Chapter

Accumulating knowledge in researching technology- enhanced learning: going with the flows

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ABSTRACT

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ACCUMULATING KNOWLEDGE IN RESEARCHING TECHNOLOGY ENHANCED LEARNING: GOING WITH THE FLOWS

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Introduction

In this chapter we take up the problematic of the co-existence of two constructs, 'knowledge cumulation' and 'interdisciplinarity'. This problematic came to our attention as we worked on an 'interdisciplinary' research project funded as part of the Technology Enhanced Learning (TEL) Programme in the UK. The project is called 'Personalisation of learning: constructing an interdisciplinary research space' (RES-139-25-0368) and appropriately the research team was a multi-disciplinary one. In this chapter we focus on just one of the project aims: 'researching the discourse processes, practices, opportunities and management challenges of interdisciplinary collaboration' as well as on the concept of 'knowledge cumulation'. Both 'interdisciplinarity' and 'knowledge cumulation' are two terms that are embedded in the TEL Programme documentation. From the early stages of our research collaboration we have become puzzled by the ways in which the idea of 'knowledge cumulation' is both present and absent in our interdisciplinary conversations. In order to work with the tensions around the coexistence of the two seemingly incompatible concepts of 'interdisciplinarity' and 'knowledge cumulation', this chapter draws on actor-network theory (ANT).

Collaborations between disciplines and institutions are a key characteristic of contemporary knowledge production and professional practice. These collaborations are symptomatic of a blurring of boundaries between disciplines and institutions, which partially reflects the current emphasis on 'practice' and 'working knowledge' (Symes & McIntyre 2000), as well as on the complexity of 'real world' questions that contemporary research is currently responding to. In addition new technologies, such as digital repositories and virtual collaboration environments foreground the changes in practices around knowledge creation, where educational institutions and learners are not simply consumers but also knowledge creators (Carmichael 2007).

However while the concept of interdisciplinary 'makes sense' its realisation is often fraught and problematic. Each discipline area is located within a particular set of discourses and histories, within specific social structures using particular kinds of language – all of which inform particular kinds of research interests and

questions. Therefore at times the dialogue between disciplines occurs within a contested space requiring a considerable amount of negotiation as the participants work around various stakes, theoretical perspectives, investments and power relationships (Carmichael 2007; Scheeres & Solomon 2000). As a consequence of these negotiations, the interdisciplinary outcomes are part of the capacity building process (Newell 2001).

Not surprisingly, interdisciplinary research is understood to be an important way of approaching research in TEL. TEL crosses subject and theoretical areas including technical domains (e.g. computer science, technology); design disciplines (e.g. system design, human computer interaction design); learning fields (e.g. education, lifelong learning, cognitive psychology) and disciplines concerned with communication, communities and discourse (e.g. social sciences, linguistics). Furthermore the emergence of technologies and their use for knowledge construction means that one or two disciplines can no longer adequately provide the breadth of vision and practices that work with the complexities of contemporary life, work and learning. Appropriately (in our terms) the 2006 UK TEL Programme invited a reconfiguration of TEL research in terms of the *new collaborations* (interdisciplinary) and *new accountabilities* (users and others). This is recognisable as part of the contemporary emphasis on modes of knowledge production which indicate cross discipline, cross sector collaborations and doing relevant research (Gibbon *et al*. 1994).

As indicated earlier the research team was an interdisciplinary one. The team is made up of 12 collaborators working in the same university. They are located in different disciplines and fields (social sciences, education, human computer interaction design, computer science, informatics, and business). Included in the group are 3 professors, 3 programme directors, and 2 learning technologists. Identified in a different way there are 4 educationalists, 5 technology designers and 3 people linked with user groups. While interdisciplinary research and interdisciplinary higher education academic programme may be increasingly understood as desirable, the disciplinary homes of academics together with the disciplinary structures of universities help to sustain disciplinary identities and silo-like practices. Therefore it is unlikely that this group would have come together for an extended research project without the specific interdisciplinary conditions set by the TEL Programme and by the cross-disciplinary interest in the topic 'Personalisation of Learning'.

