Learning as ‘Knowing’: Towards Retaining and Visualizing Use in Virtual Settings

Demosthenes Akoumianakis
Department of Applied Informatics & Multimedia, Technological Education Institution (TEI) of Crete, Greece // da@epp.teicrete.gr

ABSTRACT

The paper elaborates on the assumption that in modern organisations collaborative learning is an enacted capability that is more about ‘acting’ and co-engaging in shared practices. In such settings, virtual learning can be conceived as an emergent knowledge process with no pre-determined outcomes that occupies multiple online and offline constituencies. Then, retaining and visualising the history of co-engagement in practice becomes a pre-requisite for effective e-learning environments. Using two case studies exploring the social production of radically different information-based products, namely networked music performances and vacation packages, the present work frames virtual learning in the traces online ensembles leave as their members co-engage (both online and offline) in socially constituted activities. The analysis leads to several findings, with most prominent the following: (a) ‘Knowing’ is accomplished through recurrent co-engagement in a designated practice, (b) Learning in online settings emerges through the intertwining of online and offline activities, and (c) Artefacts of practice need to embody critical design qualities, if they are to serve learning as ‘knowing’ in practice.

Keywords
Virtual learning, Distributed collective practice toolkits, Visualization, Online tells

Introduction

Learning organizations rely heavily on distributed information processing, which is characterized by the norms and local practices of the sub-unit, customized styles of work and situational influence on problem solving. Learning in these settings is frequently framed away from the universal, the general and the timeless and more in relation to the local the particular and the timely (Toulmin, 1990; Suchman, 2000). To grasp the basics of such learning, researchers have explored a variety of theoretical constructs. Wenger (2001) uses the notion of communities of practice to coin ‘a group of people who share an interest in a domain of human endeavour and engage in a process of collective learning which strengthens sense of community’ (p. 1). The basic idea rests on anthropological perspectives that examine how adults learn through the performance of social practices rather than focusing on environments intentionally designed to support learning. Arguably, this type of learning is outside an instructor-student-course context and more likely to be encountered in settings where the community addresses not only the technical acquisition of skills required by a specific practice, but also the informal and social aspects of creating and sharing knowledge. It is in these communities of practice that people learn the intricacies of their job, explore the meaning of their work, construct an image of the organization, and develop a sense of professional self. Then, learning becomes an enacted capability, mediated by technological artefacts and enabled or constrained by the intrinsic configurations of people, artefacts and social relations.

Visual aids are widely recognised as amplifiers of the learning capabilities of humans used to foster sense-making and process complex information. Card, Macinlay & Shneiderman (1999) introduced the term information visualization to qualify a research area concerned primarily with the interactive manifestation of complex information structures. At the time, the focus was on computational manipulation of large data sets to extract value and amplify the users’ cognition. Since then, a variety of techniques have been developed for framing ambiguous states, bringing order to complexity, making sense out of seemingly unrelated things and finding insights that are buried in data. With the emergence of networked environments, information visualization was expanded in two prominent directions. The first, coined as social visualization, seeks to provide informative accounts of the social contexts in which information is created (Gilbert & Karahalios, 2009). The second, referred to as knowledge visualization, focuses on the ‘use of visual representations to improve the creation and transfer of knowledge between people’ (Eppler & Burkhard, 2004).

This paper presents an effort to exploit the synergistic use of both types of visualization to trace aspects of virtual learning in the history of recurrent co-engagement and the socially constituted activities of an online ensemble. The focus is on learning that emerges in practice and in the course of collaborative co-engagement in the social
production of artefacts whose historical design record pre-dates and frequently determines their tangible and material substance. Earlier works have convincingly demonstrated how this type of learning can be facilitated through virtual prototypes that pre-exist certain types of consumer goods (von Hippel & Katz, 2002). The current paper extends this body of knowledge into information-based product lines such as online vacation services that pre-exist the packages in which they are embedded and collaborative music rehearsals that pre-date the live performances or recorded audio files experienced by users. In all these cases, the material and the virtual substance of the artefact become strongly intertwined in a social production process that is organized around ‘construction-negotiation-reconstruction’ cycles. It is argued that throughout these cycles, learning stands out as an emergent knowledge process that can be revealed by (a) retaining social data i.e., electronic traces people leave as they go about their daily routine and patterns of interaction fostering competence building during social production and (b) using social visualization and knowledge visualization to detect facets of collective learning.

