

Infrastructures, institutions and networked learning

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Abstract

The use of networked technologies has become ubiquitous in universities in advanced industrial countries. The same physical spaces may still be used for teaching but an infrastructure to support digital technologies is now in place allowing the widespread use of high speed networks and Web 2.0 services by academic staff and students. Institutions of higher education have a set of interests in making their investments in networked technologies productive and effective and they have to choose how far the institution should develop their own means of support and how far they should rely on publicly available resources and networks which are then used for educational purposes. This paper explores one institution and seeks to illuminate what kinds of questions are asked when a new institutional initiative to supply networked resources, including Web 2.0 services, takes place and how those decisions are taken. What is the infrastructure for networked learning and how does it come about?

Keywords

Institutions, infrastructure, policy, practice, Web 2.0.

Introduction

Most academics do not have control over the infrastructures they employ for teaching. In face to face settings rooms are often booked centrally and academics rarely have a decisive voice in the design of the physical spaces that they use. In the new teaching and learning environments infused with digital technologies there is a remediation taking place. The current phase of this remediation takes place in the context of a shift towards what are called Web 2.0 services. Networked learning uses a network infrastructure that is supplied and often controlled by others. In some cases these are specialist units within higher education institutions in some cases they are national bodies or in other cases some aspects of control are delegated to external bodies. If we think of the ways in which text is now supplied as a resource for teaching and learning the locally based library is still a focus for organising and supplying certain texts but many of these are supplied by international publishers and national repositories while other ephemeral texts lie outside library control. The single point of contact through a library may hide a complex of internal and external relations. This institutionally focused supply of resources also takes place in a context in which the first port of call for academics and students alike is likely to be a search engine or Wikipedia. Whilst both teaching and learning and the supply of resources are governed by legal regimes, policies and procedures, fundamental aspects of local practice, including networked learning practices, are influenced by largely infrastructural factors. This paper examines what we might mean by the term networked learning infrastructure and how it becomes part of the mundane practices of a higher education institution.

This paper, working from this theoretical platform, specifically examines the early stages in the design and development of a new Virtual Learning Environment (VLE) in a UK distance university (In other countries this might be termed a Learning or Course Management System). The research relies on participant observation and interviews with key informants who were concerned with the selection and development of the VLE up to the first major release. The VLE contains tools such as blogs, wikis and an e-portfolio and it clearly aims to move the institution into the perceived world of Web 2.0. A question remains, however, about how far these technologies and the social practices associated with them are compatible with the institutional aims of the university and the ways in which the technological infrastructure will interact with local pedagogical practices.

Infrastructure

The term infrastructure is in common use and we wish to begin from this common understanding. Infrastructure relates to the often unremarked upon elements that support day to day interactions. It can apply to the sewerage system, the roads and the utilities such as gas, electricity and water. Infrastructure though often out of sight comes into sharp focus when it fails. In the summer of 2007 floods in the United Kingdom suddenly focused public attention on the vulnerability of water and electricity supplies. On a much grander scale the plight of New Orleans after hurricane Katrina was a classic example of infrastructures failing and in that failure immediately becoming highly visible. A striking feature of this view of infrastructure is the way in which it affects developed modern societies most deeply. Indeed infrastructures are arguably a defining characteristic of the modern era and equally the digital infrastructures of the just-in-time, global and instantaneous, can be thought of as a defining characteristic of what has been termed the post-modern.

Edwards discusses infrastructures as socio-technical systems, which though they are often viewed in terms of physical hardware are reliant on complex organisational practices for maintenance and to make the infrastructure meaningful. For example infrastructure is not just composed of the pipes and pumps that form part of a water system, it is also composed of the organisational elements that allow the infrastructure to be maintained and understood and to become so reliable that users of the infrastructure rarely have to think about it. Edwards makes the point that this 'background' feature of infrastructures is in some sense definitional for an infrastructure.

“the fact is that mature technological systems - cars, roads, municipal water supplies, sewers, telephones, railroads, weather forecasting, buildings, even computers in the majority of their uses - reside in a naturalized background, as ordinary and unremarkable to us as trees, daylight, and dirt. Our civilizations fundamentally depend on them, yet we notice them mainly when they fail, which they rarely do. They are the connective tissues and the circulatory systems of modernity. In short, these systems have become infrastructures.” (Edwards 2003 p 186)

As socio-technical systems they rely on an integration of artefacts of various scales and kinds with social and organisational features in a constant dialectical process.