In the Programme call for research proposals, the conditions for investigating 'interdisciplinarity' and cross sector collaborations deploy a particular discourse that frames success, and excellence in terms of '*cumulation of knowledge*' (Understanding, creating, and exploiting digital technologies for learning 2006:6). It is possible to recognise this as a response to pressure for accountability in educational research. For example Whitty writes: 'Although the overall picture

was not entirely bleak, politicians reading the headlines and press reports could perhaps be forgiven for believing that UK education research as a whole was characterised by the following features…..Failure to produce cumulative research findings….. Theoretical incoherence ….Inaccessibility and poor dissemination…..Poor cost effectiveness..'. (2005:2). This rhetoric invokes the language of 'value for money', 'results for investments' and 'evidence-based' practice, drawing attention to the current focus on the economic benefits of education.

In response, the public face of the TEL Programme foregrounds the values of 'authentic interdisciplinarity' and equal 'engagement of users, stakeholders and potential beneficiaries'; (Understanding, creating, and exploiting digital technologies for learning 2006:5,6). However at the same time there is an implicit construction of 'cumulation' as hierarchical, incremental, additive, and progressive; and 'knowledge' as a commodity with fixed quantifiable characteristics. The form and content of the outcomes are predefined. We suggest that there is a risk that the TEL vision will be undermined if the requirement for demonstrating 'knowledge cumulation' is regarded as unproblematic rather than as a construct that for the time being does rhetorical work for reconfiguring TEL research.

What follows is a discussion of our use of a particular theoretical frame to explore the workings of our TEL research project. We use actor-network theory as it allows us to explore the complexities that we describe as a *messy* landscape of interdisciplinary research practices. Exploring our research in this way challenges the more idealised accounts of knowledge cumulation practices.

Setting the Stage

Actor-network theory (ANT) is increasingly influential in education (Fox 2005; Nespor 1994), the social sciences (Latour 2005; Law 2004) and technology design (Suchman 2007), and 'part of a shift form individualized, psychological approaches to understanding of knowledge-building to more social and cultural interpretations.' (Edwards & Nicoll 2007:187). The ANT frame offers a way of understanding this transition which is not fixed in time or space but is distributed and enacted so that 'when we act we're simultaneously interacting with the people and things in the immediate environment *and* with people and things spatially and temporally removed from us, but none the less present in the situation in some way.' (Nespor 1994:3).

Theorising learning transition in interdisciplinary research entails tracking reconfiguration of research practices and changes to the relations of power and knowledge. Interdisciplinarity implies boundary transgressions and challenges disciplinary training, habits and even identities (Andrew Barry *et al.* 2008).

We find ANT is useful in examining eddies and whirlpools in the ebb and flow of reconfigurations. In our analysis we use four ideas from ANT:

- *What becomes important?* The activity of constructing the world as textured relationships (networks), which include actants that are human, physical artefacts (e.g. computers, machines, charts) and semiotic (e.g. the idea of 'knowledge cumulation').
- *How does the stable state come to be?* The occasional stabilisation of networks which produce regimes of truth and embody rules of engagement and rituals, ways of thinking and understanding, and language practices.
- *What is invisible?* A stable network is understood as a black box which is treated as a 'fact', - where 'facts' and 'explanations of closure' suggest certainties that put aside contradictions and complexities which we might otherwise become problematic.
- *What is forgotten or simplified?* The performative activity in unstable networks which are characterised by controversies and uncertainties in the way people talk and write about groups, actions, objects and facts.

The remainder of this chapter is divided into four sections. Three of the sections start with an observation which identifies a theoretical lens and uses it to deconstruct our collaborations in terms of: 'Becoming a TEL project', 'Doing TEL project work' and 'Performing on a TEL project' (respectively). We conclude with some insights into how ANT makes the invisible more visible, and how the performative activity (including the unspeakable) can scaffold a network there by creating research practices which are somewhat different from the idealist public narrative.

