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Polycontextuality: Driving Professional Change in Online Communities of Practice

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POLYCONTEXTUALITY: DRIVING PROFESSIONAL CHANGE IN ONLINE COMMUNITIES OF PRACTICE

Multi-contextualité : conduite du changement professionnel dans les communautés de pratique en ligne

Completed Research Paper

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Abstract

This paper reports on a case research project that investigated how online communities facilitate professional change. The context was an ICT professional development programme which aimed to transform teaching in New Zealand. Research indicates that transformations in professional behaviour require changes in professional knowledge – interpretive frameworks, values and methods. However, there is little understanding of how to facilitate this. We focused on this issue, guided by the question, "How do online communities of practice facilitate the embedding of professional knowledge?"

Embedding was driven by repeated crossings between engagement spaces (communication contexts) in a polycontextual system. Polycontextuality *has been linked with expert knowledge acquisition. Here, the number of contexts was dramatically increased. As individuals crossed between engagement spaces, with a shared focus, they adapted and recombined content to fit the demands of each context. This required deep engagement with ideas. Embedding was evidenced by theory-practice crossings, and personalisation of recurrent, powerful themes.*

Keywords: knowledge transfer, embedded knowledge, polycontextuality, online communities of practice, social technologies

Résumé

Cet article examine comment les communautés de pratique en ligne facilitent le changement professionnel à travers l'acquisition de nouvelles connaissances professionnelles. Ces communautés virtuelles, assistées par un système multi-contextuel, permettent l'utilisation de connaissances dans des espaces variés. Cette utilisation diversifiée rend possible l'incorporation de ces connaissances dans les pratiques.

Introduction

This paper reports findings from an exploratory case research project that investigated the role played by online communities of practice (CoPs) in professional change. The context for the research was a three-year ICT professional development programme for New Zealand schools. Its objective was to integrate the use of ICT tools into a new, student-centred teaching approach. This represented a paradigm shift for many participants, repositioning the teacher's role from a leader to a facilitator of learning, and reconceptualising 'effective practice.' The programme was not about the adoption of ICT per se, but about its use to drive the new paradigm: "*We are not learning how to use ICT, nor are we involved in developing ICT resources to match our curriculum. We are working on a new pedagogy for learning - looking at a new way of teaching"* (programme provider, cited by Cognition (2007)). The government had also positioned ICT as a driver of change through teachers' participation in online communities.

Previous research has demonstrated that transformative change in professional practice must be supported by changes in *professional knowledge* – interpretive frameworks, beliefs, values and methods (Richardson and Placier 2001), in order to be successful. Our study focused on this critical dimension of professional change, which is poorly understood. In particular, there is no theory to explain how this change might occur in the context of online communities. With the increasing uptake of online, social community technologies, and the inevitability of future changes in workforce roles driven by social, technological and economic trends, this can be seen as a strategically important area of study.

The study's aim was to identify how online CoPs can facilitate the transfer of professional knowledge, with an emphasis on understanding the process through which new professional knowledge becomes *embedded* – integrated more deeply into individual and organisational interpretive frameworks, routines and work practices. We also set out to identify the technologies, roles, and other factors that contribute to this process. Our research project was guided by the question, "*How do online communities of practice facilitate the transfer and embedding of professional knowledge?"*

This paper begins by summarising key themes in the research literature concerning knowledge, professional knowledge, professional change, the process of embedding knowledge, and the potential for online communities to support this process. Following this, it outlines the context and motivation for the study, and the research design and method. This is followed by a summary and discussion of the research findings. The paper concludes by considering the implications of these findings for future research and practice.

Literature Review

Changing Meanings of Knowledge

Throughout most of the twentieth century, knowledge was seen as being the outcome of a person's education and experience. Contemporary educational theorists, however, have come to view knowledge as being fluid, generative and performative (Bereiter 2002; Gilbert 2005). This view aligns with knowledge management theory, in which the primary value of knowledge is seen as being in its use (Brown et al. 1989; Dunford 2000; Nonaka and Takaeuchi 1995; Snowden 1999). This new perspective on knowledge and its value is leading governments to transform school systems to deliver this new paradigm and build a foundation for the so-called knowledge economy (Gilbert 2005).

This change has profound implications for teachers. It signals a shift in their role, from being a leader and instructor, to being a broker of learning, and requires a transformation of their practice and professional knowledge.

Professional Knowledge and Professional Change

Professional knowledge is the knowledge which underpins a person's performance in their professional role, such as an engineer, a project manager, or a teacher, and which they use to interpret, understand and execute their day-to-day work. While professional organisations concern themselves with codifying profession-specific knowledge, at the individual level, professional knowledge is both unique and impossible to capture. It is highly contextualised, personalised, and activity-oriented, being deeply interwoven with a person's professional experiences and interpretive frameworks (Borko and Putnam 1996; Bromme and Tillema 1995; Elbaz 1983). Workers continually reconstitute their *knowing* across time and different contexts, and as they change their practices (Orlikowski, 2002). The blended, somewhat amoebic quality of professional knowledge is aptly conveyed by Davenport and Prusak's description of knowledge as *"a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information"* (1998, p.5).

Embedded Professional Knowledge

Professional knowledge can be seen as a type of *embedded knowledge.* Embedded knowledge is knowledge that has become strongly contextualised (localised, customised, and/or personalised) and tightly integrated with other contextualised knowledge. (Related terms, illustrating the variety of ways in which knowledge may be embedded, include absorbed, embrained, encoded, encultured, institutionalised, integrated, internalised and routinised.) Embedded knowledge may be tacit in nature (embedded within understandings, beliefs, processes, and/or routines) and/or explicit (embedded in documents, tools, systems and/or processes). Its strong contextual dimension and its high degree of integration with other knowledge makes it *sticky* (Szulanski 2000), i.e., difficult to 'unstick' or transfer.

With increasing experience, the professional knowledge of individuals becomes more deeply personalised (Tillema 1995) and more stable (Bennett 1992). Professional knowledge can develop into self-reinforcing structures, or schema: a blend of interpretive frameworks, attitudes, values and beliefs. These structures can make behaviour change difficult, as they can act as filters to incoming knowledge (Louden 1991, p.189), which can lead people to reject, or abandon, ideas that do not readily fit their existing schema (Handal 2004; Tillema 1995). Where the goal of professional development is transformative change, new practices must be underpinned by compatible interpretive frameworks and beliefs if they are to become embedded in practice in a sustainable way (Handal 2004; Keys 2006; Richardson and Placier 2001; Smith et al. 2005). The question as to *how* new professional knowledge becomes embedded is therefore a crucial one.