Star and Ruhleder criticised the common usage of infrastructure and posed the difficult question 'When is an Infrastructure?' (Star and Ruhleder 1996). They were concerned most particularly with the notion of 'sinking into the background' because they viewed infrastructure as a relational concept and did not accept the commonsense view of an infrastructure as the substrate upon which other things ran.

“we hold that infrastructure is a fundamentally relational concept. It becomes infrastructure in relation to organized practices. Within a given cultural context, the cook considers the water system a piece of working infrastructure integral to making dinner; for the city planner, it becomes a variable in a complex equation. Thus we ask, *when* - not *what* - is an infrastructure.” (ibid p113)

Stressing the fact that it is the use context and use practice that defines whether or not a given technology becomes an infrastructure Star & Ruhleder suggest eight dimensions of infrastructure:

- Embeddedness (integrated in social structures and practices)
- Transparency (can be used without removing focus from the task)
- Reach or scope (goes beyond individual tasks or processes)
- Learned as part of membership (an inherent part of an organization)
- Links with conventions of practice (shapes and is shaped by practice)
- Embodiment of standards (builds on standards and conventions)
- Build on an installed base (must relate to existing technologies)
- Visible upon breakdown (loses transparency and is drawn in focus when it breaks down).

These dimensions are of a very general nature and they could characterize a wide range of phenomena, which points to the potential ambiguity and complexity of seeing infrastructure as a relational concept. Star and Ruhleder argue that an infrastructure occurs when the tension between local and global is resolved, when local practices are afforded by a larger-scale technology, which can then be used in a natural, ready-to-hand fashion (Star and Ruhleder 1996 p.114). We might think of how these dimensions apply to networked learning. It is generally the case that digital technologies are integrated in social structure and practices but it is less clear that they are transparent. Often teaching staff and students find

the technology a distraction from the task at hand. The reach of the technological infrastructure in tertiary education is now well beyond individual task and processes but in many cases it is not learned as part of membership and there are many development programmes specifically targeted at making the infrastructure an inherent part of university organisations. The digital technologies deployed are now linked with conventions of practice and standards are widely in place. The installed base in universities is now long standing and part of a process of continuous renewal. Many of us will already have experienced the sudden and disruptive breakdown when technologies that are now relied upon suddenly breakdown. This can simply be the failure of email, but it can be the failure of a submission system for assessed work at a critical point or an asynchronous conferencing system failure mid-course. Overall I think it is clear that digital technologies now form part of a widespread infrastructure in tertiary education.

Information infrastructures

Before moving on to consider infrastructures in the context of learning it is worth pausing to consider whether there are any particular features that apply to infrastructures used in work contexts and those concerned with information in particular. Infrastructures in digital environments carry forward the notion of socio-technical systems in which the social and technical are inextricably intertwined and artefacts and technologies are linked together with organisational and social practices to make an infrastructure. Hanseth and Lundberg examined what they called information infrastructures in the context of complex work organisations. They pointed to the following features of an information infrastructure.

Infrastructures are *shared resources* for a community; the different components of an infrastructure are integrated through *standardized* interfaces; they are *open* in the sense that there is no strict limit between what is included in the infrastructure and what is not, and who can use it and for which purpose or function; and they are *heterogeneous*, consisting of different kinds of components – human as well as technological. (Hanseth and Lundberg 2001 p349)

While Hanseth and Lundberg were examining work in a medical setting and patient's records in particular these features may also be relevant to education infrastructures.

Information infrastructures are shared as opposed to private, a Virtual Learning Environment (VLE) rather than a standalone application. They rely on standardised interfaces between components which allows the different elements to combine to provide an integrated whole in the form of an infrastructure. Infrastructures are open and heterogeneous in the sense that they are theoretically open to any number of users, components or computer systems linking to them. In this sense infrastructural systems are like the internet and web rather than closed systems. Hanseth and Lundberg go on to distinguish between work oriented infrastructures and what they term 'universal service infrastructures' intended for the use of all citizens (Hanseth and Lundberg 2001 p365). In education we are generally dealing with some kind of admixture of these two, with a constant movement between local infrastructures oriented specifically to learning, such as VLEs, and wider infrastructures that impact heavily on learning, such as search engines.