Becoming a TEL Project

Our first observation is on the black boxing of the 'knowledge cumulation' construct. The term black box is used in engineering and software design whenever a piece of machinery or code becomes very complex, and the complexity is represented as a black box about which nothing needs to be known except its input and output. The black box denotes confidence in what is inside. What is inside is finished and no longer part of the research. TEL assessment criteria construct 'authentic interdisciplinarity' as the subject and object of research but in contrast 'knowledge cumulation' is black boxed. Latour writes about the effect of black boxing: 'no matter how controversial their history, how complex their inner workings, how large the commercial or academic networks that hold them in place, only their input and output count.' (1987:3).

Looking inside the black box in the context of our TEL project consider for example a flashback to March 2006.

Story 1. Behind the scene

'On a sunny Tuesday in March 2006, I went to Brunei Gallery Lecture Theatre at SOAS in London for the TEL Programme town meeting. Before going I has some hurried snatched conversations with colleagues, here are some snippets: "Why technology enhanced what happened to e-learning", "It is probably about building demonstrators"; "You need a track record of technology funding, it is hard to go in cold, who do you know?"; "Yes, xxx is shrewd, she thinks it's techie more than education"; "Interdisciplinary won't count in the RAE"; "Use your intuition if it feels like a dead end drop it"; "Makes me tired just thinking about it"; "You go for it – but I haven't got much time"; "Think of it as part of constructing our research identity, I would be good to mobilise". The briefing was organised formally in an auditorium with comfortable seats and dimmed lighting. The stage was set with corporate backdrop; this was big, real, and exciting. I came away thinking there is a shift - it felt like a new kind of questioning. It might be worth having a go if we can come up with the right story. On the other hand questions from the floor came from people who where known to the speakers (who used their first names). Those on the outside signalled - "what is in it for my business", "my University is new realistically we are not going to get a look in, are we?" I did not stay for the networking workshops (it was too late to build partnerships) but I did go back to the office and forage for clues on the web on where this had come from, to work out where it might go.'

(Constructed from researcher's diary and quotes: 10-03-07)

Uncertainty, relationships at work, pressure, lack of time, competition, conjecture, intuition, hearsay, risks and costs, search for clues, controversies this is what is inside the black box. Evidence of 'knowledge cumulation' had to be gathered, collated and constructed as part of the interdisciplinarity collaboration.

Following scene 1 a pragmatic decision was made to 'find' researchers from different disciplines but from within the same University. Most of the people approached had at some time been on the mailing list for an Open and Distance Learning Interest group. At least 5 of the final group had significant research funding in their own field and regarded her/him self an e-learning expert. Everybody had heard of the TEL call, but nobody knew 'much' about it. The problematisation was bottom up in the words used to persuade the group: 'we do e-learning, we do e-learning research, personalisation of learning is relevant to what we do, how do we become funded researchers?' The first meeting was all about mobilisation of individual assets for a common purpose.

The 'game' was to submit a credible bid for funding. Who was best placed to lead? What technology should we focus on? Who are the users? What about financial arrangements? What level of commitment? What key papers to reference? What collaborations to highlight? And the 'game had to be 'played'

under pressure: Not enough time! Not enough admin support! Exam marking! What about my sabbatical coming up? How to work around access to Je-S? Partially convinced players needed to be persuaded. Each member of the group agreed to contribute 2 sides of A4 text and provide a list of their relevant references (own and others). That was as far as anybody was prepared to commit to a venture which would be too good to miss (if it turned out to be a win) but also a risky waste of time (felt like a likely looser)!