How Does New Professional Knowledge Become Embedded?

It is critical to effectively embed new professional knowledge in individuals and organisations. Unless new knowledge is embedded across an organisation, it will be unevenly dispersed and/or applied in limited ways, resulting in inconsistencies or isolated, temporary benefits. Embedding knowledge allows organisations to respond flexibly to changing conditions and new understandings, maintaining relevance and effectiveness. It also facilitates cohesion through convergence in the interpretive frameworks of employees (Sanchez 2005). Despite its undoubted importance, the *knowledge embedding process* is poorly understood. While knowledge embedding has been examined in both the KM and the broader IS research literatures, there is neither agreement about the nature of the process, nor a good understanding of how it can be facilitated. Argote et al. (2003), for instance, have identified the *embedding of knowledge in organisations* as a key topic into which research is needed.

Knowledge management (KM) research represents the embedding of knowledge as part of the larger process of *knowledge transfer* or *knowledge creation*. Some authors portray knowledge transfer as being made up of successive stages (Boisot 1998; Kwan and Cheung 2006; Szulanski 1996), with embedding occuring in the final stage(s). Others present embedding as a continual process (e.g., Orlikowski's *knowing* (2002)) contributing to *knowledge creation* (Nonaka 1998) or *organisational learning* (Argyris and Schön 1978, 1996; Sanchez 2005). These authors emphasise the importance of day-to-day socialisation in gradually transforming and aligning employee knowledge.

The above *stage-based* and *continual process* views can be seen as complementary perspectives on the knowledge embedding process. The *stage-based* views provide high level frameworks for managing change, while the *continual process* views highlight the gradual changes in knowledge that arise through day-to-day interactions. In

combination, these views emphasise the complexity of the embedding process, its reliance on various sub-processes, and its fundamentally social nature.

Despite the research frameworks cited above, there is a lack of granularity in much KM research. Many studies focus broadly on knowledge sharing, rather than on the intended result, knowledge that 'sticks', or is embedded. In addition, the majority of research into knowledge transfer has been conducted in face-to-face settings, without considering the online dimension(s) of the embedding process.

A further issue is that there is a limited understanding about how knowledge embedding occurs at the *micro level*. There is no clear consensus about how the professional knowledge of individuals becomes embedded. However, one powerful recurring theme occurs in the literature on professional learning. This concerns the need for professionals to actively and repeatedly bridge the so-called *theory-practice* duality. Schön (1983, 1987), for example, argues that individual reflection is key to professional change: an individual's understanding is seen as being continually transformed through the interaction of *reflection on action* (an individual's interrogation of practice in retrospect) and *reflection in action* (making intuitive, real-time changes to practice). Similarly, Bromme and Tillema (1995) see the professional as operating in a field of tension between *theoretical knowledge* and *professional action*, where they must continually transform new theories, integrating and tuning them to fit the demands of practical situations. Guskey (2002) and Huberman (1995) argue a bottom-up view, that outcomes from emerging practice impact on beliefs and understandings. An initial shift in attitude is needed to kick-start change, but it is the experience of successful outcomes that promotes deeper changes in attitudes and beliefs, driving further changes in practice. Leinhardt et al. (1995) view the development of teacher knowledge as a recursive process, based around the continual integration of *dualities* that arise between the knowledge gained in practice (which is *procedural, specific* and *pragmatic*) and that gained in academic settings (which is *declarative, abstract* and *conceptual*; pp 402-403).

A key problem associated with embedding knowledge at the individual level is the fact that new ideas cannot necessarily be integrated with existing knowledge. In the context of transformative change, this means that incompatible beliefs and frameworks must be *restructured* to fit the emerging paradigm (Bromme and Tillema 1995; Tillema 1995). Connelly and Clandinin (1994) found that by retelling and rewriting stories about practice and its outcomes, teachers experienced *"awakenings and transformations"* that promoted changes in their understanding (p.158). In order for new knowledge to become embedded, it may even be necessary to *dis-embed* pre-existing knowledge and practices (Malhotra 2002; Szulanski 1996, 2000).

Information Systems and the Embedding of Professional Knowledge

Given the undoubted importance of embedding knowledge, it is relevant to ask how information systems might facilitate this process. Albino et al. (2004) have noted that *"the real value of technology in supporting knowledge transfer is not yet fully understood"* (p.586). There is little empirical research that considers how IS might successfully facilitate the process of embedding knowledge, with most literature addressing this theme at a theoretical or visionary level.

Information technology to support KM has been classified by Davidson and Voss (2002) into *codification* systems, which focus on 'capturing' knowledge into knowledge databases; and *personalisation* systems, designed to connect people with each other. Various authors (e.g., Wagner and Bolloju, 2005) have suggested that these personalisation or *social* technologie*s* – such as discussion forums, weblogs (blogs) and wikis – are well-suited for supporting professional knowledge transfer in the context of online communities.

These social technologies have been shown to support personal reflection. Leinhardt et al. (1995) observed that the lack of opportunity for refective, analytical thought in the traditional workplace is the primary barrier to professional knowledge development. MaKinster et al. (2006) applied situativity theory in a study of student teachers' reflective practice in different online contexts, and found that the nature of different social online contexts impacted both on the quality and nature of reflections, and on perceptions of value. Reflection undertaken among colleagues was more valued than reflection in a private online context, while reflection among more experienced teachers was the most valued context of all. This study suggests that the social dimension of an online context may be a key variable in the knowledge embedding process.

Exploration of these social (or collaborative) technologies, such as wikis, blogs and collaborative publishing tools, in the Web 2.0 environment, is at an early stage, but this seems a promising area for future research. The social

practices facilitated by these technologies can be seen as aligning closely with the knowledge embedding practices identified by Orlikowski, Schön and others. For example, wikis allow collaborative editing (*aligning effort, sharing identity*); discussion forums provide moderators (*supporting participation*) and weblogs provide opportunities for storytelling (*retelling,* promoting *reflection, translation* and interpretation).

