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Designing social media for informal learning and knowledge maturing in the digital workplace

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Abstract

This paper presents an original approach to designing social media that support informal learning in the digital workplace. It adapts design-based research to take into account the embeddedness of interactions within digitally mediated work-based contexts. The approach is demonstrated through the design, implementation, and evaluation of software tools supporting a particular type of informal learning called *knowledge maturing*. The paper: introduces and presents the rationale for, and concept of, knowledge maturing; presents a new design methodology for developing social media that support informal learning and knowledge maturing; focuses on one prototype, for ‘people tagging for organisational development’, that was produced by the methodology (and concisely describes two others); presents the formative evaluation of the highlighted prototype; and finally, discusses the implications and insights arising from this work.

Keywords

context, design-based research, formative evaluation, informal learning, knowledge maturing, work-based learning.

Designing social media for informal learning in the digital workplace

Informal and situated learning at work is being given increasing attention within national research and development agendas, and throughout Europe in particular. This is because it is well attested that informal learning plays a key role in improving an organization’s capabilities (Eraut 2004). This position is now combined with the possibilities for catalysing, amplifying, and exploiting informal learning through social media, which is also becoming the focus of much attention in recent research literature (e.g. Ravenscroft *et al.* 2009; Hatzipanagos & Warburton 2009). However, designing social media for informal learning within work-based

contexts also poses new and significant challenges for design processes. With the variety of different forms of informal learning, it is not a clearly defined concept or process with clearly defined boundaries. As a consequence, the design process is not only a process of designing social media for a known purpose and context, but is also a practice for better understanding the phenomena and features at play. The design process itself becomes a collaborative learning process, and its results are not limited to digital artefacts, but are coupled with an evolving understanding of how these artefacts mediate human activities in particular contexts. Another way of looking at this is that designing social media is an intervention within existing digital cultures that promotes, optimizes, or catalyses desirable technology-mediated processes and practices.

One way to tackle the somewhat diffuse and poorly defined nature of informal learning processes is to define models or frameworks that more clearly

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characterize these processes, link these processes to changes in related social and knowledge-building processes (e.g. Scardamalia & Bereiter 2003), and link to concrete contexts and communities. This position is illustrated below where we introduce informal learning as knowledge maturing in the digital workplace.

Promoting informal learning and knowledge maturing: the MATURE project

One type of informal learning linked to emerging social learning practices in the digital workplace that is well-defined is *knowledge maturing* (Maier & Schmidt 2007). This adopts a perspective of looking at informal learning not only from an individual, but also from a collective point of view. It can be understood as ‘*the advancement of knowledge (i.e. learning) on a collective level*’ (Kunzmann & Schmidt 2009) where knowledge ‘*becomes less contextualized, more explicitly linked, and easier to communicate*’ (Schmidt et al. 2009).

The main idea within this framework is to explore and promote the interlinkage of individual (informal) learning processes and collaborative (organizational) learning and knowledge management processes. The key dimension for assessing the harmonization of these (individual and collaborative) processes and practices is the changing nature of knowledge according to different phases of ‘maturity’ that have been identified and specified within an empirically derived model of *knowledge maturing* (Kaschig et al. 2010). This organizes knowledge maturing processes into five main phases (Maier & Schmidt 2007): (1) *expressing ideas*, in which new ideas are developed by individuals from personal experiences or in highly informal discussions; (2) *distributing in communities*, in which a common terminology that is shared among community members is developed; (3) *formalizing*, in which created artefacts are transformed from being inherently unstructured to being more purposive and structured; (4) *ad hoc learning*, in which material is prepared in a pedagogically sound way, enabling broader dissemination; and (5) *standardization*, in which individual learning components are put together to cover a broader subject area, and thus become teachable to novices.

The first three stages are particularly important to the maturing process, as these phases, unlike the latter two, are not well supported by current knowledge manage-

ment and technology-enhanced learning (TEL) tools. In particular, the transition from expressing individual ideas to their taking roots within a community, and in turn their transformation into formal and reusable knowledge, is crucial to the success of enterprises.

This model is the foundation of a large European Commission-funded integrated project called MATURE (Continuous Social Learning in Knowledge Networks), which is investigating how technology-mediated informal learning leads to improved knowledge practices in the digital workplace that, in turn, lead to better collaborative working and organizational performance. One of the project’s main motivations is to, within enterprises, reconcile the success of Web 2.0 developments with the failure of top-down organizational systems – such as learning management systems, competence management systems, or knowledge management systems. The aim is to bring together (typically) highly motivated bottom-up knowledge sharing activities, and top-down guidance towards shared goals. We call this an enterprise 2.0 perspective on knowledge and learning, which is characterized by *enhanced collaboration* and a culture of *employee participation* (Schmidt 2008). As a consequence, informal learning activities are the key activities to investigate, especially when viewed through the processes required for knowledge maturing.

Investigating and developing these concepts (of informal learning and knowledge maturing) was the focus of a large-scale 4-year project that started in April 2008, which had its main objectives as:

- empirically develop a better understanding of real-world knowledge maturing practices and barriers, for example through ethnographically informed studies, large-scale interview studies, and in-depth case studies;
- conceptually describe and model this understanding of knowledge maturing as a ‘model landscape’ that can be used to analyse problems and develop solutions, which encompasses analysis instruments, descriptions of key activities, and indicators; and
- technically develop reusable services that support knowledge maturing and provide a construction kit for context-specific learning and maturing environments.