The paper is structured as follows. First, an effort is made to review the concept of ‘knowing’ in practice and discuss the role of and challenges for visualization in fostering learning as ‘knowing’ in practice. The following section presents distributed collective practice toolkits, emphasizing how such tools can exploit visualization to capture aspects of emergent knowledge processes. Then, two cases studies are reviewed where visualizations are employed as shared practice vocabularies capable of capturing online and offline collaborative behaviour, thereby unfolding a variety of informal learning patterns during network music performance and vacation package assembly, respectively. In light of the two cases, the discussion section consolidates critical issues for supporting knowing in practice and elaborates on implications for e-learning designers. The paper is wrapped up with a summary and conclusion.

Background and Related Work

Scholarship on organizational learning tends to create a sharp distinction between knowledge and ‘knowing’, highlighting some of the challenges confronting the process of ‘knowing’ in practice. This section reviews relevant works on the relationship between learning and the process of ‘knowing’. Through this lens, it is made possible to frame e-learning in the ‘virtual tells’ of the socially constituted practice of the collaborators and assess the role of visualization in facilitating reflective action in boundary spanning collaborative settings.

Learning as ‘Knowing’ in Social Production

The concept of knowing is evident in the works of several authors, including Schon (1983), Maturana and Varela (1998) and Orlikowski (2002). Schon in his field study of five professions argued that the skilful practice exhibited by professionals did not consist of applying some a priori knowledge to a specific decision or action, but rather of a kind of knowing that was inherent in their action. On this ground, he concluded that ‘our knowing is in our action’ (Schon, 1983, p. 49). In a similar vein, but motivated by an interest on the biological roots of learning, Maturana and Varela (1998, p. 27, 29) define knowing as ‘effective action’ and observe that ‘all doing is knowing and all knowing is doing’. Recently, Orlikowski (2002) coined the term knowing in practice to claim that ‘… knowledge and practice are reciprocally constitutive, so much that it does not make sense to talk about one without the other’. A common theme in these works is that ‘knowing’ is continually enacted through people’s everyday activity; it does not exist ‘out there’ (incorporated in external objects, routines, or systems) or ‘in here’ (inscribed in human brains, bodies, or communities).

For the purposes of our current analysis, it is important to assess the means through which such enactment relates to e-learning contexts during social production. Social production is the term used by Y. Benkler to define ‘a new modality of organizing production’. Such a modality is ‘radically decentralized, collaborative, and non-proprietary; based on sharing resources and outputs among widely distributed, loosely connected individuals who cooperate with each other without relying on either market signals or managerial commands’ (Benkler, 2006, p. 60). Today, there are numerous examples illustrating how social production materializes into new and innovative products and services. For instance, projects such as Linux, Apache, Firefox and Wikipedia rely on the social production of open source software (Gilbert & Karahalios, 2009). Social production is also catalyzing traditional industries. For example, tourism is rapidly transformed from a business-to-business or business-to-customer industry to an information-based industry. Collaborative frameworks such as eKoNES (Akoumianakis, 2010) bring social
production to the forefront, changing radically the way in which products are assembled, marketed and used. Similarly, consumer good industries turn into social production processes as a means for sustaining innovation. In this vein, the notion of user toolkits for innovation (von Hippel & Katz, 2002; Franke & von Hippel, 2003) generalizes an approach where innovative user communities are provided with a means (i.e., virtual prototypes, visual artefacts and design abstractions) for articulating new design capabilities.

In all these examples, learning emerges and obtains material forms through the recurrent and socially constituted activities of collaborators as they engage in social production of some type of product. The rationale for such learning results from the heterogeneity of user demand that makes custom, ‘precisely right’ solutions valuable to buyers. As to the type of learning that takes place, it is by and large emergent and unpredictable. Arguably, in none of the examples mentioned above, can the result be foreseen from the start or replicated in exactly the same manner by different configurations of people, artefacts and social relations. Consequently, learning during social production exhibits the features of an emergent knowledge process, conceived of as embodying ‘… deliberations with no best structure or sequence; requirements for knowledge that are complex, distributed across people and evolving dynamically; as well as an actor set that is unpredictable in terms of job roles or prior knowledge’ (Markus et al., 2002).