Organisations are placing an increasing emphasis on the use of online technologies to facilitate knowledge transfer via online communities (Dubé, Bourhis et al. 2006). One type of online community that has received particular attention in the literature is the online Community of Practice.

Online Communities of Practice (CoPs)

The term Community of Practice was coined by Lave and Wenger (1991) who studied situated learning in face-to-face apprenticeship-type settings. A Community of Practice (CoP) is a group of people who interact on a regular basis, united by a shared interest or profession, and the value that they place on learning in that area (Wenger 1998; Wenger et al. 2002). CoPs are distinguished by a sense of *joint enterprise* around a topic of interest, relationships of *mutual engagement* that bind individuals, and a *shared repertoire* of artefacts, assumptions, language, and understandings (Wenger et al. 2002). Through their ongoing social interactions with, and contributions to, the CoP – a process termed *situated learning*, individuals are seen as being continually engaged in the process of constructing their professional identity.

Online CoPs are CoPs which rely, to some extent, on ICT to connect their members (Dubé et al. 2006; Lai et al. 2005), although their members may also meet face-to-face[1]. They typically cross organisational boundaries and combine the use of traditional communication media with various online tools (such as e-mail, videoconference, newsgroup, forum, chat, on-line meeting space, shared database, website, and intranet), establishing a shared virtual collaborative space. Online interaction is seen as having the potential to strengthen CoPs by making members' interactions more visible, by extending reach and sustaining interaction when members are separated (Davenport 2004; Davenport et al. 1999), and by building an online archive of interactions that facilitates reflective practice, leading to personal learning (Davenport 2004; Hara and Kling 2002).

The emergence of interactive, social online tools has given rise to new conceptualisations of online CoPs. Some researchers have proposed that online CoPs include communities of reciprocally linked individuals within high-density areas of blogging networks (Efimova and Hendrik, 2005; Hodkinson, 2004). In blog-based communities, discussions are neither bounded by a shared online platform nor facilitated. Instead, they are distributed among the blogs of members, who employ practices such as tagging, RSS feeding and social bookmarking to monitor the conversation. Castro (2004, 2006) has argued that, in today's environment of multiple, open online communication channels, overlapping CoPs may deal with the same subject, with individuals participating in more than one community. He proposed a model of overlapping community structures called a *CoP Conversation Space Ecosystem* which is fed by, and feeds, the conversations of the community (2004, p.3).

In reviewing recent CoP developments, Castro (2006) has aptly noted that the face-to-face community phenomenon described by Lave and Wenger (1991) *"...has not disappeared, but a good part of its current manifestations show marked differences from the more traditional versions, thus exposing some underlying assumptions linked to the social, economic and technological context in which they were first made. The new observable creature does not fit well within the old theoretical framework"* (p. 3).

In relationship to our research topic, it is questionable to what extent *situated learning*, a concept designed to explain the immersive face-to-face process of professional knowledge acquisition (Lave and Wenger 1991) is applicable in an online CoP context. Our literature review has highlighted a lack of theory to adequately account for the process of professional learning or 'deep' knowledge transfer (embedding) in online communities.

[1] The term *Blended CoPs* is sometimes used to distinguish CoPs which have both online and offline dimensions from fully 'virtual' online communities. Because our study focused primarily on the value of the online dimension, we have elected to use the term Online CoP

Research Context and Rationale

Our research project sought to investigate how the process of embedding professional knowledge could be facilitated by online communities. This topic was both relevant and timely. As the literature review has revealed, the process of embedding new knowledge is known to be difficult in the context of professional change, but there is limited understanding about how it occurs, or how IS can facilitate it. Secondly, New Zealand's school system provided a context in which this topic was strategically significant. The government had outlined an urgent need to *embed* knowledge about effective teaching throughout the school system (Ministry of Education 2005a; 2006), placing an emphasis on online CoPs to help achieve this. This was underpinned by a desire to leverage a significant investment in technological infrastructure while reducing geographical barriers to knowledge transfer. Teaching is traditionally an isolating job, but in New Zealand the situation is pronounced, with nearly half of all schools having fewer than seven teachers (Lai 2005; Ministry of Education 2005b).

The topic is also of international relevance. Citing the failure of global top-down school reform initiatives in the UK and elsewhere, Hargreaves (2003) has promoted online CoPs and networks as the key to systemic educational transformation, providing opportunities for rapid, horizontal peer-to-peer, knowledge transfer. Unfortunately, there is a lack of research to support such visionary literature. As Hargreaves himself acknowledges, *"we know too little about the dynamics of on-line communities, both in general as well as in education"* (ibid, p.15).

The question of how online communities can assist in transformative professional change is also of much wider societal relevance, as individuals increase their digital participation, as it becomes increasingly mobile and social, and as the emergence of the knowledge economy forces a reconceptualisation of traditional roles and workplaces.

Research Strategy, Design and Method

Interpretivist Perspective

Orlikowski and Baroudi (1991) outline three categories for consideration when selecting an appropriate paradigm for IS research: positivist, interpretivist and critical. Researchers taking on the positivist perspective assume that reality is objective and can be studied or measured independently of the researcher. Quantifiable variables and hypotheses derived from existing theories can be tested to increase the understanding of IS phenomena under examination. In contrast, critical inquiry assumes that reality is strongly associated with the contextual and historical dimensions of the research situation. Its main goal is to highlight social inequities associated with the IS phenomena and to advocate changes where appropriate. Finally, the interpretivist perspective guides research that attempts to seek the meanings which people give to organisational structures and processes that emerge within a particular IS phenomenon. By being engaged with the situation being studied, the researcher tries to understand the research participants' experiences and report as accurately as possible the overall impact of these experiences. Our research followed the interpretivist approach.

Case Research Method

Our research was guided by the question, *"How do online communities of practice (CoPs) facilitate the transfer and embedding of professional knowledge?"* We used a Case Research design. Case Research is considered to be the most suitable strategy when the researcher has little control over events, the focus of research is a contemporary phenomenon within a real-life context, and/or if *how* or *why* questions are being asked (Yin 2003). All three conditions were present in our study. The case research approach is also considered an appropriate research method for organisational studies because of the way it uses direct observation and systematic interviewing to gather data (Yin 2003; Cresswell 2003). Our use of qualitative methods, based around the study of events in their natural settings, suits the interpretivist paradigm. Qualitative methods also have also been recommended by Miles and Huberman (1994) as being suitable for novel situations in which a depth of understanding is sought, such as was the case in our study.