Although this paper focuses on the design methodology for delivering the third objective, this design

process was highly interwoven with the first two objectives. It ensured that the resulting designs embraced empirical findings and conceptual investigations, and in turn, added to both the empirical and conceptual perspectives. Such technical support for knowledge maturing processes requires new approaches and tools for key functions in organizations and enterprises, such as (1) community-driven quality-assured content management; (2) collaborative competence management; (3) bottom-up enterprise taxonomy management; and (4) agile business process management and task management. As (2) is a particularly important and yet sensitive area of informal learning support, we have chosen the 'people tagging' tool, which directly addresses this issue to demonstrate our design approach.

People tagging for organizational development: collective informal learning about work-based competencies

An important and clear example of a tool we developed to support informal learning and knowledge maturing, which will be used for exemplification throughout this paper, enables *people tagging for organizational development* (Braun *et al.* 2010). Fig 1 shows a typical screen from the tool. Put simply, this tool addresses the

problems of finding out 'who is competent in what' within organizations, and also the embedded maintenance of such knowledge in changing organizational contexts. It supports the informal learning required in finding the right person to talk to, who can help with an activity or solving a problem. For example, in a careers guidance context, we might need to find who has the most recent knowledge and labour market information relevant to a particular occupation (e.g. advisors on teenage pregnancy in Fig 1), or experience with specific situations (e.g. advising young people in a particular area in Fig 1). This is a 'lightweight' approach based on collaborative tagging that is used to gather information about people inside or related to an organization along with related documents. Individuals collaboratively tag each other according to the competencies and topics they associate with one another. In this way, a collective and situated review of existing skills and competencies is gained. These tags can also be collaboratively evolved into a (bottom-up) taxonomy that can act as an alternative to static competency or skills catalogues.

This particular tool represents a twofold knowledge maturing process: (1) collective knowledge about others becomes more explicit and refined within a work-based community, and hence more mature; and

The screenshot shows a search interface with the following elements:

- Navigation tabs: [Browse People](#) and [I tag People](#)
- Search bar:
- Results summary: Results: 22 documents and 3 people found
- Search refinement: I understood that you searched for: [vacancies](#) [Teenage Parents and Teenage Pregnancy](#)
Broaden your query (also show documents annotated with): [Health](#) [Wooler Job Vacancies](#) [LAC and Care Leavers in Northumberland](#)
Narrow your search (only show documents annotated with): [Wooler Job Vacancies](#) [vacancies](#) [LAC and Care Leavers in Northumberland](#)
- Document results:
 - [vacancies](#)**
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 - [LAC and Care Leavers in Northumberland](#)**
[LAC and Care Leavers in Northumberland](#)
Northumberland Youth offending Service Teenage Pregnancy Team ... For example, the young people visited Connexions offices in Blyth, Alnwick and Ashington, and Children's ... being made available. These were also introduced these at the Ashington Office and the changes have
<http://www.northumberland.gov.uk/default.aspx?page=8121> [Edit](#)
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[Apprenticeships](#)
Vacancies start to appear early in the year. Register with the Apprenticeship Vacancies website and search/apply for vacancies online at www.apprenticeships.org.uk. Your Connexions ... Centre can tell you about vacancies, help you apply and advise you about interviews. You
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 - [Connexions Cumbria](#)**
[Connexions Cumbria](#)
- People profiles (3 shown):
 - Profile 1: **is associated with:** 1x Apprenticeship Vacancies 2x Blyth Vacancies 1x Seaton Valley NEET 1x Link PA for B-Skills 2x CV Information [Show profile or Contact](#)
 - Profile 2: **is associated with:** 1x Teenage Pregnancy Team Accreditation Project 1x LDD at the College 1x Teenage Parents and Teenage Pregnancy 2x Teenage Pregnancy and Young mums 1x Blyth Community Team [Show profile or Contact](#)
 - Profile 3: **is associated with:** 1x Tracking 1x Ashington Vacancies 1x Core 3x Ashington team Reception 1x Ashington Staff Knowledge 1x Administration [Show profile or Contact](#)

Fig 1 A typical return from a search in the people tagging tool.

(2) knowledge about how to describe others' expertise develops from informal tags to clearly defined concepts and stable relationships in a taxonomy. This corresponds to the first three phases of the maturing process. *Ideas are expressed* (phase 1) about the competencies that people have, these are *distributed in a work-based community* through collaborative tagging (phase 2), and these competency assignments become *formalized* (phase 3) through acceptance and use for collaborative work-based practices, and links to related content, documentation, and organizational competence taxonomies. Fig 1 shows the people who were returned from a typical search using this tool, who are anonymized in this example. Following a search on *teenage pregnancy* and *vacancies* in a specific area (*Ashington*), it shows the people, on the right-hand side of Fig 1, and the topics (such as job vacancies) and content (such as relevant documents) that were returned on the left-hand side. The person who has performed this search is now in a position to approach, communicate, and collaborate with the returned people towards a common purpose, avoiding timely and less accurate 'asking around' about 'who does what'. This is fine-tuned by the fact that additional specific subtopics and resources are associated with the returned people to further refine the people-searching process. Similarly, they have Web links and documents that will also be useful.

At a general level, this tool formalizes the communication and knowledge exchanges that operate within human networks, by using a social media approach to make explicit and public that which is often conveyed in ephemeral and personal communications.

Challenges for design: why innovate design processes?

In considering the issues raised our introduction and the people tagging example above, we can draw out four key challenges for designing tools to support informal learning processes in digitally mediated, or digitally rich, contexts. These are the following:

- Informal learning processes are subtle and complex, so we need to actively investigate, define, and design simultaneously in context, or we 'investigate by design' (Ravenscroft & Pilkington 2000).
- We cannot fully anticipate the behaviour of instantiated informal learning tools, and any network effects,

etc. without actually deploying them in a community (i.e. you cannot separate social media design from instantiated social media processes). Therefore, exploring, understanding, and articulating emergent collaborative processes and practices are crucial.