Facilitating learning as an emergent knowledge process of ‘knowing’ in virtual settings poses several challenges for e-learning contexts. First and foremost, learning is intertwined with designated artefacts of practice. These need not be codified (i.e., documents, tutorials, slide shows) as in the case of instructor-student-course e-learning contexts, but dynamic, socially constituted and evolving. Secondly, learning is enabled or constrained by inscriptions in technology (i.e., APIs) determining not only what is retained from the activities in which collaborators engage in, but also how these remains are related to the artefacts of practice and their history. Finally, the capacity to learn is determined by the e-learning context’s (or system’s) affordances in the sense that possibilities of action at anyone time are only partially given and dependent on the intent of the actors enacting them. These translate to rather distinct requirements for visualizations aimed to serve learning as knowing in practice.

Visualizing Traces of Practice and Online ‘Tells’ to Foster Emergent Knowledge Processes

Visualization is a technology that can be exploited to capture the social-dynamics of knowing in practice. Traditionally, information visualization supports comprehension and analysis of data by individuals using various techniques (Card, Macinlay & Shneiderman, 1999). In more recent efforts the focus shifts to address visualizations in collaborative settings (Bresciani & Eppler, 2009) and knowledge management (Zhang, Zhong, & Zhang, 2010). There have been various efforts in this direction, following slightly different paths. Fisher and Dourish (2004) in their Soylent system describe how collective activity can be revealed and how single-user experience can be reconfigured to support collaborative tasks. In their Many Eyes system, Vigas et al (2007) elaborate on how public visualizations can be created using user-uploaded data and then how such visualizations facilitate large-scale collaborative usage. In CodeSaw, Gilbert and Karahalios (2009) examine social production processes in open source software development communities focusing on visualizations that impact the work of the communities themselves.

A common thrust in these efforts is to capture data that is created (locally) at remote sites and turn it into knowledge shareable and accountable by collaborators. Although this approach may be sufficient to provide informative accounts of what knowledge is articulated across sites, thus answering questions on taxonomic forms of knowledge (i.e., tacit versus explicit), networking patterns and structure, it is not immediately evident how it serves knowing in practice. Specifically, in collaborative settings where the virtual is intertwined with the material realities of collaborators, it is important for visualization to capture not only what knowledge is created or transferred but also emergent properties of knowledge processes i.e., what use knowledge is put into and how this relates to new capabilities.

There are at least two key research challenges in this context. The first is retaining and managing the electronic traces of collaboration in virtual settings. If such traces are retained in an e-learning context then visualization can provide useful insights to past and on-going practice of collaborators, thus to the learning that takes place. In this account, visualization can be conceived of as a tool for excavating virtual settlements, thereby fostering learning. The second challenge stems from the situational nature of learning which necessitates analysis of the intertwining between online and offline activities. Phrased differently, in organizational e-learning contexts learning is not only
about using knowledge to determine practice, but also about understanding how practice re-constructs or creates new knowledge. This time visualization should aim to address the more demanding tasks of amplifying the enactment of knowledge in the collaborators’ local settings and unfolding how such enactments are manifested online to enrich the community’s social capital. Collectively, these challenges motivate a research agenda that expands the potential contributions of visualization to e-learning.

**Distributed Collective Practice Toolkits as e-Learning Contexts for Organizational ‘Knowing’**

Recent collaborative R&D efforts have explored the challenges identified in the previous section in different application domains where social production becomes predominant modality for organizing collaborative work. The focus has been on building distributed collective practice (DCP) toolkits (Akoumianakis, 2009a; Akoumianakis, 2009b) to promote a practice-based perspective on distributed organizing and learning. Before presenting concrete experiences, this section provides an informative review of DCP toolkits, concentrating on their components that rely on visualization to foster learning as knowing in practice.