Planning the Study

The context for the study was a three-year national ICT professional development programme, in which clusters of schools participated. Each cluster was made up of a group of 3-6 schools that had assembled for the purpose of the programme and agreed on a common focus. The aim of the programme was to integrate ICT into teaching practice in a way that increased teaching effectiveness, supporting a new, student-centred pedagogy. Its intent was transformative change, challenging teachers' role, their relationship with students, and their understanding of what comprised 'effective practice'.

The study used a single case design (Yin 2003) with embedded subunits. Forty one members of four clusters (16 shools) were selected as research participants. The selection was based around the identification of (a) mature online communities, which our literature review had suggested would be most likely to have succesfully embedded new knowledge in the course of the programme, and (b) clusters where distance between schools was a barrier to frequent face-to-face meetings. The maximum driving time between schools within participating clusters ranged from around 40 minutes to 3 hours. Study participants were lead teachers (change agents), teachers, school leaders (principals and deputy principals) and facilitators, based at schools in rural and provincial centres.

Data Collection

Three methods of data collection were used: conducting semi-structured interviews (face-to-face or telephone) with the participants; reviewing recorded data from online forums, blogs and other online discussion media; and reading supporting organisational documents (e.g. meeting minutes, policy documents and etc) to obtain an overview.

Each interview took about one hour. Interviews were recorded on digital audio recorders, and immediately reviewed so that key points could be noted and themes and ideas teased out prior to the next interview. Interviews were transcribed as soon as possible, and the transcriptions were returned to the participants for checking and validation.

In the course of data gathering, it emerged that a subset of key individuals belonged to a further online CoP. This fifth CoP was an unofficial, informal virtual community of distributed educators which overlapped with the official cluster communities, making particularly strong use of Web 2.0 technologies. In order to better understand the behavior and role of this community, four further members were interviewed.

Data Analysis

Our study aimed to develop theory in an area in which there is little understanding. Rather than using an a-priori model or theoretical lens, we employed an inductive approach to data analysis and theory generation, seeking the patterns, generalisations, and relationships that emerge from the data gathered. An inductive approach that iteratively generates and refines theory is viewed as being particularly appropriate for research into a *how* question, especially in an area in where there is little understanding and a lack of published theory (Creswell, 2003).

The first step in the analysis of the data involved open coding of the first interview transcript. We imported the word-processed interview transcript into a qualitative research data management computer software called NVivo[2]. The computer software created a number for each line of the transcript. We then electronically highlighted each line or a set of lines, capturing the conceptual substance. We labelled these slices of the data as concepts and assigned a conceptual code, consisting of a name and a number, to each unit. We then examined all the remaining lines in the transcript and for those lines, which represented a conceptual unit, either gave the same conceptual code or another code, depending on the conceptual similarities or differences with previous assigned codes. This process was repeated for the next interview transcript involving another participant.

The conceptual units from the first two interview transcripts were again examined for similarities or differences and grouped into clusters of conceptual units, which we called subcategories, and which represent a higher level of abstraction. This grouping process was done by the electronic indexing and retrieval system in NVivo.

[2] See http://www.qsrinternational.com

We repeated this process for all the remaining interview transcripts. As a result, new and higher levels of abstractions (categories and core categories) among these theoretical subcategories were formed. These theoretical categories and the relationships between them eventually became a 'first cut' of the emergent theory reported in the latter sections of this paper.

Findings

Overview

Three of the four clusters used online communities (CoPs with both online and offline dimensions) as a means of facilitating professional knowledge transfer. In addition, all three depended on the informal Web 2.0 community for meeting their knowledge-related needs. This distributed community acted as a bridging layer, linking the cluster-based CoPs (to which its members also belonged) to an international online CoP. All participants subscribed to a national listserv (used for programme broadcasts) and nearly all had attended an annual national conference at least once. Keynote speakers at this conference included influential thought leaders with a strong Web 2.0 presence ('alpha-bloggers').

Each cluster operated an official CoP within a national online community, hosting private forums and resource repositories. Members of the clusters also interacted regularly via instant messaging (IM), face-to-face (in the staffroom and at workshops), email, phone and SMS; and (in one cluster) video-conferencing. A number of individuals followed wikis and blogs, and those who also belonged to the Web 2.0 community had 'stepped up' to develop their own online identities. These people authored blogs, commented on the blogs of others, participated in national conference forums, and made extensive use of additional social technologies, such as RSS feeds, Twitter, and Delicious (social tagging and bookmarking) to follow each other and a group of international thought leaders and practitioners. These people were a mix of sanctioned lead teachers and facilitators and some non-official leaders. All were strongly reliant on relationships beyond their own cluster. A subset of this group also created voice-threads, podcasts, and Teacher Tube videos; and/or participated in external online CoPs (such as *Tapped In*, *Blogmeister, Ning*, and an *EduIsland* in *Second Life*), sometimes cross-posting from these external interactions to community blogs or forums. The combined result of this activity was a continual, highly distributed, platform-agnostic conversation:

"It's funny isn't (it), this whole joining the conversation, what is the best platform for it? We link up through Frappr, you[sic] r my friend in Ning, you leave stuff on my blog, I've done that to you (I think) and I've got your email address too. So many avenues to communicate and I haven't picked up the phone yet. How are we to keep track?" (Teacher's e-mail, republished on their blog)

Diverse Engagement Spaces in a CoP Ecosystem

The environment within which participants interacted was not a single, bounded, online community, but a complex socio-technological system, fitting Castro's (2004, 2006) description of a *CoP Conversation Space Ecosystem.* It can also be seen as a *polycontextual* system, made up of diverse engagement spaces – communication and sensemaking contexts, interconnected by people, their relationships, a common interest, recurring themes, and a technological infrastructure.

