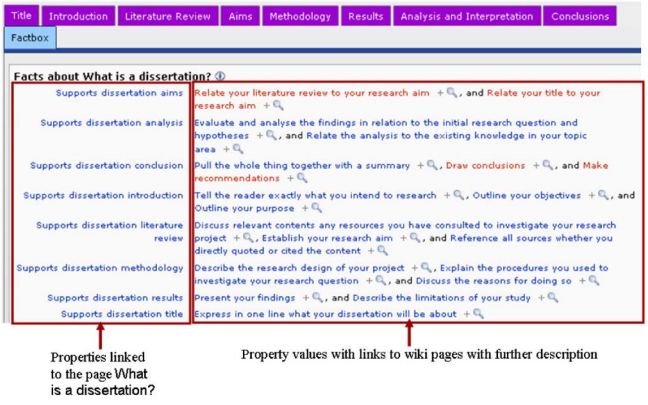
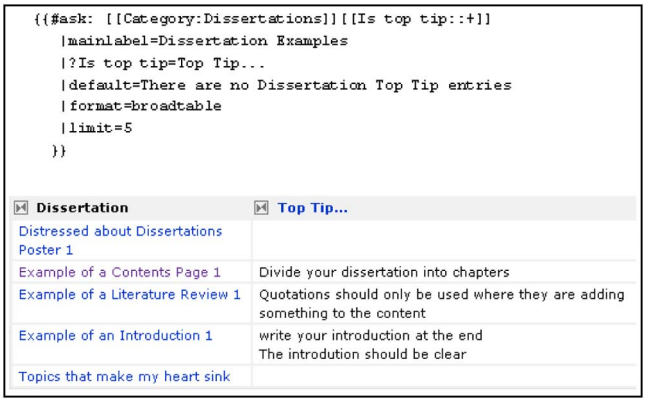


Fig. 6. Example factbox summarizing the markup for the page "What is a dissertation?" The buttons correspond to the embedded properties associated with the category dissertation.



```
{{#ask: [[Category:Dissertations]][[Is top tip::+]]
   |mainlabel=Dissertation Examples
   |?Is top tip=Top Tip...
   |default=There are no Dissertation Top Tip entries
   |format=broadtable
   |limit=5
  }}
```

Dissertation	Top Tip...
Distressed about Dissertations Poster 1	
Example of a Contents Page 1	Divide your dissertation into chapters
Example of a Literature Review 1	Quotations should only be used where they are adding something to the content
Example of an Introduction 1	write your introduction at the end The introdution should be clear
Topics that make my heart sink	

Fig. 7. Example table generated with a semantic query collecting all dissertation examples where user comments make explicit links to dissertation tips using the "Is top tip" property. Similar tables are generated assembling questions related to specific categories (e.g., questions related to choosing a topic).

5.3.3 Adding Semantic Markup

Semantic forms are provided for users to add properties to wiki pages with instances of semantic content, which facilitates the *adding of semantic markup*. Fig. 5 illustrates the semantic form used for adding an instance of an example and the semantic markup (properties and values) associated with this instance. Embedded properties are encoded as fields in the form (e.g., `has title` or `has link`) or can be added using the notation [[`property::value`]] (e.g., [[`is top tip::Divide your dissertation into chapters, see Fig. 5`]]). The same wiki notation can also be used to add new properties and values.

Using semantic forms or direct semantic annotation, users can add semantic markup in the form of [[`property::value`]] which adds a triple <`content, property, value`> to the emerging ontology (`content` is the wiki page and `value` usually corresponds to some important part or characteristics related to the content in that page). This provides a means for users to articulate their thoughts about a particular piece of content and to add semantic tags for sharing with other users.

5.3.4 Retrieving Semantic Markup

While the basic organization of the content is by wiki pages, use of semantic features enables more guidance for contribution and better organization of related content. **Semantic queries** are used to mine the semantic markup and generate *summarizes* which enable "mashing" content into a wiki page. Semantic MediaWiki embeds queries to generate **factbox** summarizes of the properties and values assigned to wiki pages (Fig. 6).

Using semantic queries, new tables can be derived that pull together content related to selected categories and properties. The table in Fig. 7 appears on the ADE home page and is generated using the query.

Tables for scaffolding are generated dynamically and change as content evolves. This provides a structured overview of shared components and summarizes the values added with the semantic markup.