- The adoption and use of these sorts of tools, in turn, reformulates existing communication and knowledge practices, and emerges new ones. This means that we need to foreground the 'human reality' of the digital intervention, for example, how individual differences might influence levels of acceptance.
- Collectively, these (1–3 above) mean that we cannot design and evaluate in traditional ways, such as through assessing the degree to which a technological intervention is a clearly defined solution to a clearly defined problem. Similarly, in a similar sense, ongoing evaluations are implicit in the design process itself, and not conceived as separate and discrete activities. Design is inherently an ongoing and iterative process, and involves an ongoing dialogue among all stakeholders.

These challenges necessitate a new, agile, and socio-technically sophisticated approach to design that accommodates the co-evolution of human behaviour and the development and use of social and semantic technologies. In addressing this challenge, we combined relatively recent ideas in design-based research (e.g. Barab & Squire 2004; Wang & Hannafin 2005; Ravenscroft *et al.* 2010a) with another approach of *deep learning design* that is particularly focused on designing TEL in the Web 2.0 landscape and beyond in ways that are particularly responsive to issues associated with context (e.g. Cole 1996; Boyle 2002; Ravenscroft & Boyle 2010).

Design-based research and context

Our initial inspiration for a suitable design approach was evolutionary prototyping within a design-based research framework.

According to the design-based research collective in a seminal issue of *Educational Researcher* (2003):

The challenge of design-based research is in flexibly developing research trajectories that meet our dual goals of refining locally valuable innovations and developing more globally usable knowledge for the field (Design-Based Research Collective 2003).

This approach is particularly relevant to our design problem, as we are exploring and aiming to promote and realize learning as a process of knowledge maturing in particular workplace settings, and also uncover more general insights. Specifically, this has involved developing systems within careers advice (in the UK), training for the construction industry (in Spain), and a large software company based in Germany (SAP). And more generally, we have developed a generic framework, a model of knowledge maturing, that can potentially apply to technological approaches to the continuous development of social software and knowledge networks within any knowledge worker context.

The related approach of deep learning design also informed the design process through its emphasis on ‘context’, a focus explicitly stated by Ravenscroft and Boyle as:

Deep learning design is, ostensibly, an approach for producing enhanced contexts for learning. (Ravenscroft & Boyle 2010)

The following section explains how we adapted ideas and methods from design-based research to take greater account of context and the embeddedness of social media interactions to produce a methodology for developing social media supporting informal learning and knowledge maturing.

Overview of the design process

Design-based research for informal learning has to take into account a particular challenge that the design

process itself is a *learning and problematization* process that interweaves the deepening of understanding of underlying features of informal learning and the design of supportive tools that promote it. We built upon previous research, including the ontology-centred design approach in SOPRANO (Service-oriented Programmable Smart Environments for Older Europeans) (Klein *et al.* 2007) and AGENT-DYSL (Accommodative Intelligent Educational Environments for Dyslexic Learners) (Schmidt & Schneider 2007), that designed systems for people with special needs, which in certain ways mirrors the complexity of designing informal learning support, in that key features and issues emerge during the design activities. The process is an iterative, spiral-shaped approach where in each cycle we have *the same recurring generic activities (prioritization, learning and problematization, design, and evaluation), but these may be realized by different methods that will deliver differing and evolving features and outcomes, so that design methods are appropriate in addressing emerging and evolving requirements. Or putting this another way, design is an ongoing and creative process incorporating mixed methods, not the application of predefined methods, to produce predicted designs.* After introducing the design process in this section, we describe it in more detail in the next section, with reference to the development of the previously introduced tool (in Fig 1) that enables ‘people tagging for organisational development’.

Similar to agile development processes, the first step of the design cycle that is visually represented in Fig 2 is

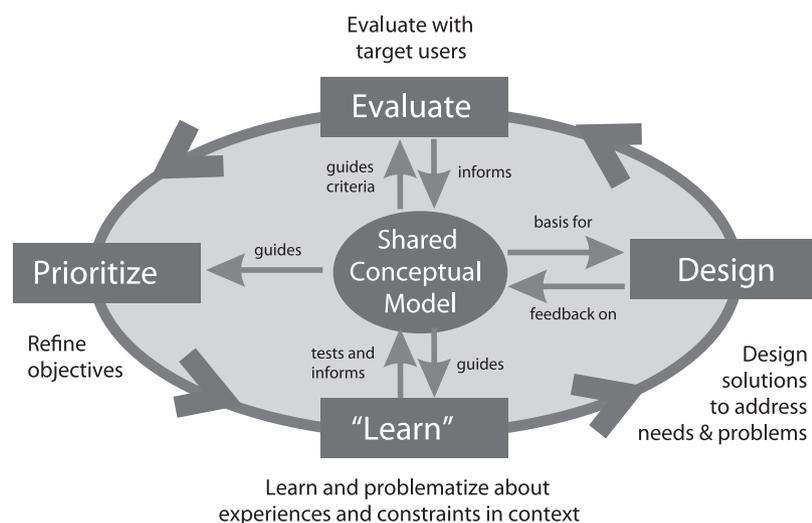


Fig 2 Overview of the MATURE design process.

prioritization. In this important phase, the objectives are defined (or refined from the previous cycle). This prioritization is either the result of an initial interpretation of the problem space or a reflection on the results from a previous cycle. The outcome of this reflective process is transformed into a vision for the next cycle (and usually also reaching beyond), which also contains concrete objectives representing what the design team attempts to achieve, along with open questions that need to be answered. These objectives are not concrete development objectives (e.g. feature X for component Y), but rather more general objectives about which aspects to focus on.