DCP toolkits are software components intended to facilitate co-engagement of a virtual ensemble in a designated practice. Architecturally, they are characterized by two interoperating constituents – a community management component and a practice vocabulary (Akoumianakis, 2010). Their design is grounded on practice-oriented information systems research (Orlikowski, 2002), thus promoting analysis of collaborative engagements based on technology constituting structures and cultural artefacts of practice. Technology constituting structures are broadly conceived of as functional inscriptions for community management (i.e., registration, communication, information sharing) and non-functional qualities such as connectivity, plasticity and social translucence. Cultural artefacts are traceable evidence of a community’s existence, purpose and underlying practice. A recent study presents an analysis of how these two concepts can be used to classify a broad range of collaborative technologies and social networking sites in terms of their practice orientation (Akoumianakis, 2009b).

In DCP toolkits visualizations are recruited for two primary reasons. The first is to represent elements of a practice vocabulary whose manipulation leads to acts of communication in virtual space. Typically, such visualizations employ metaphor to facilitate sense making and to anchor collaborative activity in virtual settings. The second reason is to consolidate traces of collaboration as retained by the DCP toolkit. This time visualization provides a means for excavating historical remains of collaborative practice within the virtual settlement of a DCP toolkit.

**Visualizations as Practice Vocabularies**

A practice vocabulary may be designed so as to reconstruct elements of an accepted and widely used practice or to enable change by fostering totally new practices. To this end, practice vocabularies implement primitive objects which allow assembly of more complex collaborative artefacts of various types. One category of artefacts depicts the result of individual or collective contributions, e.g., product models, standards, style sheets, etc. Another category of assembled artefacts may detail interdependencies of tasks or objects in a cooperative setting, e.g., organizational charts, classification schemes, taxonomies, etc. Yet another category may comprise artefacts that specify a protocol of interaction in the light of task interdependencies e.g., production processes and workflows, schedules, office procedures, bug report forms. Through these artefacts, toolkits allow graceful translation of the virtual, which is recognizable and accountable by all, to the local setting of different partners and vice versa. Thus, devising appropriate visualizations that afford representation of practice vocabularies serves not only the purpose of transferring knowledge across (physical or field) boundaries, but also the goal of consolidating the collective intelligence of a virtual ensemble.

**Visualizing Online Traces of Collaboration**

The second role of visualization is to represent virtual ‘tells’ of collaborators as they engage in a designated practice. This kind of visualization differs from the previous type as it is primarily intended to either reconstruct an event of the past (through its virtual remains) or to frame on-going activities of a virtual ensemble in relation to an evolving agenda. In effect, such visualizations are intended to capture social data such as the users’ actions on artefacts of
practice, messages exchanged, issues raised, postings in forums, etc. Frequently, such online traces of collaboration depict offline activities. Thus, social proxies are devised and retained to anchor the offline activity in relation to the current state in the virtual setting. These requirements make the design of visualizations more complex to implement as they are strongly dependent on affordances (or non-functional qualities) inscribed into the DCP toolkit, such as the DCP toolkit’s API, type and form of metadata, compliance to de facto standards, etc. In turn, these by and large, determine the social data retained and how they are filtered or transformed to the target data set for visualization.

**Case Studies**

This section reports on two representative case studies that provide useful insights on how visualization has been used to facilitate ‘knowing’ in practice using DCP toolkits in two different scenarios of social production, namely music notation lessons and assembly of information-based products such as vacation packages for tourists. The music notation lesson case (Akoumianakis & Alexandraki, 2010; Alexandraki & Akoumianakis, 2010) provides insights to virtual learning by reconstructing widely accepted practices based on established music notation constructs. The vacation package assembly case (Akoumianakis, 2010) presents an example where new virtual practices (and their supporting knowledge) are acquired, internalized and enacted by members engaging in cross-organizational collaboration. Despite their difference in focus, both cases emphasize learning that is emergent and framed in the social production of designated collective artefacts. Table 1 summarizes the conditions and criteria of the two cases.