Adding and retrieving semantic markup enables capturing and organizing the multiple-perspective of same piece of content. Furthermore, associating text tags (values) to semantics (categories and properties) provides explanatory and metacognitive levels to the associated "tags" which promotes deeper learning.

6 User Trial in Fashion Design

ADE was trialed with several user communities (Section 3). Here, we discuss the findings of the trial with Fashion Design undergraduate students and tutors, which spanned stage III and stage IV of the AWESOME methodology (Fig. 1). FD constituted the longest running trial within the project. This allowed us to observe and evaluate a more natural use of the ADE and had the added advantage of enabling us to work with a disciplinary group where neither learning technology nor social scaffolding were elements of their existing dissertation writing practice.

6.1 Experimental Design

6.1.1 Purpose

There were two related purposes 1) to explore the scope for the initial technical solution and identify further improvements and 2) to examine how ADE related to current dissertation writing practice.

6.1.2 Users

The trial involved four tutors and 29 FD undergraduate students split into two groups:

- *Group 1*: Ten full-time undergraduate students who had just finished their year out in industry; three tutors—dissertation supervisors and the course coordinator. The trial spanned the students' entire dissertation period
- *Group 2*: 19 full-time second year undergraduates and their tutor who were introduced to the ADE during a research methods module preparing them for their final year dissertation.

Student participation was voluntary and did not bring any course credits. The students were anxious about their dissertations and motivated to seek as much support as possible during their completion. The majority of students regularly used social networking tools such as Facebook

and Twitter. While the students used Wikipedia, they had not contributed to wikis themselves. They made extensive use of websites and services provided by the university, and used presentation and word-processing software.

The tutors had used popular social systems in their personal lives (e.g., blogs, forums, Facebook). They did not use social software in their teaching, and used mainly face to face supervision.

6.1.3 Procedure

ADE was used as an addition to the traditional face-to-face dissertation help provided. An ecological experimental approach was followed to analyze how the new technology and current practice could interact and coevolve. Both the current dissertation practice and the exploratory nature of social software were deliberately preserved. No specific instructions on how to use ADE were given beyond an initial introduction to the environment. Standard dissertation support was provided to all students (those from the trial and those who chose not to take part). This enabled us to get unbiased views about user acceptance and connection between technology and practice. To get a deeper insight into how the ADE could be embedded in practice we used action research: two researchers from the AWESOME team were involved in the FD trial—one as a tutor on the research methods module and the other as a community moderator assisting with the ADE use.

6.1.4 Usage

Group 1 students started using ADE when it went live in July. Traceable contributions were made by six students mainly in mid August. One student also contributed in July and September, the summer vacation period, and was significantly more active than the others. Student contributions were mainly on the user personal pages or to ask questions. The moderator and tutors added examples and comments, and contributed answers to questions. The students logged on several times and used ADE to gather information and as a repository. From October, students relied more on their frequent tutorials with their tutors than with the ADE but they nevertheless reported using it as a backup while writing or when they got stuck.

6.1.5 Data

Throughout the trial, we collected qualitative data comprising:

1. ADE content (examples, comments, questions, answers, and students' moods indicated in the user personal spaces),
2. the emergent ontology,
3. individual student interviews, and
4. a focus group with tutors.

The data analysis was done by the two researchers who took part in the FD trial, and who were not part of the technical development team. The qualitative data was transcribed and analyzed using grounded theory. The emerging themes are presented below.

6.2 Social Scaffolding Activities

Both students and tutors considered the collective nature of the environment appealing. Our analysis identified several aspects associated with social scaffolding.

6.2.1 Student Questions

Students said it was *more likely that they would ask a question than add an example*. The issue of personalization and anonymity emerged when discussing the FAQ section. This function had been successful partly due to its overt anonymity. It became clear that had students had to identify themselves they would not have been willing to ask what several of them referred to as "stupid" questions. In fact, none of the questions *were* stupid, but they were the kind of questions which students (and perhaps some tutors) might have felt they should already know because they had received the information already. This provided a solution to the finding concerning the *significance of when and where students receive information* [34].

6.2.2 Student Experience Sharing

The most active student shared her experience:

> "Just thought I'd let you all know in case it helps. Let me know if anyone else has any ideas!"

Her reason for doing so, as reported later in the interview, was to encourage other students to share their experience and give each other advice. The same student also praised the way she felt supported when someone (the moderator) had replied to her question on methodology by recommending a book. However, the student gave up:

> "I won't bother with that any more."

since the other students did not engage in experience sharing or comment on her experience.