In the people tagging example (Fig 1), the initial priorities related to exploring the influence of the people tagging of competencies within organizational cultures. This was a top-level priority issue that raised important questions such as: Do employees understand the people tagging approach? What if people do not like being tagged? Does tagging conflict rather than complement traditional competency records?

Prioritization is followed by a phase of *learning and problematization* about experiences and constraints in the context. This is an exploratory phase in which design teams investigate the key features in the target context, and requires the involvement and participation of target users as much as possible, for example observations and interviews prior to implementations and user tests. This is an important, although frequently neglected, step in design processes that is often seen as requirements engineering. But unlike traditional software engineering, a main goal of this activity is the deepening of the understanding of the context and design space among design team members, and not necessarily the explication of formal requirements. Therefore, it is important that any usual division of labour between those doing requirements engineering and software development does not decontextualize experiences and lose important insights and depth.

In the case of the people tagging tool, this involved comparative field studies in different organizations (as described in Braun *et al.* 2010), a large-scale interview study (as described in Kaschig *et al.* 2010), and focus group interviews. These facilitated the collaborative conceptualization of the way in which social technologies could address individual and organizational problems and opportunities.

The next *design* phase involves creative technical processes to devise and provide potential solutions or original social media processes linked to technical design and implementation activities. This also requires significant communication and dialogue with users. The notion of 'requirements' is also important in this design phase, but in our (embedded social media case), these become 'requirements-in-action' instead of a 'contract' between those understanding the context or problem and the developers aiming to address it. The goal is also to obtain early and ongoing feedback on important assumptions in the technical design process, for example that certain functions will support certain aspects of informal learning.

Evaluation is an ongoing activity throughout the design process that becomes less exploratory and more confirmatory as development proceeds, where particular methods map to these changing roles for evaluation. In practice, this means that early evaluations are similar to participatory design approaches, using open-ended and exploratory methods, such as workshops around conceptualizations and mock-ups. Later evaluations will investigate the performance of tools against criteria, such as usability, suitability, and performance according to informal learning objectives (e.g. groups are working together and sharing knowledge more effectively).

In the example of the people tagging tool, this involved close collaboration with representatives of a career guidance organization. Early mock-ups and prototypes were developed and demonstrated in workshop settings, where both open and structured feedback were received, and these findings were incorporated into subsequent developments in an ongoing fashion. These technical design studies were also coordinated and influenced by the shared and instantiated conceptual model for informal learning and knowledge maturing (Kaschig *et al.* 2010). This informed the technical design activities, and was itself evolved through these design activities.

Applying the design approach: design cycles and methods

The following subsections describe the two design cycles that have been performed within the MATURE project according to the design framework described earlier and in Fig 2, through mapping these to specific methods that were used in the project as the social media

tools evolved. These cycles are also described in greater Ravenscroft *et al.* (2010b). The project adopted three key techniques to realize its design process, namely design studies, use cases, and demonstrators. These were all influenced by, and adapted to account for, overarching principles about organization and prioritization that were derived from the conceptual model of knowledge maturing and emerging user and contextual requirements. In the subsections later, we describe the design process and highlight (e.g. through the use of bold type) those aspects that refer to the development and use of the people tagging tool.

The first design cycle was exploratory and investigative in nature. It collaboratively specified contextualized design spaces (e.g. through use cases) along with the proposal of candidate approaches (e.g. through design studies) for supporting informal learning and knowledge maturing. The evolution of the overall design can be seen through changes during the second cycle, which represented the informed narrowing down of design activities (e.g. through prioritizing and aggregating use cases) towards tools (the demonstrator prototypes) that could be used and evaluated in relevant contexts.

Cycle 1: design studies, initial evaluations and use cases

The starting point for the first design cycle, which lasted a year, was an initial version of the knowledge maturing model and various visions for its technology-enabled instantiation. So the first design cycle focused on *exploring* the design problem and solution space from multiple perspectives that incorporated conceptual, technical and user orientations.

Prioritization

During the first prioritization phase, two methods were deployed in parallel: ethnographically informed studies (empirical) and design studies (design-oriented).

The empirical studies (Barnes *et al.* 2009) immersed design team members into the workplace reality of several organizations, such as a large hospital, a software company, and a career guidance organization, to gain an in-depth understanding of problems in knowledge maturing processes, and individual and organizational needs in this respect. The design studies were early and critical ‘experiments in design’ that explored

key aspects, and ‘played out’ prioritization candidates and ideas that needed to be validated prior to embarking on further design activities.

For the design studies, initial design ideas were collaboratively developed, and design teams were formed for each of these, which included technical, conceptual, and user partners. In total, eight design studies were defined, three of which are listed below as examples:

- *A semantic media-wiki for maturing career guidance knowledge in action (a participatory and community-based approach to the quality control of documents);*
- *A knowledge maturing dialogue game (providing the means to link collaborative ontologies with dialogues about them);* and
- ***People Tagging for Collaborative Competence Development¹ (a participatory approach to competency assignment and development that is highlighted throughout this paper).***

These design studies were devised and specified during the prioritization phase, and then performed during the problematization and design phases. Their nature and specification represented a balance of what was organizationally valuable set against what was technically possible.

Problematization and design

The problematization phase was realized through continuing and extending the empirical studies and design studies. The design studies, in context, gained feedback on initial prioritization ideas, discovered integration potentials, gained experience with supporting knowledge maturing processes ‘on the ground’, and by implication, elicited any ‘early warning signs’ that needed to be considered and addressed as the project progressed. Practically, they were focused and time-limited, based on existing tools with limited further developments, incorporated both conceptual and software development foci, and provided a mechanism to work with and initially build relationships with the user community at an early stage of the design cycle.