<table>
<thead>
<tr>
<th><strong>Table 1. Cross-case conditions</strong></th>
<th><strong>Community setting</strong></th>
<th><strong>Shared practice</strong></th>
<th><strong>Local settings</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Music notation lessons</strong></td>
<td>Moderated squads comprising one tutor and a music learning community of peers</td>
<td>Interpreting and negotiating music scores to acquire new music performance skills</td>
<td>Identical and differentiated only by the performers’ choice of musical instrument</td>
</tr>
<tr>
<td><strong>Cross-organization product development</strong></td>
<td>Virtual alliance of business partners offering competing or complementary services</td>
<td>Negotiating details of aggregate product lines (vacation packages) by assembling services</td>
<td>Differentiated by organizational boundaries and locally instituted work practices</td>
</tr>
</tbody>
</table>

**Figure 1. The distributed music notation lesson toolkit**
Case 1: Music Notation Lessons

A music notation lesson is a multi-site engagement by one moderator (or music theory tutor) and several participants with the aim of constructing, negotiating and reconstructing a music notation so as to produce individual and collaborative music performances. To conduct a music notation lesson, moderators prepare music materials (i.e., notation, recordings, videos, etc), schedule the music lesson and invite participants in synchronous collaborative practice sessions. Participants may access shared contents in their own pace, while during the lesson they negotiate the act of interpreting music materials against their technical virtuosity. In turn, this is manifested as individual or joint music performance. There are two prerequisite for taking part in music notation lessons. Firstly, users must accept the moderator’s invitation and register to the corresponding ‘room’. Such ‘rooms’ are dedicated portlets of the Liferay content management system, which serves as the community support medium. Registration is a two-stage process where participants first become members of the community (by building their music profile) and then register to ‘rooms’. Secondly, users download the practice toolkit, which allows them to co-engage synchronously in the micro-negotiations of a music lesson. An example of this client toolkit is depicted in Figure 1. As shown, the toolkit implements a dedicated room for each participant with online material related to the music notation lesson (i.e., the replicated representation of music) and the shared resources (private space) as extracted from the Liferay room.

The role of visualization in a music notation lesson

Visualization of the designated practice vocabulary amounts to assembling static learning materials available in the Liferay portal and then rendering them through visual encodings that afford interactive manipulation. For instance, static XML scripts of a music agenda can be visualized as an interactive music score using JMusic toolkit. As a result the music score can be replicated across sites and become sensitive to collaborative actions. In effect, the music score bridges across two virtual settlements – the Liferay community where collaboration is asynchronous and the music performance toolkit where collaborative activity is synchronous and dynamic. The music score acts as a boundary object which translates knowledge retained in one virtual settlement as XML script to another virtual settlement. The translation entails much more than the technicalities of mapping elements of a source domain (i.e., XML tags) to symbols in a target presentation vocabulary (Java Swing objects of the interactive music score). It assigns meaning to an unknown context as learners need not and typically do not understand XML. As a result, through translation the scope of the learning object is enhanced since it now affords a range of uses related to or emerging from the actual performance.

A consequence of visualizing the music score is that it is now possible to retain its actual use (i.e., how it is modified and reconstructed) during a music session. Such use can be exploited to enhance our understanding of the collaboration evolving around the music score and to reveal how codified knowledge is put into practice. To this effect, the JMusic toolkit and API were augmented to establish new functionalities, including programmatic manipulation of current object of focus, single and multiple note selection, annotations, marking score segments, changing music parameters, etc. (see Figure 2) so as to establish proxies for what musicians typically do offline. Additional collaborative features were aimed for replicating music scores across sites, granting access and control, fostering awareness and social translucence (i.e., social proxies for current object of focus, participants, current floor holder), managing annotations for conveying intentions as well as visual enhancements of the music score to depict scent and cues.

(a) Pop-up menu for manipulating score elements
Limitations, revisions and concluding remarks

A number of experiments have been conducted to assess the value of the DCP toolkit for network music performance (Alexandraki & Akoumianakis, 2010; Akoumianakis & Alexandraki, 2010). Through these experiments it became evident that learning occurs as collaborators negotiate shared resources and artefacts to record a music performance. The learning outcomes include not only improvements in virtuosity or the recordable individual and group music performances, but also the dynamics of collaboration leading to these accomplishments as traced by the toolkit. In fact, these can be reconstructed at a later time to provide useful insights to what has taken place in a virtual ensemble and how a designated cultural artefact of practice (i.e., the recorded music performance) was achieved. It was also revealed that there are aspects of learning which are constrained by the affordances inscribed into the music notation toolkit. Specifically, it was observed that correct musical performance could still occur through suboptimal material actions, such as misuse or misplacement of instruments, wrong notes and erroneous rhythmic patterns, as enacted in practice. It follows that an appropriate e-learning context should be capable of revealing learning not only as outcomes but also as enacted capability. This can be achieved by inscribing new affordances into the toolkit so as to allow designated artefacts of practice to sense local (offline) actions, thus intertwining between online and offline constituents of practice. To respond to these shortcomings, score following capability was introduced through audio to score alignment and multimodal note selection.