Each engagement space was associated with a distinct culture of use – implicit rules governing the agenda, language, tone, style and register of communication undertaken within it. For example, blogs were a semi-formal but highly personalised genre, in which authors were expected to cite one another, voice their opinions, and share their stories in ways that demonstrated learning. Blogging culture placed a high value on new perspectives on themes of shared interest, stories of novel ICT-based practice, and inspirational content that reinforced the community's belief in the potential of technology to inspire student learning. In contrast, Twitter was a highly informal text messaging tool, used by individuals to post brief text-based 'tweets' updates (often on hour-by-hour activities) to self-selected followers. Tweeting culture encouraged individuals to post as humans, boasting about successes, complaining about challenges, and using a humorous low style that contrasted strongly with their blog-based professional personas ("*What is it about Twitter that brings out the naughty child in us?"* – teacher's blog). Tweeting was a low-visibility, low risk activity that created powerful social allegiances that could be called on, for example by requesting visible feedback on blog postings. This system of specialised contexts, conventions and

genres can be seen as arising from human-technology interaction, as the community matched technological opportunities and constraints to shared and individual needs.

Different engagement spaces within the CoP Ecosystem were leveraged to support a range of complementary needs, sometimes resulting in mutually reinforcing outcomes. For example, at the outset of the programme, schools had held staff meetings to discuss challenging content and collaboratively develop forum responses. This had reduced barriers to online participation while securing conceptual buy-in, sowing the seed of a common vocabulary that was embedded through subsequent online dialogue, promoting intra-school alignment. Prior to exposing their ideas in forums or blogs, individuals often rehearsed their thinking in colleagial contexts, typically via IM or Twitter. 'Testing out' of thinking in a safe online context helped teachers to better articulate their ideas, and to improve and validate their thinking, through the input and implicit approval of respected peers.

"... it was being able to get ideas and opinions from other teachers at other schools, from a wider group, rather than just here... that validates ideas too, in that the teachers here could think, "Hey, yeah, there are other people thinking the same as us, or making the same comments, and that makes our thoughts and ideas okay." (Lead teacher, interview)

IM was also used by facilitators to drive online participation, provide off-the-record feedback on formal posts, and solicit a change of tone when a challenge was made to emerging ideas and norms. The engagement of community members as contributors and/or readers in online forums helped to mitigate the impact of traditional workplace boundaries: classroom walls became more transparent as teachers gained visibility to their peers' emerging practices and problems, and their after-hours planning and reflection processes. This, in turn, created new entry points for daytime discussions.

"(I discovered) things that, even within the school, one of the teachers who teach had been using, and I didn't know she was in the school doing that. You could then go and say, "Hey, can I see what you've done?" I could actually walk over to the classroom and say, "Oh, can you show me how to do this?"" (Lead teacher, interview)

Crossings as a Driver of the Knowledge Embedding Process

The ongoing cross-leveraging of online and offline engagement spaces, exemplified above, can be seen as a series of inter-contextual *crossings* which helped to embed new knowledge and norms at organisational level. These crossings helped to establish cultures of reflection on practice, strengthen internal relationships, and align interpretive frameworks, based around a set of shared of themes and metaphors.[3]

Analysis of communication records revealed that c*rossings* were also a key driver of the knowledge embedding process at the individual level. Crossing engagement spaces required individuals to cross between different sub-communities, different roles and personas, different literary genres and social conventions, as well as between synchronous and asynchronous modes of communication, online and offline contexts, and the work and home environments. The system of engagement spaces can be seen as creating a series of contextual dualities that needed to be continually negotiated by individuals: online/offline, visible/invisible, formal/informal, reflective/active (theoretical/practical), leader/learner, and home/work (see Figure 1).

As individuals repeatedly crossed between online and offline, formal and informal, public and private, reflective and active, and visible and invisible engagement spaces, they needed to adapt their communication approach to fit the different genres, conventions and audiences associated with each setting. This involved them in an ongoing process of recontextualisation, requiring them to translate, interpret, adapt, combine, argue, justify and re-articulate ideas. For example, a blog posting might draw on an idea stated in an online forum, but there were community pressures for the idea to be more expansive, more argumentative in structure, and more authoritative (backed with examples) in this new context. Supporting examples could be gathered from colleagues, via an IM discussion, or a Twitter exchange. The effort involved in this recontextualisation process was significant: The challenge in creating a blog or forum posting was less about how to articulate one's thinking, than working out what one's thinking was, and how it related to the views of others. This process of recontextualisation through crossings served to clarify and deepen personal understandings:

[3] The majority of research participants were leaders and change agents. The changes reported are school level trends, as seen by these participants. Within schools, teachers did not all came 'on board' with new ideas at the same time, or to an equal degree.

"My learning is a dialogue. I read, comment, cross-comment, post, hyperlink and think and link. The views of others influence my thinking- through this dialogue I have to re-define my thinking- by justifying why I think the way I do I clarify in my own head what it is that I do actually believe." (Teacher, wiki)

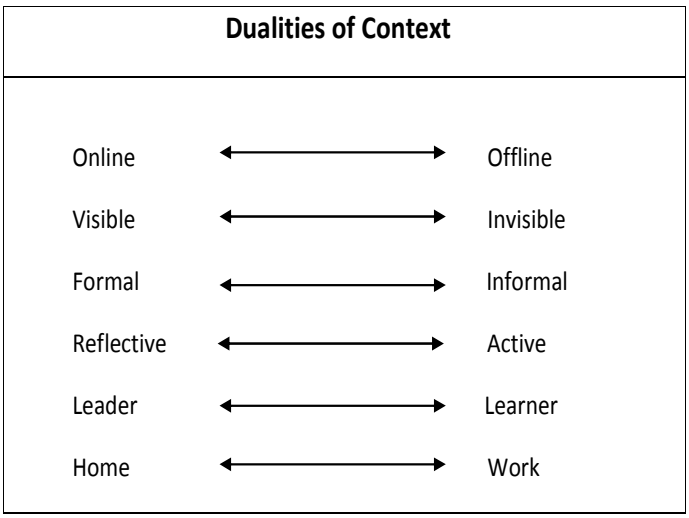

Figure 1. Crossings – Dualities of Context

Crossings also occured in real time. Members of the Web 2.0 community reported engaging in IM dialogue with peers during conference keynote speeches. By using a collaborative engagement space as a synchronous side-channel, they were able to interpret, contextualise, validate, and enrich the speech 'on the fly' through a joint critiquing process:

"After I... begun to have more contact with people within the conference via twitters it changed the dimension of the conference. It changed from being...thoughts between the speaker and myself to the possibility of having other peoples opinions i.e. the (keynote speaker's) presentation and the twitters and examples that were given in rebuttal or agreement with her presentation. It meant that I was questioning and thinking during the keynote to a higher dimension than if I was just sitting there listening to HER." (Teacher, blog)

Theory-Practice Crossings

The literature review has identified individuals' efforts to integrate and reconcile the theoretical and practical dimensions of practice as critical to development of their professional knowledge (Bromme and Tillema 1995; Leinhardt et al. 1995). Similarly, Wenger (1998) views professional learning in a CoP context as involving a continual tension between the duality of *participation* and *reification*. This theme was reinforced by our findings.