In the case of the people tagging example, the design study consisted of two related approaches: developing the conceptual and technical frame for a people tagging approach that was combined with a collaborative vocabulary development; and field experiments (with pen and paper) in two different settings (a careers

guidance organization and a large research group of approximately 40 people (familiar with informal learning and knowledge management issues) to learn about the likely acceptance of, and barriers to, the people tagging approach.

Initial evaluation

For the people tagging design study, the initial evaluation showed that, while there were initial concerns about the collaborative approach to competency assignment the central idea was recognized as valuable in addressing a clear need (for efficiently finding the right person to talk to) by the groups within the two contexts. The evaluation also highlighted individual and cultural differences that needed to be accommodated within the design. For example, while there were clear and negotiated visions for social media solutions and improvements, there was a clear variance in levels of social media literacy within the user groups.

Having performed this initial validation of the design activities across the project, the next step was to more thoroughly locate design processes within concrete user scenarios and develop applications within focused interdisciplinary teams, comprising technical developers, conceptual experts and users. This necessitated a 'language of design' that could be shared by the interdisciplinary teams and communicated externally, which lead to an elaborated and specialized use cases technique (Bittner & Spence 2002) being adopted.

Preparing the second cycle: further prioritization and problematization through use case development

To represent the bottom-up and user-oriented nature of relevant technology-mediated activities, we developed a comprehensive set of use cases as design-oriented boundary objects (Bowker & Star 1999). These were elaborated to incorporate the conceptual model (of knowledge maturing) and linked this to the technical requirements that realized the functional goals of the use cases.

The use cases were developed iteratively. After initial definition in small groups, they were consolidated. This involved merging cases, structuring them into common areas and elaborating them as appropriate. Top-down and strategic coordination of the use cases was realized through clustering the individual cases according to key activities, or 'areas' for knowledge maturing, such as:

- *Area I. Learning by searching for and exploring artefacts for the task at hand*
- *Area II. Learning by finding and communicating with people*
- *Area III. Becoming aware of developments and changes*

For example, the second area, *learning by finding and communicating with people*, focused on improving knowledge maturing by improving direct contact between people, and was represented by the following specific cases:

- *UC II.1 Find people for a specific topic*
- *UC II.2 Tag people for sharing the 'knowing who'*

At the end of the first design cycle, we had investigated whether proposed technical developments could realize the key aspects of knowledge maturing; mapped the phases of knowledge maturing that could be supported; established the priorities from a bottom-up user and top-down conceptual perspective; and outlined concrete usage scenarios (in the form of use cases) linked to the knowledge maturing model. This provided a platform for more considerable technical developments and technology-enabled knowledge maturing, within the decided usage contexts, in the following design cycle.

Cycle 2: demonstrator prototypes and phased formative evaluation

The second cycle of the design process, which also ran for a year, retained the use case technique, but further prioritized and reassessed the cases, and linked them to the next stage of technical development, which was four demonstrator prototypes. Adopting this approach of developing and evaluating distinguishable but related tools that could be combined later through a Web services approach avoids the criticism of what is called 'hill climbing' in design-based research, which refers to an overly narrow focus that this methodology can give rise to.

Prioritization and problematization: reassessing and rationalizing the use cases

After the eight initial design studies had been completed and evaluated, the use cases were reassessed, priori-

tized, and rationalized. The use cases were reduced in number, from 47 to 33, by aggregating and combining similar ones.

As part of the problematization step, the prioritized use cases were aggregated into coherent stories for end-users and their environment, which resulted in the definition of *knowledge maturing demonstrator prototypes*, each of which concentrated on specific aspects of knowledge maturing: content, people, processes, and semantics.

Designing and implementing demonstrator prototypes

The demonstrator approach was particularly motivated by the emergent issue that the design challenges for knowledge maturing could not be completely covered by the use cases for a number of reasons. First, the nature of the requirements for the software that was being developed, which is interlinked with complex and contextualized knowledge worker practices cannot always be pre-specified. Instead, many requirements emerge 'in action' and inform development in an incremental way. Second, inserting another, somewhat abstracted step, between the use case technique and the user's direct involvement in the system development was also problematic. It incorporates an 'interpretative step' of linking technical requirements to 'touchable' and 'visualizable' tools that would create ambiguities and differences in interpretation across stakeholders. Consequently, we used the use cases as a design 'backbone' that directly linked to the development of demonstrators that, in turn, incorporated concrete knowledge maturing scenarios that could be easily understood by all stakeholders. So these demonstrators linked to the user scenarios via this use case backbone and end-user feedback, represented 'live' and evolving requirements.

So the 'knowledge maturing design' at this stage consisted of a set of use cases clustered according to areas corresponding to the model of knowledge maturing that were then linked to specific demonstrator prototypes that realized them. As the people tagging demonstrator was described earlier, we will now briefly describe another two to illustrate the breadth of our design approach. These are based on descriptions given in Bradley *et al.* (2010).

Prototype 1: assuring quality for social learning in content networks. This prototype actively supported social learning in a distributed and networked setting

with a focus on content aspects. It was designed for career services, for example to provide up to date labour market information. Quality assurance processes are key issues in this context, and relate to individual advisors finding appropriate and up to date information as fast as possible, and to meet the organizational need of achieving a coherent and high-quality organizational identity in the development of their knowledge artefacts. Fig 3 shows the features of this tool that can be accessed through the 'management' interface. This allows users to create new articles (text editing); organize and share resources (through visualization and tagging); search for relevant information (searching); contact other colleagues (through discussion media); and provide quality indicators for resources (rating).