Summarizing our experiences, several conclusions can be drawn regarding the relevance of visualization to learning through co-engagement in music notation lessons. Firstly, with respect to the taxonomic classification of knowledge visualization by Eppler and Burkard (2004), our music notation toolkit uses visual metaphors to provide a language for collaboration. The score is interactively manifested to provide a shared context of reference for the collaborators, structuring unknown contexts (i.e., XML) and/or actions and assigning them with meaning. In line with other research in HCI, the visual score and its manipulation do not match precisely the real world metaphor. Affordances enable the visual metaphor to exhibit plasticity, awareness of collaborative engagement and social translucence, thus serving as boundary artefact bridging across online and offline settings. Secondly, learning is not revealed so much from what is readily available as encoded, pre-existent and ready-to-consume knowledge, but from the enacted capabilities acquired in practice through collaborative construction, negotiation and reconstruction of cultural artefacts of practice. Detecting (or excavating) such learning amounts to visualizing online traces of collaborative behaviour and the virtual ensemble’s cultural remains (i.e., recorded performance).

Case 2: Vacation Package Assembly

This case was conceived and designed to assess social production of in-vacation packages for tourists. These are information-based products which act either as supplements to vacation services acquired through conventional means or as catalysts for selecting a destination site. Vacation packages are assembled by electronic squads which in
themselves exhibit an emergent structure. Initially, a squad is dynamically formed by all neighbours registered in the neighbourhoods (i.e., accommodation, food and beverage, transportation, cultural heritage, etc) assigned to a designated package. Although membership is explicitly confirmed, members can decide to opt out at any time. Consequently, a squad may undergo several cycles of reformation until it becomes stable. A vacation package is incrementally constructed and negotiated on the grounds of issues arising in due course. Such issues may range from setting attributes of the package (i.e., duration for certain activities) to negotiating prices or discount policies for service offerings. Once all issues are resolved, the vacation package is assembled into different possible presentation vocabularies (see Figure 3).

The left-hand instance in Figure 3 presents assembled packages in a portlet context. The annotated sequence of actions designates how a package may be explored by customers. The right hand instance presents exactly the same content augmented using social widgets for tagging, rating, commenting, etc. For electronic squads, vacation packages remain aggregate products until prospective customers externalise their intentions by reflecting upon or choosing specific vacation arrangements and business partners. This is a form of tailoring an abstraction so as to translate it into a concrete offering for specific requirements. Through such tailoring, the abstract package may be instantiated into several concrete vacation plans, all within the scope of the package family. Micro-negotiations between squad members are manifested using a different visual vocabulary (see Figure 4). As shown, the package is visualized as a two-dimensional activity panel (or schedule) with individual activities represented through social proxies referred to as elastic buttons (Akoumianakis, 2010). These are socially translucent proxies for designated services, making use of visual scent to encapsulate the history of negotiations (i.e., comments, tags, issues raised, etc) for an activity.

In such a setting, learning as enacted capability at individual, group or alliance level can be revealed through virtual excavation. For instance, at the alliance level, it is possible to assess the types of vacation packages assembled over time, how they are shaped by requirements of certain user groups (i.e., elderly versus young people) and how the alliance responds to these requirements. At the level of electronic squads, enacted capability is revealed through patterns materializing into cyber-structures such as cliques (i.e., consumption of service X correlates with consumption of service Y across several vacation packages). At individual (organizational) level, learning amounts to assessing implications of co-engagement on the business strategy of different types of partners, such as SMEs or large vacation establishments.