6.2.3 Student Reluctance to Contribute Examples

Students reported several reasons for their reluctance to add to or comment on the ADE dissertation examples *time constraints*, *fear that other students might copy ideas*, *not wanting to unintentionally mislead peers*. This last point emphasizes the tutor focus of these students. The interviews revealed that they would *expect the tutor to add examples*. Texts that were clearly contributed by tutors carried authority:

> "I think, it would be better with the supervisors on it as well because it's all very well students like recommending things that they've looked at but I'd feel happier if it came from a tutor because you trust what they say."

This raises the issue of *trust* and *authority*—commonly associated with social computing environments.

6.2.4 Importance of Seeding

All students agreed that seeing contributions from peers was useful to get ideas or just see that others were struggling:

> "reading other people's work makes it more real."

There was a willingness from tutors to provide genuine and annotated examples which could be used to familiarize students with the dissertation genre. Due to the open nature of the trial, the seeding was done without any specific support or guidance. It became clear that the seeding process should have been done systematically, as it will be critical to the successful deployment of ADE in practice.

6.2.5 Divergent Expectations

The complexity of user engagement on the part of students, as well as tutors and the diverging expectations of these

groups became apparent. *Students relied on tutor authority*, whereas, *tutors saw the environment as primarily an area for independent student collaboration*. This underlines the main characteristics of current practice where the expectation is that institutional, authoritative, support is provided. It also became apparent that the influence of previous online experience seemed to shape use, as the majority of users viewed it as repository which they could refer to when they had problems. On the other hand, the Facebook-like *personal space* was the main way students shared experiences. They used this space to say how they felt about their dissertations. This suggests ADE could better exploit social aspects of the personal space to facilitate community engagement.

6.3 Role of Semantics

The data analysis indicated some benefits and challenges of using semantics in ADE.

6.3.1 Content Structuring and Chunking

The overall feedback was very positive on content and layout. Students remarked positively on the access to information provided in *manageable chunks* (e.g., by providing buttons which were connected to semantic properties) and *accessible when needed* (which was done using semantic queries, as shown in Figs. 6 and 7). The students appreciated the added comments on examples (this was done using semantic markup). They preferred the ADE approach of offering smaller, more manageable chunks of information at strategic points rather than the comprehensive guides and handbooks they currently receive. The *examples of literature reviews* were especially applauded as demonstrating different ways of writing this part of a dissertation. Students found this helpful in finding an approach that suited them individually. Students expressed confidence in the examples and key information having assumed these were approved of by tutors.

6.3.2 Articulating Student Problems

Tutors saw advantages in using the ADE diagnostically:

> "You could get a sense of which student is still stuck on choosing a topic and which are moving on to the literature review and which are moving on to writing."

The semantic markup enabled identification of the dissertation categories with which most questions were associated. This was mapped to the AWESOME Culture content (pulled from the students' mood expressed in the personal space), which enabled us to identify the most difficult part of the dissertation process to be the *start of the project* (defining topic) and the *start of writing* (literature review). These topics were confirmed in the interviews with the students. ADE appeared to have the capacity to ease these transitions, providing a way in and reducing the shock experienced by students when initially faced with what often seems an overwhelming task.

6.3.3 Adding Semantic Markup

Both the students and tutors made contributions using semantic forms—to ask questions (the students) or to add answers, contribute examples, and add comments (the tutors). The semantic forms had embedded properties (see Fig. 5) and automatically attached some semantic markup. Explicit semantic annotations, in terms of user-added properties and values, were made by the moderator.

6.3.4 Navigation Problems

Almost all users commented that they found it difficult, especially initially, to navigate and to understand exactly what was going on. Students reported feeling overwhelmed when first logging on. However, this problem disappeared once students had a clearer idea about both their topic and the dissertation process. This was due to

1. having too many possibilities for discovering content (e.g., through wiki pages, semantic forms, semantic tables, and factboxes),
2. overlooked usability aspects (e.g., lack of consistency and poor visibility of system status),
3. lack of training materials, and
4. existence of semantic links pointing to empty pages (e.g., some property value links, as those shown in Fig. 6). All students agreed that there should be an introduction to the site either as booklet or through online visual means. Visual tutorials were prepared during the trial to introduce ADE.