Infrastructures for learning

This sense of infrastructure has also been applied to learning and carries with it a suggestion of where design is situated in relation to infrastructure for learning.

“An infrastructure for learning is a set of resources and arrangements – social, institutional, technical – that are designed to and / or assigned to support a learning practice.” (Guribye and Lindström 2008 forthcoming)

This focus on infrastructures 'designed to and/or assigned to' takes the idea of work oriented infrastructure and applies it to learning. Guribye distinguishes between the notion of work oriented infrastructure and infrastructures for learning by pointing out that infrastructures for learning do not necessarily have to be designed by the users and might commonly be designed by a variety of actors (Guribye 2005 pp 63 and 64). It is a useful approach to examine those internal infrastructures that form part of the learning environment as it is experienced by the student and as part of the teaching environment deployed by academic staff. However we must still be cautious in the use of this revised approach because it explicitly excludes areas that are arguably of central importance in networked learning environments; that is those parts of the infrastructures that are both not designed *nor assigned* to support a learning practice, but which are routinely included in learning practices. An obvious example of this is the routine use of Google as the search engine of choice by both students and academics (Brophy et al. 2004 p11). More generally Web 2.0 services such as Facebook have a relationship to educational institutions and student learning practices but lie outside institutional control.

Potentially it is a serious mistake for those planning and designing new networked learning environments to attempt to provide a 'walled garden' within which learning activity takes place as the nature of new technologies is that they routinely breach those attempts to provide 'quality assured' safe areas in which media and technologies are under routine control.

The Open University VLE

This paper is interested in the ways these ideas concerning infrastructure can be related to the institutions of higher education and the Open University (UK) in particular as it deploys a new technological platform. Since 2004 the Open University has had a VLE project aimed at the deployment of new tools and the integration of a range of existing tools and technologies into a recognisable and unified whole. The Open University (UK) is a purely distance education based university. Courses are generally large and the university operates on an industrial scale with 250,000 registered users and the largest cohorts of students reaching over 10,000, though to put this in perspective this limit is exceptionally large and the Open University also provides course in which cohorts are in hundreds and in exceptional cases below this (e.g. the Masters in Online and Distance Education). The university has to work constantly with two main constraints, those of working at a distance and at scale. These demands and the centralised core and periphery model of the Open University, with core academics and key services being supplied from a central campus and tutoring being supplied locally through full-time regional centres and part-time associate lecturing staff. This pattern of large scale industrial production of courses, allied with a different pattern of student needs, has led the Open University to develop some of its own tools and technologies and to adapt externally provided systems, such as FirstClass computer conferencing which still provides the backbone of much online provision (for a fuller description of the OU VLE programme see Weller 2007 pp 129 – 135).

As part of the process of preparing for this large cross institution project an audit of current systems and projects was undertaken, which revealed three separate e-portfolio projects, and two related but distinct calendar projects (Weller 2007 p131). Part of the intention behind the OU VLE project was to draw together the different strands of development, related to particular course or programme needs into a more uniform approach that integrated the various elements into a single system. The original aim was to take the current systems and services and to integrate them into an open architecture based on interoperability. In the event a decision was taken during the course of the project for 'practical considerations' to adopt Moodle as a compromise between an in-house solution and a commercial solution (Weller 2007 p135).

This paper uses 12 key informant interviews with Open University staff engaged with the VLE in a variety of roles to examine how institutional and infrastructural issues played out during the process of the OU VLE project. The interviews were semi-structured and conversational in form. The interviewer had a standard list of areas to ask the interviewee about but the order of questions was flexible and the questions themselves built upon the previous comments made by the interviewee. For example:

So if I just asked you to amplify a bit more about your personal involvement, the involvement prior to the current VLE Programme, where you're personally involved?

A panel of people were selected and asked for interviews to represent all aspects of the VLE programme, 15 people were approached and 12 interviews were agreed. The group interviewed covered all main groups of VLE programme staff. The interviews took place in June and July 2007.

Institution and infrastructure

The OU VLE project which began in 2004 set out to:

- position the OU as an innovative, top quality, high profile elearning provider in the UK, Europe and other overseas markets, for staff, ALs (Associate Lecturers), students, clients and partners;
- increase the value of the online learning experience to the learner;
- facilitate partnerships;
- enable OU staff to rapidly and efficiently deliver pedagogically appropriate elearning processes that directly enhance distance students' learning (whatever the course model in use).