The reflective-active system duality facilitated knowledge embedding at the personal level, driven by *theory-practice crossings*. Participants used IM and Twitter for informal theory-practice exchange, while forums, wikis and blogs functioned as 'anchors' to capture and reflect on *theory-practice* crossings. The cultures of use associated with blogs and forums strongly encouraged reflection and the relating of one's practice to the theories of others. Analysis of these online records revealed a complex tapestry, with many kinds of theory–practice crossings. These are summarised in Table 1.

In addition to teachers reflecting on their generic teaching practice in light of theory, spontaneous theory-practice connections were sometimes recounted online. These were intuitive *Reflection-in-Action* episodes (Schön 1987) that had moved individuals forward in their understanding, adaptation, and application of theoretical knowledge. An

example of this is outlined in Table 1, example (b). Online reflection was also triggered by challenges. In two instances, IM was used for real-time interventions, with individuals interrupting their colleagues' teaching for unscheduled in-class mentoring, which was invisible to students (see Table 1, example (e)). This was a remarkable departure from the closed-door tradition of teaching and illustrates the potential for collaborative processes in the course of professional change. Such interventions were made possible by a shared history of engagement on a theoretical topic, the resulting visibility of personal knowledge constructs, the relationship of trust that had been built from social online activity, and a culture of openness in relationship to the context of IM use.

Table 1. Theory-Practice Crossings: Examples

Nature of Crossing	Example	Excerpt	Contexts Crossed
(a) Reflection on practice (in light of theory)	Teacher reflects on and reframes their practice in an online forum, adapting Prensky's metaphor of the teacher as *digital immigrant.*	*"As I read the article I found myself (wondering) what language I use with my class... do I speak the language of the pre-digital age because of the fact that all of my teachers did?... I will be more aware of this from now on".*	Forum/Classroom
(b) Reflection in practice (in light of theory)	After reflecting on a keynote speaker's theory in a blog, teacher makes a spontaneous adjustment to practice, adapting the theme of teacher as *game master*, later reflecting on the event on the blog, enfolding it in the theory.	*"Well it actually worked, I can't really believe it ... (He) was taking about the LEVEL BOSS at the end of video games ...Here's what I did... A couple came to me and said- "Haven't got any mistakes"... What's going on here I think. So I stand up and address the class. I tell them... Writing is like a game..... I said the level boss needs to be blasted and your only ammo are the words you are trying...I am now the Games Master and they possess a cheat book...."*	Conference/Blog/ Classroom/Blog
(c) Reflection on practice (in light of challenge to elicit theory)	Teacher reflects on the need to justify their ICT-based practice in light of theory, in response to a collegial challenge made at lunchtime. This highlights an unresolved underlying issue, raising its profile and extending its life.	*"..it suddenly occurred to me that I really needed to find out why this way of learning and teaching felt so right and it felt necessary, almost urgent for me to redefine my own personal pedagogy to ensure that I wasn't just bombarding my students with the "bells, and whizzy stuff" available on the "net" simply because it felt right or because I liked it. I'm also feeling an increasing need to be able to justify why "that's what we do 'round here"...*	Face-to-face discussion/Blog
(d) Reflection on reflection on theory	Teacher recounts an earlier spontaneous reflection that occurred while cycling, capturing and extending the recollected thoughts.	*"I was reading David Warlick's School 2.0 blog yesterday and as I cycled through the streets... I began to give it some more thought."*	Blog/Cycling/ Home/Blog
(e) Intervention in practice (to facilitate live application of theory)	In response to a teacher's forum comment about the limitations of clipart, a facilitator uses IM for an unscheduled intervention into their classroom teaching, prompting the teacher to engage students in a more constructivist approach to the use of the tool, as had originally been promoted in the forum.	*"I saw she was on the I-chat, and I asked her, "Why do you do that and what do you mean?" And she was saying, "Well, if I want them to draw a camel, they've never seen a camel, how do they know what a camel's like unless I show them a picture?"...and so she was then talking to her kids... saying "Mrs. French (the facilitator) wants to know about the camels. What are the things that camels have?""*	Forum/IM/ Classroom

The image that emerges from these *theory-practice* crossings is of two parallel ladders (theory and practice), with the practitioner crossing repeatedly between them, as they climb upwards, gradually refining and personalising their understanding.

"It was looking at the theory of teaching, and the practice…. the theory backed up what you were doing practically, and if you were doing something practically, you could often match it up with something in the theory, and (say), 'That's why we do that.'" (Lead teacher, interview)

"It sort of firms up what you believe, and then you look at what you're doing, and so you change that…." (Lead teacher, interview)

The 'theories' which teachers engaged with were typically the personalised, persuasive theories of thought leaders, consistent with the emerging paradigm, but based around strongly memorable themes. After considering polycontextuality in more depth, we will return to consider the role of memorable content in the knowledge embedding process.