6.4 Affective Aspects

The affective aspects proved to be of special importance to students, especially during the summer when face-to-face meetings with peers and tutors were limited. The ADE recorded students' state of mind at the beginning of the dissertation project and most added to the *feeling* option on their user page in August ranging from "nervous" to "stressed." The most positive was "Nervous—yet surprisingly excited!" Students reported that having access to the examples had helped them to see what was expected of them and reassured them that it was achievable. It thus increased confidence and strengthened students' self-efficacy beliefs:

> "AWESOME is the reassurance while you are writing."

6.5 ADE and Dissertation Writing Practice

Tutors agreed about the usefulness of the concept of the ADE. They saw the major benefits from the ADE to be providing a starting point and an anchor for students. Tutors saw the potential of the ADE to provide *genuine and annotated examples* which could be used to familiarize students with the dissertation and support them as they explored and practiced the skills needed to research and write their own. Combining this information with *online mediated peer discussion* would provide community support, which they hoped would enable students to *use face-to-face tutorial time more effectively*. They were also interested in the potential to monitor student progress—in terms of engagement with the dissertation writing process—at a formative stage. An additional benefit they identified was the ADE's *staff development potential*: articulating individual tutors' tacit knowledge (via semantics) and making it easily accessible to colleagues encourages reflection and dialog on supervision practices.

Tutors highlighted the advantage of ADE in that the information is both dynamic and static; students can access relevant content on demand in a structured way; as frequently as they need to and when they need to. They

Fig. 8. A table using semantic queries to group the derived dissertation tips in categories. This is shown on the ADE main page.

do not have to spend valuable face to face time with a supervisor clarifying the format for a bibliography or the word length—when such issues arise they are picked up in questions or indicated as top tips, and are pulled automatically into the corresponding tables. Tutors can address issues once and make them available for the whole (and future) cohorts.

The ADE, in gathering and reproducing the experience of the dissertation journey as a social, rather than individual, process has great potential to effect change in how the dissertation is perceived and experienced by students. The students unanimously stressed ADE's potential to support dissertation writing:

> "I will definitely be happy to use AWESOME, probably not so much for 'blogging' and speaking to others but more for information and advice."

Students thought they would use ADE when they were writing their dissertation and encountered a problem. The main use is likely to be as a repository but there is potential to make this a more dynamic and interactive environment if the community and personal space are connected appropriately. The resistance to collaboration will have to be directly engaged with and may involve a cultural shift away from the competitive individualism of academic work to the collaborative values of employment and employability.

6.6 Further Improvement of ADE

Three key issues identified in the user feedback were addressed in the latest version of ADE, currently being prepared for use in the schools of Education and Computing at the University of Leeds, United Kingdom.

6.6.1 *Improving Navigation*

Following user feedback about navigation, we undertook several improvements. *Usability* was improved by making layout consistent throughout, unifying the user interaction in all semantic forms, including meaningful and unified headings in all semantic query tables, reducing the number of buttons, suppressing links to empty pages.

Use of semantics was optimized by unifying the labels of common properties across categories (tips and comments), providing semantic forms for entering semantic markup for all social exchanges, grouping content according to categories and providing an overview table in the main page (Fig. 8).

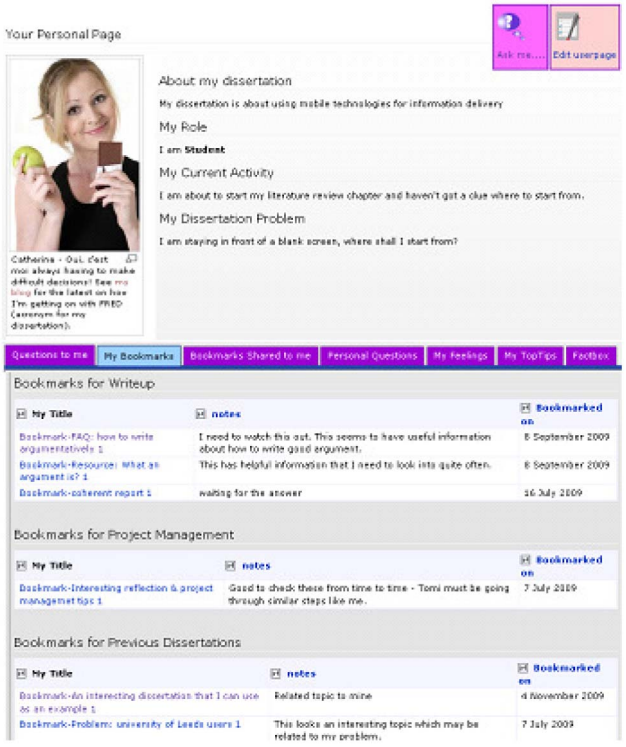


Fig. 9. An example of student personal space including access to the community information space via personal bookmarks.