Story 2. Nothing ventured anything gained

> Person y: So how are we going to do this, there are some big egos here?
> Person x: The only way this is going to work is if we make everybody a Co-principle investigator.
> *Refers to printed emails covered with highlighter and exclamation marks.*
> Person x: I have everybody's texts. Can't believe everybody had the same brief! We are all over the place or in different places.
> Person y: Don't try to integrate it. Use it as data and quote. Play up the 'University of business the professions' branding.
> Person x: We'll have to make the links between the publications (from the group). How do we show cumulation? The call puts a lot of emphasis on the reference list.
> Person y: References depends on who we think the referees are going to be. Include a reference of funded output from each of the agency listed in the call – don't want to hurt anyone's feelings.
> Person x: Ok so tactics! And how are we interdisciplinary?
> Person y: That's what we are going to research but we also have to be it now (laugh)
>
> (Constructed from researcher's diary and quotes: 18-03-07)

This heterogeneous account is not an arbitrary prelude to the real work. The proposal physically emerged from a series of localised contingencies, last minute decisions and workarounds. As in other accounts of constructing research, context and contents merge (Latour, 1987). The idea of temporal issues opens up a nexus of meanings. There is the sense of academics teaching time, career aspirations as in life time, and project time with deadlines, all of which compete for attention and priority.

This raw account of becoming a TEL project challenges more sanitised versions of rational, methodical 'knowledge cumulation'. It works around the need to demonstrate 'knowledge cumulation' in a certain way by co-constructing potential collaborators, materials like the 'reference lists', and ideas like the 'the University brand' - as coherent indicators of 'knowledge cumulation'. Does the co-construction of coherence change or influence the practices of people who take part or does the straight jacket of constructs like 'knowledge cumulation' result in public stances with particular audiences in mind? The performative nature of

ANT networks means that activity is closest to the ebb and flow of what is changing so we now turn to the 'doing' of our TEL project.

Doing a TEL Project

The second observation is that disciplines work through actants that are carriers of the discipline. Actants include people, artefacts and particular research practices. Disciplines are disciplinary and so regulate how we framed our activity and purpose even as it is played out in the coming together of different discourse.

Story 3. In search of method

Person x:	I really like the ANT metaphor of research as travelling on foot, at a slow pace, as a way of experiencing and seeing culture and landscape (backpacking), compared to the rapid freewheeling on the superhighway towards a fixed destination (driving).
Person y:	so that makes you a backpacker when you say here: 'From the project's inception (during bid writing) the group has collectively and individually generated discursive texts. The conversations in our meetings have been recorded. In addition we have also assembled quotes and thick accounts from online and face-to-face communications and field notes from observation.'
Person n:	the project needs more structure a super highway to travel on?
Person x:	no point in building one lets pick a motorway a kind of 'Route 40' that people know about.
Person y:	you mean carefully select DELPHI (Lempert *et al.* 2003) as a tool for structuring our conversations. 'The group began by asking what are our research questions, and how can we build on current theoretical frameworks, issues and findings?' Drawing on discussions at face-to-face meeting a questionnaire was developed. The questionnaire was distributed online and extended textual responses were collected for 12 questions**. This was followed up with discussion, abstraction and refinement of various positions and changes.'
Person x:	doesn't sound like ANT except DELPHI becomes an actor….

<div align="right">(Constructed from quotes, technical reports and DELPHI questionnaire 29-03-
07, Metaphor in Latour, 2005)</div>

** The questionnaire included the following questions:
What do you understand by 'interdisciplinary'?
What do you understand by 'knowledge cumulation'?

<div align="right">(DELPHI questionnaire round 1: 11-12-07)</div>

Some terms are a common part of the research world even though uses, customs and practices vary radically, e.g. methodology, research questions, and data. This is not the case with the phrase 'knowledge cumulation'.

Story 4. Never heard of it

Person x: I'm looking at the responses to the question: 'What do you understand by knowledge cumulation?'

Person y: It seems people have things to say about 'research questions', 'methodology' etc. but when it come to 'knowledge cumulation' it is a blank.

Person x: Yes comments like: 'I simply don't use this term' , and 'I don't know the term', and 'This is not a term I am familiar with'. Some people link it to interdisciplinarity for example: 'Is this meant to refer to the interdisciplinary dimension? The whole better than the parts? Or longevity, the older the wiser?' and 'Does it refer to the fact that bringing people from different disciplines together means that the overall body of knowledge is enhanced?'