Polycontextuality as an Enabler of Professional Knowledge Transformation

In relationship to our research focus – the embedding of professional knowledge – the feature of the CoP environment which made these crossings so powerful was its *polycontextuality*. Traditional workplaces are to a degree *polycontextual*, in that they comprise different communication contexts, such as official meetings, coffee conversations, email dialogues etc. Goodwin (1990) has described these contexts as professional *microworlds* that provide *"particular forms of access, structures that shape perceptions and talk, ways of acting etc."* (p. 46). Studies of expert cognition have demonstrated that polycontextuality can contribute to professional learning in situations of novelty (Engeström et al. 1995; Goodwin 1990; Reder 1993). This is because, as professionals move between different activity contexts, or participation frameworks, they integrate knowledge from, and across, these contexts, revising their knowledge in the course of doing so. The development of new professional knowledge is seen as being facilitated primarily by this movement between contexts. Polycontextuality can be seen as providing a more granular view of the work environment than situated learning theory (Lave and Wenger 1991), which has traditionally underpinned studies of CoPs. It places *boundary crossing* as central to personal knowledge transformation. KM research has also highlighted the importance of boundary crossing in knowledge transfer exercises (Anacona and Caldwell 1992; Cranefield and Yoong 2007; Harada 2003; Pawlowski and Robey 2004). The act of crossing boundaries requires the boundary spanner to filter, interpret and translate knowledge and to create mediating concepts, or boundary objects (Star 1989), such as metaphors and models. These make ideas accessible to others, and facilitate the transfer of knowledge from one context into another.

In the case of the ICT clusters, online community participation had led to a significant expansion in the number of professional engagement spaces, creating a situation of enhanced or *hyper-polycontextuality*. For active online community members, the increased availability of engagement spaces was linked with a higher-than-usual frequency of inter-professional communication, extending well outside of working hours. By leveraging social technologies to provide new contexts for reflection on practice, the system mitigated against the barriers to reflection that exist in many traditional work environments, highlighted by Leinhardt et al. (1995) as being antagonistic to the embedding of new knowledge. In one cluster, where online forum participation had been deemed mandatory, the impact was particularly profound. Each of the four participating schools reported experiencing a dramatic and unexpected transformation in workplace culture, as the online forum themes and associated culture of passionate dialogue infused the workplace:

"It created this wonderful... atmosphere of discussion about what learning and teaching was. And we weren't, by the by, discussing rubbish, and who wasn't on duty and so on, but the majority of the discussion in the staff-room was what was happening online. So, while I found the on-line discussion interesting, I was, as Principal, more fascinated by the flow-on effects within our staffroom." (Principal, interview)

The process of repeated *crossings* within the polycontextual system can be seen as a kind of engine that helped to drive the embedding of knowledge.

Powerful Content and the Personalisation of Knowledge

The complex polycontextual landscape resulted in individuals undertaking personalised trajectories of sensemaking that differed from those of their colleagues. However, this occurred within a broader environment of convergence of knowledge and beliefs. While teachers undertook repeated crossings, the themes and threads of ideas that influenced them, and which promoted community-level convergence, spread to permeate different contexts. Thematic repetition occurred across engagement spaces, with particular themes being favoured, and more strongly reinforced, by the community.

Powerful content – memorable metaphors, typically introduced by thought leaders, such as Prensky's (2005-6) *teacher as a digital immigrant,*Warlick's (2007) *telling a new story*, and the ubiquitous *teacher as learner*, facilitated the convergent personalisation of interpretive frameworks, as these motifs were appropriated, varied and recontextualised by individuals in the CoP. These metaphors can be seen as community boundary objects or interpretive anchors.

In the process of *crossings*, memorable themes had a tendency to inveigle themselves deeply into the consciousness of individuals, merging into their language and thought patterns. An example of this can be seen in Figures 2 and 3 below, where, after a series of crossings, a teacher unconsciously replicates a previously cited set of themes in a blog posting. Given the strong citation protocol in this blogging community, the absence of a citation in the final posting is significant. It indicates that the ideas have become so deeply embedded, through repetitive exposure to the original thought leader's themes and variants, that they have become internalised and appropriated to form part of the teacher's personal knowledge. The source themes, while recognisable, have been recombined, varied, and extended in the course of a value-adding personalisation process.

These findings suggest that the themes of memorability and cultural contagion are worthy of further investigation in the context of knowledge transfer in online CoPs. The mnemonic power of ideas is a key psychological factor underpinning epidemiological theories for the transmission of culture (Norenzayan and Atran 2004).