6.6.2 *Connecting the Community and Personal Spaces*

The students liked the Facebook-like personal space provided and used it as a gate to access ADE and connect to the community (by sharing their moods and dissertation experience). Significant changes were made to turn the personal space into a focal point enabling not just social interaction but also interaction with the community-produced content. This is done via personal bookmarks: when the student finds an interesting page (e.g., a question, an example, or a resource), they can click on a "bookmark" button and add a link to this page in their personal space. The semantic markup of the page is automatically captured, enabling the appropriate organization of bookmarks according to dissertation categories. We also added ways for users to share bookmarks with peers or with the whole community (i.e., adding social recommendations like functionality in a wiki). The personal space is expanded to also allow users to post questions to other users, which automatically appear in their space. Fig. 9 gives an example of a students' personal space.

6.6.3 *Optimizing the Seeding Process*

The seeding process is paramount for triggering the social scaffolding process. The trials enabled us to identify the key aspects in seeding. First, it is crucial to have a repository of authentic examples and an easy method to load these examples into ADE. For the Computing instance, we had a repository of past dissertations. Appropriate wrapper tools were developed to import this repository into ADE. This provided a starting point for tutors to add annotations (e.g., Fig. 9 illustrates top tips associated to dissertations from that repository). To optimize the annotation process, we

analyzed existing feedback given to students in past years to identify the main dissertation problems and solutions. This was used to tune categories and properties in the ontology according to specific domain and community, as well as to create scenarios to assist the seeding process.

7 Discussion and Conclusion

In this paper, we have presented a new approach—semantic social scaffolding—for harnessing social computing and semantics to create innovative learning environments for collaborative knowledge construction and community-based learning. The key characteristics of our approach are:

- use of an ontology to provide a pedagogical structure underpinning the collective space,
- use of evolving, user-generated semantic markup to provide a set of vocabulary for participants to share, filter, and build upon their experiences in a specific domain of interest, and
- use of social computing tools to simulate and stimulate the kind of informal peer support and social scaffolding occurring in the real world.

The coevolutionary methodology proved essential in promoting tutor engagement in the seeding process for each ADE instance. Creative ideas on the tailoring and adoption of ADE came from tutors as they acquired a better understanding of the new capability offered by the technology. Student engagement was dependent on the tutors' adoption. With the limited duration of the trials, it is premature to make conclusions but the design, implementation, and user trialing of ADE, enables us to draw out some of the lessons learned. We believe these have broader implications for future TEL adopting SSW principles and tools.

7.1 User-Centric Design and Development

The AWESOME project illustrates key methodological issues relevant to SSW-based TEL. Designers, developers, and users usually have *divergent expectations* of what technology should, or should not, include and how it can be embedded in practice. This is particularly challenging with innovative tools and methods, such as SSW, the potential of which is yet to be shown. A coevolutionary approach with a rapid demonstration of benefits to users, like the one presented in this paper, can accelerate the convergence and alignment of expectations. All parties have to be prepared to go through this process *step by step* with an *open mind*, willing to *experiment* and *change* their views. Having open-minded user champions and developers are key.

Initially, pedagogy partners preferred the wiki and blog-like free text interactions, while technology partners felt that semantics should be more prominent as it would offer potentials for intelligent features. To bridge this gap, the articulation of key problems and the shaping of ADE happened iteratively and *gradually*, adding features and experimenting with the role of semantics. Because the environment was used in *real settings*, quick incremental changes were preferred. It also meant contentious issues (inevitable with innovations) were discovered—and resolved—more quickly.

However, innovations sometimes require new practices, in which the users have no experience. Following user preferences blindly may not be the best way forward. For example, navigation problems were reported in the FD trial as users were overwhelmed by the options (as clickable links) on content pages. As an experiment, we developed a version of ADE which offered fewer clickable links on a page, and significantly reduced the use of semantics. This made the environment closer to a wiki extended with Facebook-like facilities. While the user community seemed to prefer the new interface, it became clear that stripping out semantics would affect the scaffolding. This experimental reduction in the use of semantics enabled us, pedagogues and technologists, to see its key role in focusing and channeling social exchanges. This also led to differentiating the core and emerging ontology and identifying their role in ADE.