Figure 3. Vacation packages assembled and published using different presentation vocabularies
The role of visualization in vacation package assembly

In an effort to explore some of these issues a variety of social visualization mechanisms have been introduced in the vacation assembly toolkit. Figure 5 presents a high level depiction of the practice agenda of an electronic squad (i.e., an elaborated vacation package in the tailoring phase). The network structure depicts the members of the electronic squad (red circles in the inner part), their contributions to the specific package (i.e., green circles depicting services offerings) and the requests by prospective customers (blue ovals in the outer parts of the network). In this visualization, network links have standard semantics and serve to indicate relationships of equal strength. Nevertheless, there have been experiments with alternative visualizations where oval properties (such as size, colour and placement) and link width have been used to reveal additional semantics (Akoumianakis, 2010).

Figure 5. Exploration of a distributed practice agenda

A quick overview indicates not only structural properties of the vacation package, but also relative user preferences and competition per service category (i.e., business partners competing for the same service). As this visualization is
dynamic, it allows assessments across time intervals. Figure 6 reflects a different time instance with more requests posed to business partner 16. Similarly, it is possible to excavate changes in customer behaviour (i.e., choices made by user ‘liferay.com.1152’), squad structural properties (i.e., partners committed to or opting out) and popular service types. Cross vacation package analysis is also useful, as it unfolds recurrent engagement of peers in different practice agendas. Finally, these visualizations can also be augmented with dynamic querying features and filtering mechanisms to allow further excavation. For instance, Figure 7 and Figure 8 depict the state of affairs for business partner 16 at a certain point using clustering and/or social zones.

**Figure 6.** Aggregate account of activities, business partners and prospective customers

**Figure 7.** Exploring distributed practices by activity state
Using the explorative tools described above, it became possible to conduct assessment across different vacation packages (Akoumianakis et al., 2011) which have revealed interesting insights to learning. Specifically, it was observed that in virtual alliances partners have different conceptions of the learning that takes place and vary in their capacity to learn and appropriate the benefits of virtual networking. For some, learning amounts to internalizing a new technology that suits business objectives. For others, learning is conceived of as new capabilities and continuous attainment of improvement goals.

As an example of the latter, in one of the alliances investigated the primary beneficiaries were large vacation establishments and innovative SMEs offering differentiated products in alternative tourism. They reported that visualizations allowed them to trace behaviour across vacation packages and identify cross-sector cliques (i.e., customers visiting a cultural site tend to dine in a specific tavern, choose the same accommodation, etc) which led them to refine elements of their virtual presence and strategy. Members of the same alliance also reported on limitations and possible extensions in the current version of the vacation package assembly toolkit. For instance, it was claimed that the toolkit should allow them to share vacation packages in popular social networking sites (Facebook, LinkedIn and TripIt) as this would enable establishment of persistent micro-communities amongst customers. Clearly, these findings support the view that learning is an enacted capability which can be revealed through visualizations that do not merely consolidate a virtual settlement, but also augment it by making explicit the enacted configurations of people, artefacts and social relations.

Discussion

In the light of these exemplar scenarios, it is argued that visualization can have a profound impact on organizational learning in virtual settings – it can foster social accomplishment by surfacing traces of recurrent acting and co-engagement in practice, thus a kind of ‘knowing’ in practice. At the core of this finding are some hidden qualities that visualizations need to exhibit. In this section, an attempt is made to briefly elaborate on these qualities and assess their implications for novel organisational e-learning contexts. Hopefully, this will make the contributions of the present work more targeted and explicit.
Visualizations as Languages for Recurrent Co-Engagement in Boundary Practices

The relationship between learning and ‘knowing’ in practice has been convincingly addressed in existing scholarships (Lave & Wenger, 1991; Suchman, 2000; Orlikowski, 2002). Our contribution extends these results to online collaborative settings by claiming that visualizations can act as linguistic domains for acting and reflecting upon the history of co-engagement in a virtual practice. The above rests on a conception of visualizations as boundary artefacts fostering learning as enacted capability in communities of practice. Notably, in both case studies presented earlier, meaning and action, at any given time, are mediated by artefacts. It is the interpretive capacity of these artefacts that anchors unknown contexts and assigns meaning to vacation packages and music performance, respectively. In doing so, these artefacts implicate learnt communicative behaviours that exist only within the respective communities of practice. Thus, these artefacts constitute not only community language in the sense that members use them for ‘speaking’ to another, but also a kind of cross-community language since different communities can make sense of and reconstruct the remains of another.