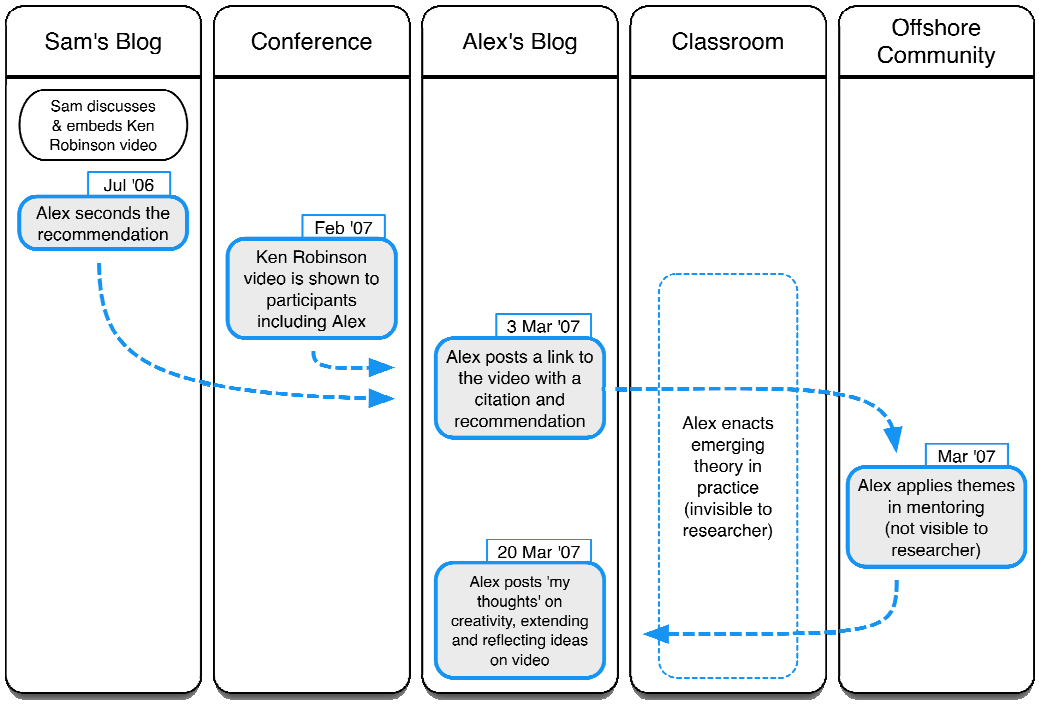

Figure 2. Embedding Memorable Themes via Crossings

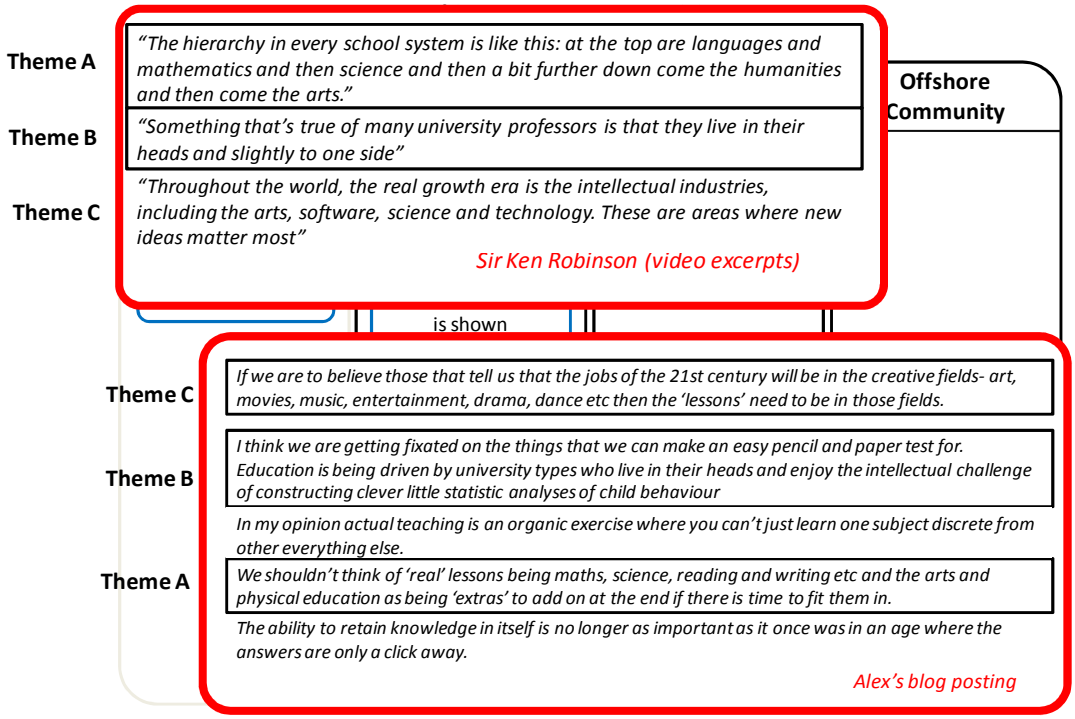

Figure 3. Embedding of Memorable Themes ('Source' Content at Top)

Summary and Conclusion

This interpretivist study focused on a complex online community, or *CoP Conversation Space Ecosystem* (Castro 2006), in the context of a professional change initiative. The aim of the research was to identify how the embedding of new *professional knowledge* (interpretive frameworks, values and methods) occurs in the context of online CoPs, helping to address a lack of understanding in this area. Previous research has shown that sustained transformations of professional behaviour cannot occur without the establishment of supporting knowledge structures. With the increasing uptake of online and social community technologies, and the inevitability of future changes in workforce roles, driven by social, technological and economic trends, this can be seen as a strategically useful area of study.

In the case studied, the embedding of knowledge supporting a new teaching paradigm was driven by the repeated crossings of online community members as they traversed multiple engagement spaces (communication and sense-making contexts) within a polycontextual system. Boundary crossing has previously been linked with knowledge transfer, while polycontextuality has been linked with professional knowledge acquisition (Engeström et al. 1995; Goodwin 1990; Reder 1993). Polycontextuality in this case was amplified through human-technology interaction, as diverse online technologies were matched to various needs, and bound up with distinct cultures of use. As individuals crossed between engagement spaces, driven by a shared interest, they had to reinterpret, vary and recombine content to fit the demands of each context. This required ongoing theory-practice crossings and a deep engagement with ideas. Embedding of knowledge was evidenced by the recurrence and personalisation of powerful, memorable content. Polycontextuality helped mitigate the impact of traditional boundaries, facilitating the embedding process at organisational level. As teachers engaged in online interactions, their classroom walls became more transparent, creating new opportunities for workplace engagement. Online-offline crossings facilitated a new culture of face-to-face engagement in the workplace, which in turn promoted deeper online engagement.

This study has the usual limitations of interpretive and case-based research, in terms of the transferability of findings. In addition, our theory regarding the role of polycontextuality and crossings does not aim to address all of

the contextual factors that impacted on knowledge embedding. For example, the programme's change-based focus, strong relationships, a layered community structure, and a collegial just-in time help system, also helped to drive embedding, and to promote convergence. The availability of 'release time', funded by the programme, was the key enabler of online participation. This raises the problem of sustainability in professional contexts where individuals have few reflective opportunities during working hours. This was not an educational study, so it did not aim to measure change in practice or its impact on students independently from participants' reports. The risk of a community of believers becoming a group of *"nodding dogs,"* as one participant put it, is readily acknowledged.

This paper contributes to IS theory by suggesting a mechanism to explain how knowledge transfer and embedding can occur, in the content of change, in contemporary online communities. It presents a complex online CoP as a set of polycontextual engagement spaces, culturally differentiated communication contexts, created by human-technology interaction as available technologies are matched to common community needs. Today's online CoPs are operating in a more complex environment than early generation CoPs. The uptake of user-centred Web 2.0 collaboration tools, and the arising distributed nature of conversations, can be seen as dramatically enhancing the situations of polycontextuality and boundary crossing that professionals have historically faced (Engeström et al. 1995, Goodwin 1990; Reder 1993). Based on our findings, we suggest that this enhanced polycontextuality, when leveraged appropriately by a change-focused community, has the potential to facilitate 'deeper' professional knowledge transfer than might otherwise occur in a situations where individuals have little sustained face-to-face contact.

Future research into online communities and social networks could further explore the impacts of polycontextuality and memorable content on knowledge transfer, for example by investigating the longitudinal impact of Web 2.0 participation on the development of personal and organisational knowledge, and by considering ways of leveraging online community infrastructures in managed change environments. The results of such research would be relevant in contexts ranging from organisational professional development programmes to societal level change programmes.

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