In brief, this tool (below) provided various socially innovative and rich ways to find, understand, and establish the quality of *content* that supported work-based activities. The following prototype, in contrast, paid a greater attention to the development of shared *semantics linked to dialogue*.

Prototype 2: collaborative development of understanding. This prototype that is described in detail in Ravenscroft *et al.* (2010c) supported a community of practice in developing a collaborative understanding of their domain by interweaving the development of a shared information repository and vocabulary (ontology) with dialogues about them. Technically, this was realized through mashing-up a social bookmarking and collaborative ontology tool (SOBOLEO, Zacharias & Braun 2007) with a dialogue game tool (InterLoc, Ravenscroft *et al.* 2009; Ravenscroft 2010). Fig 4 below demonstrates how the dialogue game approach scaffolded and supported the ontological classification of resources, related to 'aqueducts' in this example. This was achieved through specifying pre-defined moves and sentence openers of a dialogue game in terms of the key semantic interaction actions within the ontology tool (e.g. 'Is narrower than', 'Is broader than', 'Is related to'), and supplementing these with attested and more argumentative or critical openers from existing dialogue games (e.g. 'I think . . .', 'Is it the case that . . .', 'I disagree because . . .'). The dialogue game transcripts (on the right-hand side of Fig 4) are then stored with the concepts that were discussed (accessible through a 'Performed Dialogs' section, on the left-hand side of Fig 4).

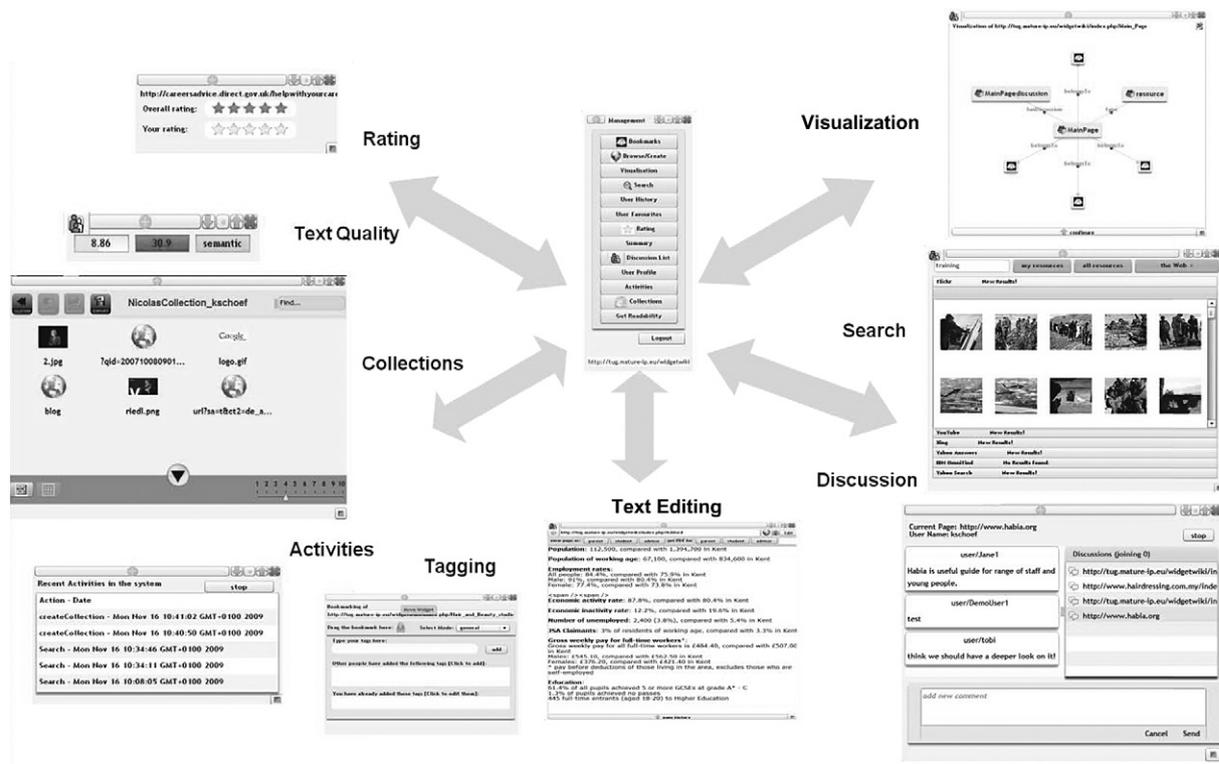


Fig 3 Interface from the assuring quality in content networks prototype.

Phased formative evaluations and findings

Each demonstrator prototype underwent two phases of formative evaluation. The first phase (conducted during the first design cycle) emphasized participatory design, relationship building, and collaboratively exploring the fit between organizational knowledge maturing problems or opportunities and potential social media innovations. These are reported fully in Bradley *et al.* (2010), and can be considered as, ostensibly, part of the participatory design process. The output of the first phase was improved prototype designs. A second phase of formative evaluation was then performed for each tool that emphasized an assessment of their acceptance by users; general suitability and ‘fit’ in introducing an informal learning innovation within their proposed contexts of use; and the degree to which they addressed, or were likely to address, knowledge maturing in their contexts.

As we cannot cover all the second phase formative evaluations in this paper, for exemplification, we focus on the highlighted people tagging tool. The evaluation of the other tools is given in Ravenscroft *et al.* (2010b), along with a more detailed account of the evaluation of the people tagging prototype.

Formative evaluation of ‘people tagging for organisational development’

User and expert evaluation. This prototype for ‘people tagging for organisational development’ was formatively evaluated within a careers guidance service and by four human resource (HR) experts based in a German university. In the first phase of formative evaluation that lasted for 3 months, the prototype was introduced to four and then eight careers guidance practitioners in a workshop setting who fed back on suitability and usability, which led to necessary technical refinements.