The two cases bring into sight an additional perspective on the boundary role of visualization. This stems from the emphasis on the boundary between virtual and material aspects of different social worlds and the intertwining between the virtual and the material contexts of an activity. For instance, in vacation package assembly reservation for accommodation comprises a definition of accommodation as a package component (online sub-activity recognizable by all) and declaration of commitment to provide such service by members (offline sub-activity in a partner’s information system). However, ‘knowing’ in practice is revealed only through the ‘boundary to local’ translation enacted by customers and the effects this may have on parties involved. Similarly, in the music notation lesson the score becomes de-contextualized offline in the local setting of a musician, making music performance an activity that spans online and offline contexts. Once again, ‘knowing’ in practice emerges through assessment of how an online context (i.e., score) is enacted and translated into music performance. This leads to an interpretation of practice as institutions of distributed activities spanning virtual (online) and material (offline) contexts. Thus, it stands to argue that for visualizations to act as languages for recurrent co-engagement, they should be designed so as to exhibit affordances that foster translations of boundary to local and vice versa.

Implications

The case studies presented in this paper raise several implications for developers of organizational e-learning systems. Firstly, it is important that e-learning systems are designed so as to retain use. The vast majority of existing systems are designed with a primary focus on archiving knowledge (i.e., procedures, templates, specifications, etc) and facilitating sharing across and/or reuse by organizational units or parties. This limits their capacity to foster the process of ‘acting’ and ‘knowing’ which embody elements of social, dynamic and situational conduct. Web 2.0 and the plethora of technologies coined as social computing can improve the current situation. For instance, novel APIs make provisions that retain traffic and capture semantic properties of what users actually do online.

Secondly, visualization can be used to appropriate such social data so as to reveal use patterns across time intervals. This makes the choice of visualization a critical design decision. Our work indicates that instead of relying on structured visualizations with proven and accepted use in learning, such as concept maps for example, designers should explore creative options facilitated by 2D and / or 3D visualization toolkits, undertaking the effort to extend or expand them as needed. It is argued that such toolkits offer greater flexibility for articulating social data and more intuitive representations of complex phenomena.

Finally, in cases where visualization relies on virtual ‘tells’ and electronic remains, it is important that it facilitates excavation in virtual e-learning settlements. This bares implications on the design of learning objects and the affordances inscribed in the e-learning system and the visualization. Specifically, in addition to designing learning objects as collections of content items, exercises and assessments, combined based on a single learning objective, designers should focus on qualities whose presence or absence determines how these objects are used in practice. Our case studies reveal that such qualities require provisions for abstraction, social translucence, awareness and plasticity. In turn, the e-learning system should implement inscriptions that allow it to retain use in forms that can be processed to allow an understanding of how organizational knowledge is put into practice as well as how practice reconstructs available knowledge.
Conclusion

Visualization has a potentially important role in organizational learning – that of fostering learning as ‘knowing’. Our analysis builds on two different cases where visualizations are used to reveal learning and how it emerges in different configurations of people, artefacts and social relations. Both cases depict learning contexts that are detached from the traditional instructor-student-course model of learning that focuses on acquiring knowledge. Instead, they assume learning as social accomplishment, an enacted capability mediated by artefacts, and as such, facilitated by appropriate knowledge visualizations making use of metaphor to visualize domain-oriented concepts and electronic traces of collaborators. Augmentations of the visualizations make provisions for social awareness, plasticity and social translucence to facilitate boundary crossing (in each case) and the intertwining between online and offline practice.

Our main conclusions are three-fold. Firstly, visualization should aim to catalyze not only the transfer of knowledge that is ‘out there’ so that it becomes internalized and codified by the learner, but also what social practice and collaborative doing make this knowledge to be. Secondly, the power of visualization in organizational learning stems as much from symbolic mediation of organizational action as from the capacity to represent intertwined online and offline realities across different boundaries. Finally, visualization conceived of as the organizational language that mediates collaborative activity and leads to recurrent co-engagement in practice, need not be approached through the lens of re-producing online what people are used to doing offline. A more challenging option is to design for totally new practices that sustain novel (learnt) communicative behaviours and induce innovative changes of habit.

References