Person y: It might be because the question is at the end, but saying nothing at all is different to saying what does it (knowledge cumulation) mean. Most people just aren't familiar with the phrase.

Person x: Some of the group want us to get on with it ….you know knowledge cumulation…

<div align="right">(Constructed from quotes Responses to questionnaire round 1-03-07, and quotes: 12-03-07)</div>

So is 'knowledge cumulation' a new idea or new to some people in the group? At some level, in the bid writing, we responded to national and international discourse around what counts as cumulative knowledge, and how this is negotiated, represented and warranted (James & Brown 2005). This was constructed on behalf of the group by the application writers. On the other hand 'knowledge cumulation' may have other labels and no label at all and still be embedded in discourse. The question of *what is* 'research' and 'progression' for our TEL project is a localised version of the multiple co-existing discourses around 'knowledge cumulation' and 'interdisciplinarity' in the governance of the TEL programme. This is evident in controlled conflicts in story 5, and account of how interdisciplinarity is understood in story 6.

Story 5: Getting on with research

'At the first meeting people in the room divided broadly but not cleanly into two camps. C1 is tentatively called "applied technology science" (the e in e-learning), and c2 is even more tentatively called "learning /education". C1 came with artefacts (lap top, PDA) their mobiles were visible and ready. In-between times the conversation revolved around devices, hints and tips on "must have" technologies, and can't wait for (this or that) technology. C1

people "demonstrated" and "explained" to camp 2 people, who responded with (forced) ohs and ahs.'

<div align="right">(Researcher's Diary 09-12-06)</div>

'At one stage availability of the domain name 'ourspace.org' was checked before we could discuss this as a possible short name for the project. The response via wireless was not questioned even though the initial answer (yes) was inaccurate. The technology empowered those in possession of the technology to influence the act of naming.'

<div align="right">(Researcher's Comment 24-11-08)</div>

Frustrations became to surface as the group struggled to understand itself.

'Is this about interdisciplinarity or is it about personalisation of technologies', 'what are our research questions', 'when are we going to start', 'what are the milestones', 'Shouldn't we be using technology on a technology project'. Technology solutions to the 'problem' of slow progress were offered; 'I use a really good online project management site and it is free'. 'We need to be pushy and show visibility what about a streaming video of our meetings'. This jarred with voices from elsewhere, 'we have already started – this conversation is part of the research', 'this is not only a technology project'. Back again: 'but what do we do with this stream of text and talk how does it answer real research questions not just exploring'.

<div align="right">(Constructed from quotes: 20-03-07)</div>

It seems that in the doing of our TEL project we rejected the label 'knowledge cumulation' but different senses of this emerged in our activities anyway. The activity is not so much consensus, synthesis, and integration but more like speaking different languages, identity assertions and conflict management. Disciplines do not frame research questions in the same way so framing common research questions is a stumbling block even when the topic (in this case personalisation of learning) is shared.

Performing on a TEL Project

The third observation is the uncertainties around the meaning of actions, objects and facts when different people and people in groups are acting out (performing) interdisciplinary activity.

Each researcher expressed strongly that their involvement in the project was part of an existing identity coming out of a personal history that provided them with relevant research capabilities. In many different acts online, in face-to-face meeting, formally and informally, they reiterated a simple faith that interdisciplinarity made sense. Everyone in the group saw her/himself as a person

who has crossed boundaries, for example between different types of work, between academia and industry, across sectors and disciplines. However interdisciplinary identity work brings into play disciplinary identities that go beyond subjective border-crossing skills to include particular kinds of research interests, questions and languages. Therefore the construction of interdisciplinarity is regulated by the disciplines. Consider for example the differences between the three positions in story 6.