A second phase of formative evaluation was conducted with 15 careers guidance practitioners who used the tool for 4 weeks as part of their everyday working practices. After this usage period, an intensive evaluation workshop was performed with six people, consisting of four key representative users of the tool, along with the technical lead and an academic expert in careers advice. Due to the collaborative nature of the tool in which all interaction is public, this focused face-to-face feedback involving four users was representative and also fitted in with the reality of assembling distributed users, with busy schedules, in one physical location.

The screenshot shows a web application interface. At the top, there is a header for 'aqueduct' with a RSS icon. Below the header, a definition states: 'a conduit that resembles a bridge but carries water over a valley'. There are three tabs: 'Broader Concepts' (with 'bridge' selected), 'Narrower Concepts' (with 'Pont du Gard' selected), and 'Related Concepts' (with 'water supply' selected). Below these are sections for 'Newest Documents' and 'Interesting People'. The 'Newest Documents' section lists three items: 'Aqueduct - Wikipedia, the free encyclopedia', 'Pont du Gard - Wikipedia, the free encyclopedia', and 'LES AQUEDUCS ANTIQUES'. The 'Interesting People' section shows profiles for 'Andreas Schmidt' and 'Miguel Amerigo'. A 'Performed Dialogs' section lists several dialogues with 'show dialog' and 'continue dialog' links. On the right, a 'Dialogue Area (justfx)' window is open, showing a conversation between 'justfx' and 'eduardo' about the concept of 'aqueduct'. A context menu is open over the dialogue area, listing actions like 'Delete', 'Describe', 'Create', 'Question', 'Assert', 'Challenge', 'Info-request', 'Relate', 'Merge', and 'Reason'. The 'Relate' option is selected, and a sub-menu shows options like 'aqueduct is related to...', 'aqueduct is not related to...', 'aqueduct is broader than...', 'aqueduct is not broader than...', 'aqueduct is narrower than...', and 'aqueduct is not narrower than...'. There is also a 'Send' button and a 'Cancel' button.

Fig 4 Resources (about 'aqueducts') linked to a maturing dialogue game.

The user feedback workshop ran for 3 hours and was scheduled according to *personal statements* about users' experiences of using the prototype: *open group discussion* and *design oriented* recommendations. The open discussion followed up specific aspects that arose from the individual statements. Additionally, the developing design framework was used as a guideline for discussion about the appropriateness of previous design decisions, current design issues, and future design ideas.

The evaluation showed that the users accepted the tool, and viewed it as user-friendly and easy to understand, with its simplicity being seen as a specific strength. The evaluation also confirmed the fundamental design assumption about the 'Web 2.0' philosophy, as there was consensus about the value of a collaborative, democratic, and participatory approach to competence specification and management. However, the

lightweight tagging-based approach did raise problems with recognizing levels of expertise, with participants being hesitant to judge who was an expert and who was not. Similarly, although it was generally well liked and thought to be a useful tool for improving collaborative working, especially when people were not happy with the tags assigned by others, it was sometimes considered as an intrusion into the 'personal sphere' of individuals. In considering these potentially conflicting positions, the practitioners agreed that there is a tension between the collaborative, democratic, embedded, and bottom-up informal learning and knowledge management processes, and the more top-down, structured, and formal nature of organizational practices and competency frameworks.

The expert evaluation (by two HR professors and two high-level HR practitioners) tended to adopt a broader organizational frame, in contrast to the more personal

and experiential accounts from the careers guidance practitioners. They pointed out that this people tagging activity needed to be connected to other related functions and systems (e.g. existing enterprise resource planning systems). These experts also emphasized the need for a suitable system-culture-fit that requires flexibility and a good understanding of the organization into which the software is being deployed. For example, they pointed out that the freedom of open participation and transparency of changes might be alienating within more hierarchical organizations. Similarly, they pointed out that restrictions to the vocabulary might be needed to map to more established competence management approaches.

These findings from both the user and expert evaluations echo the previous research reported in Ravenscroft (2009), which has pointed out the difficulty of reconciling certain Web 2.0 features, such as collaborative tagging in this case, with pre-existing and more formal frameworks within pre-existing organizational contexts, such as institutional competency management systems.

Discussion and implications of people tagging. The evaluation showed that introducing the people tagging approach into an organization had to take careful consideration of its likely effects at an individual and organizational level. While people tagging was welcomed as a democratic way to assign competencies on the one hand, it was also seen as an intrusion into the personal sphere of individuals. The way in which it transforms judgements that are implicitly known by a smaller group into explicit judgements available within a larger group can be particularly sensitive. The reaction to this new level of transparency depends on the attitudes and biases of the individuals and the culture of the group.

Conclusions and key insights. Generally, the results showed the complex interplay of this social media tool and related individual and organizational practices and culture. A main finding was that it was difficult to anticipate how the effects of the system will 'play out' across different people and practices, and instead, the impact needs to be carefully observed during the introduction phases. Specifically, the results showed that: the simplicity of the system was attractive and important (being perceived as a 'Facebook for work'); although little knowledge maturing could be observed within the limited period of use (one month), there were insights into related notions of sharing and building expertise,

reflective practice, and the influence of social rules linked to technology use, and there is a need to carefully adapt this people tagging approach to particular (organizational) cultural contexts.