7.2 Tailoring, Seeding, and Evolution

Our original idea was that there would be *one* ADE platform offering flexible access to generic and domain specific content. The early engagement with user communities clearly showed that practices differ so widely across subject areas, institutions, and countries that it was neither feasible nor desirable to develop a *universal dissertation writing community environment*. Instead, a number of instances have been created, tailoring to specific needs of practice. We suggest that this will also be the case in future studies developing SSW-based TEL. Hence, an approach was developed to ease the creation of a new instance for tailoring: 1) a *core platform* was developed with *user guides* describing how to *tailor* the platform to different communities,[10] 2) a *public instance* was made available where potential users can have "hands-on" experience with a functioning environment (used as a starting point for gathering/tuning user requirements), and 3) the backbone core ontology with the main dissertation categories (see Section 5) was kept as standard across instances but the properties associated with the categories can vary. This could require changes in both semantic forms and queries (a developer's guide was produced on how to make such changes).

Social computing environments are affected by the *cold start* problem—users engage when sufficient quality content is available. This phenomenon is well known but little is known about how to facilitate this process with emerging SSW platforms. Our work sheds some light on seeding a semantic wiki for community learning, illustrating *what*, *who*, and *how*. We found that seeding should include 1) an *initial ontology populated using the community's vocabulary* (we followed semantic web methodologies for engaging users in ontology authoring) and 2) *authentic examples of user experience*, in any digital format (text, audios, and videos). We believe that cultivating and exploiting such experience for learning is a likely direction in the TEL. *Tutors and community moderators* play key roles in the seeding process, the involvement of early enthusiasts and champions is crucial. We found that *scenarios* and *personas* could be used to assist the seeding process (e.g., fictitious students were added to illustrate typical problems; student scenarios were given to tutors, who were asked to add appropriate semantic markup to facilitate the discovery of content).

10. http://awesome.leeds.ac.uk/getting_started.php.

Evolution is a crucial aspect in any knowledge sharing community [16]. AWESOME shows that the *emerging ontology* and *content provenance* are valuable sources for capturing the key dissertation challenges facing the community. Currently, tutors have to use semantic wiki special pages to get an understanding of the community. This is challenging for people from non-IT disciplines. Further developments should exploit the emergent ontology and content provenance to derive a model of the community, e.g., the most populated/unpopulated ontology parts, most valuable/invaluable content, common problems, or cognitively influential members.

7.3 User Engagement in Learning

The distinction between *individual and collective perspectives* was noted throughout the project. In domains where student performance is judged on an individual basis, the value of, and the engagement in, collective spaces are driven mainly by individual needs rather than by a common group/community purpose (as in "traditional" collaborative learning settings). We addressed this by developing the personal space as a gate to the collective space. The personal space can provide an individual starting point for exploring the environment based on the users past visits; social bookmarking can be exploited to offer personalized social recommendations based on similarity between students. We believe that these social aspects are an important way of engagement. Tutors found the corpus of student questions a valuable source for gaining an understanding of the students' problems. Semantic markup can facilitate the capturing and grouping of these problems, which then become reused, as other students encounter the same problem, and generate more questions. If tutors link their answers to examples, students are encouraged to explore, and contribute to, these areas of the ADE.

User participation is key to the success of community environments. We found that using collective intelligence for learning highlights that *quality* is more important than *quantity*. Successful tailoring includes developing strategies to encourage tutors and active students to contribute valuable examples, as well as facilitating the moderator's tasks.

Within the ADE, students and tutors had *different expectations* regarding their participation. While tutors felt that the students should collaborate, students expected tutors to provide content. *Low contribution* is common in wiki-like community environments, such as ADE, which facilitate learning in loosely defined domains and tasks. Students would not contribute examples or comments since they were struggling with the dissertation process and unsure what was important and why. They were, however, willing to add examples after assessment, reassured perhaps that they had understood the task. However, they were willing to ask anonymous questions, share their feelings and offer encouragement throughout the process.

The bane of many collaborative learning environments is creating dense and authentic collaboration and interactivity. As a new form of learning, students are not necessarily able to make informed decisions about the balance of negative and positive impacts of offering and/or receiving comments on work-in-progress which underpin the collaborative learning potential of the ADE. This, combined with the United Kingdom higher education context, where assessment tasks are rarely collaborative and the sector is gripped by a moral panic about plagiarism, makes it difficult to fully exploit the ADE's potential for collaborative learning. This does not diminish its capacity to demonstrate the intellectual and personal demands made by dissertation writing and provide students with mutual support as they engage with and learn abut these complex and multiple learning processes.

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