Story 6. I do interdisciplinary (already)

A postmodernist position: 'Knowledge cumulation and interdisciplinarity is just another way of talking about research, we can move the idea about and use it in different situations for different purposes, for example: public narrative (presenting ourselves); gathering (appropriating ideas to fit our frames of reference); entrenchment (I'm right); and identity work (this is what I am).'
Applied science position: 'Interdisciplinary means the bringing together of 2 or more disciplines to work on a problem of shared interest and importance. For example in project xxxxx environmentalists, engineers, and software developers worked together in an interdisciplinary team. The environmentalists were concerned with accuracy and amount of knowledge and information available. The software developers were concerned with efficiency and architecture, and the users (expert or novice) were concerned about the simplicity of the search interface and general ease of use.'
Entrepreneurial position: 'If people work together they soon co-develop…, for example as a result of the national teaching fellowship scheme, genuine interdisciplinary partnerships have arisen. I am working closely with a professor of drama. Xxxxx in Law has been working with an expert in dance. We have called this: extreme collaboration.'
(Constructed from quotes, technical reports, meeting notes, and DELPHI questionnaire 20-03-07)

As a group we accepted and embraced the label 'interdisciplinarity' but seem to interpret this from particular disciplinary perspectives. The juxtapositions in the story suggest at least the potential for irreconcilable conflict, but there are other performances, which contain the situation. In particular interpersonal alliances contained frustrations behind the scenes. In the collective forum (i.e. face-to-face meetings) care was taken to avert open confrontations though the use of humour, the sharing of chat and personal details, and the use of the terms 'we' to suggest group cohesion. The key driver for this reserve and discipline came from a shared commitment to work together. But there was multiplicity in enactment and understanding of the shared commitment. Consider the diversity in the small sample in story 7.

Story 7. Sure I'm committed

Funding. 'I know the meeting (was) challenging …but at the same time re-affirming our commitment to work towards the larger bid'
Research. 'Between us we have got to go to every TEL seminar event and make contacts with the other capacity building projects – this is our chance'
Career. 'Can you give me the Ourspace project website address I'm applying for promotion.'
Enterprise. ' The spin-off company is interested in what inter-company collaboration'
Institution. 'Now It's Personal' Learning Futures week around the themes of personalisation of learning and the future for educational institutions in 2020'
(Email 10:12:06; conversations 20:01:07, website 02:05:07)

Law writes: 'Realities are not explained by practices and beliefs but are instead produced in them' (2004:59). Considering how our TEL project was performed demonstrates the uncertain and complex lives of people, physical artefacts and semiotics.

Conclusions

Interdisciplinary research is influenced by all the personal, historical and cultural practices that shape disciplinary research. The ANT way of 'looking' makes the invisible more visible and shows that stipulating 'interdisciplinarity' and 'knowledge cumulation' is not enough to reconfigure the landscape of TEL research.

In the final report for our project we made two claims: (1) Interdisciplinarity is about understanding and enabling a strong and sustained commitment to work together; and (2) TEL interdisciplinarity is about working with disciplinary differences rather than battling though them. While we stand by these findings, this chapter demonstrates that these claims are relative.

In spite of the complexities and tensions in working as an interdisciplinary team we continued to work together until the project ended. Why was this? Is it that: 'The "coming together" seems to work best when it is not imposed but rather when it is motivated by a shared need – be it a research question or a concern with professional practice.' (Responses to questionnaire 01-03-07). But then again, at times, the shared purpose is questionable (see story 7).

Perhaps another answer is that in spite of the irreconcilable interdisciplinary conflicts, there is the potential of another project. We cannot ignore other actors on our institutional stage, and those actors are 'income' and 'academic prestige'. Funded research carries status and power. If we dig deeper into the black box of

'knowledge cumulation' what will we find? The unspoken - that, perhaps 'knowledge cumulation' is warranted by an accumulation of research income?

We show in this chapter that 'cumulation of knowledge' is constructed in a particular way. This however is not a revelation because everything is socially, culturally and historically constructed. Rather the issue is that the actor 'cumulation of knowledge' makes (or implies) contestable claims about its relationship to another actor called 'The TEL Programme'.

Acknowledgement

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