Discussion and implications: design, social media, and informal learning

In this paper, we have shown how an original design approach, incorporating design-based research, driven by a conceptualization of a form of informal learning (knowledge maturing) within authentic work-based contexts has produced a range of demonstrator prototypes, with three of the four prototypes being presented in this paper. These have been formatively evaluated and used in various contexts, ranging from careers guidance to the construction industry where they have been integrated into working practices with varying degrees of penetration, popularity, and use. Arguably, the most popular and successful of these, 'people tagging for organisational development' has been highlighted throughout. What has been clear and striking is the role of the design process itself in problematizing the design space and emerging requirements in action, instead of it being the development of a relatively well-defined solution to a relatively well-defined problem. We argue that this complex interplay of problem definition, technology-mediated innovation, and ongoing co-evolution of technologies and practices will be a persistent feature of designing social media for informal learning. What 'design' is doing in most of these situations is intervening in existing digital practices and reconfiguring them towards new and desired technology-mediated practices (e.g. Ravenscroft & McAlister 2008). But what exactly is 'desirable' often also emerges from the design process.

Through assessing and reflecting upon the success of our design methodology in producing four demonstrator prototype social media tools along with their substantial formative evaluation in work-based settings, we can make the following points about designing social media for the digital workplace.

First, developing or applying frameworks (which correspond to the 'conceptual model' in our design process model) that clearly characterize informal learning in particular contexts, such as knowledge maturing, will considerably assist the development of social media tools that directly support informal learning

processes and practices. While this statement seems somewhat self-evident, this level of definitional clarity is often absent in discourse about social media that tend to be predominantly about the features of particular social technologies. This paper shows three tools for informal learning and knowledge maturing and highlights the formative evaluation of one of these, for 'people tagging in the workplace', where the emphasis is on the processes and practices they support (such as collaborative competency assignment and development), and not just technical functionality.

Second, previous design-based research approaches (e.g. Wang & Hannafin 2005) need to be supplemented with a greater emphasis on context, for example in ways proposed by deep learning design (Ravenscroft & Boyle 2010). Consequently, the adopted methods need to concretely capture technology-mediated innovation within 'lived contexts'. This means that during design, we will typically need to prioritize mixed methods that work within the contextual constraints over more detached or experimental approaches that might avoid key dimensions implicated within processes and practices in play. The mixed methods that we applied in the reported MATURE project, including design studies, use cases, demonstrator prototypes and ongoing formative evaluations achieved the necessary coverage of clear conceptualization (of knowledge maturing) linked to technical investigation and innovation in work-based contexts.

Third, the design-based research approach that has been adopted (Ravenscroft *et al.* 2010a) has clearly worked well and been appropriate to the challenge of agile, user-intensive and conceptually coordinated design and evaluation needed for social media innovation. It has led to the successful development and phased formative evaluation of four related demonstrators within 2 years that have a level of sophistication beyond widespread social software, are usable, and embody an appropriate level of acceptability and contextual fit within complex working situations and practices.

Fourth, all prototypes experienced and overcame considerable challenges in achieving this appropriate level of usability and 'fit' within their contexts of use. Introducing the tools into authentic settings quite obviously perturbs the organizational context, which needs to accommodate the changes in practices, ideas, and perspectives that a new social media brings about. For example, although there was a clear need for people

tagging at an organizational level, there were different individual reactions to its underlying philosophy. In other words, the formative evaluations clearly demonstrated their role in negotiating and defining 'requirements in action', instead of showing neat fits between clearly defined organizational problems to similarly well-defined technical solutions. Collectively, this was a clear example of the reality of integrating technical innovations within (often evolving) organizational contexts.

Finally, behind a major focus on usability, there seems to be a more significant issue. While the design teams successfully made their applications usable, there was a challenge in making the user experiences 'understandable' in ways that will lead to take up within meaningful and embedded practices. The people tagging tool seemed to give some particularly useful insights in this respect. It was well liked and well understood by the users because its lightweight semantics were intuitive and its approach resembled, in certain ways, the features and functionality of Facebook. In other words, it built upon accepted levels and features of users' existing digital literacies, in an incremental way, corresponding with the importance of considering 'proximal practices' in design that Ravenscroft *et al.* (2009) have previously emphasized. It also satisfied a clearly understood need to 'find the right person to talk to', which conforms with what Draper (1998) calls niche-based success. This also accords with the approach to design that has been proposed by Ravenscroft and Boyle (2010), who have pointed out that good TEL designs 'control' affordances to produce enhanced contexts for learning. The people tagging tool did this, controlling the affordances of social networking to provide the more nuanced 'people tagging for organisational development'.

Conclusions

In this paper, we have presented and justified a methodology for developing social media systems for informal learning and knowledge maturing among knowledge workers in the contemporary workplace. The resulting methodology is tangible and reusable while being unashamedly subtle. This is because we have genuinely wrestled with the reality of conjoining the latest generation of social and semantic technologies, user-intensive design processes, embedding in authentic user scenarios and responding to frequent and incremental

formative evaluations. This work has shown that developing next generation social media, nuanced for more sophisticated purposes than (just) social networking and media sharing, is far more complex than our intuitions might suggest. Practices such as informal learning and knowledge maturing are embedded in longitudinal and evolving relationships among technologies, people, and communities, and influenced by practical, personal, and contextual constraints. Perhaps, the latter of these features is most important – the definition, role, and actualization of new technology-mediated contexts.

Practically, this means that future TEL design will nearly always co-evolve with related human learning practices, so that conceptualization, development, use, and evaluation will be a constant and ongoing spiral-like process, and no longer discrete steps towards a ‘final’ design. Perpetual beta is no longer a fashionable slogan but is now the widespread design reality that involves an ongoing dialogue among all stakeholders.

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Note

¹Note that at this stage of the design process, this ‘Design Study’ was named slightly differently from its eventual name as a ‘Demonstrator prototype’, which reflected the evolution and refinement of this tool.

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