Open University VLE Project Phase 1 Final Report December 2004.

The VLE project was developed into a coherent VLE programme that was to develop an overarching plan and a series of business areas for development. The OU VLE programme began in 2005 and a fixed term post for Director of the VLE programme was appointed in October 2005. The aims of the OU VLE were clearly institutional in form, speaking about the university's aims and interests and positioning the University as a supplier able to 'deliver' learning processes. The OU VLE is then a good example of an institutional approach to a learning environment and the OU VLE is set up within 'garden walls'.

The current OU VLE Programme Director has commented in his blog on the need for central functions to be integrated and under institutional control:

One of the questions which crops up regularly at the OU is why we're enhancing tools such as blogs and wikis within Moodle when there are better ones out there on the Internet which we could give access to instead. Why don't we just provide WordPress and MediaWiki which have a lot more features than their Moodle equivalents?

This is a wonderful concept. Grab the best of the open source software out there on the Internet, install it on University servers and roll it out to all our students. I wish it was that simple <http://sclater.com/blog/?p=38>

He goes on to provide four reasons why he thinks it is not so simple:

1. The University can provide a pool of expertise supporting one system
2. External products have divergent interfaces and do not provide the same support for accessibility and useability
3. Integration of the various tools would be difficult across different systems
4. A single system means no need to replicate across databases and a single authentication process

The heart of the question lies in the interrelationship between the technologies and institutional requirements built into the practices of the University. The walls around a University and its technologies are not technical requirements per se; they are the requirements of the University as an institution. This reminds me of the phrase used by James Cornford - The Virtual University is ... the University made Concrete? (2000).

The institutional requirements for integration and a degree of uniformity are reflected in divergent ways throughout the VLE programme. Different blocks or silos within the university have different points of view and slightly different views on what is important in terms of the VLE. For example here are comments from two significant groupings within the Open University VLE, Learning and Teaching Solutions (LTS) the media production centre for the University and Computer Services (AACS) which provides and supports all central IT services and it is responsible for the University's Technical Infrastructure.

Prior to the VLE effectively all e-learning that we did was hand-crafted, and for hand-crafted read horribly expensive... The aim was to move us away from handcrafted course websites. We had hundreds of those, we've still got a lot of them, but they were cripplingly expensive to produce... we would actually be spending an awful lot of work, development resource propping up existing systems, as opposed to developing new functionality with that budget. I think the VLE was an attempt to move away from having lots of separate systems, to having a single system or a single set of integrated systems that actually made it more straightforward to do the things that we wanted to do (LTS member of staff)

Well I have a very systems focussed role, so my focus is on helping to build systems to meet certain areas of functionality, and in one respect that's what the VLE is, and I guess what I'm trying to say is, I think so far we haven't actually got very far beyond where we were before we started on this process, because a lot of the functionality that currently sits within Moodle previously existed within Promises or other facilities that were made available. (AACS member of staff)

These two quotes illustrate two key features of the VLE Programme, firstly the divisions between outlooks in one area of the University and another, i.e. there is no one 'university' setting out requirements and secondly the way this coloured the view of what were identified as the most significant tasks for the programme. In one view the aim is integration with a sharp eye on costs, in the other it is the development of functionality. In many ways these two outlooks were not just divergent they were

contradictory because a desire for integration and reduced costs meant that at times a compromise had to be made on the development of functionality.

A second feature of the development of the OU VLE illustrated in the interviews was the temporal nature of the decision making process. It was a reasonably obvious and discussed part of this process that what had initially been envisaged as a service oriented architecture for the new OU VLE became altered so that the Open University adopted Moodle as the basis for the new VLE. In Martin Weller's published remark, noted above, the reason for this was given in terms of practical considerations. The interviews illustrate the kinds of contingencies that affect such decisions. First of all the starting conditions for a change in infrastructure were important:

Question -Did the OU feel that it had been locked in with First Class, that it had adopted this system which sort of grew within the OU, it's been stable, and then all of a sudden you have got this system everyone's familiar with it and ...?

[Laughter] I think to some extent we did feel that and what we do even now to move away from First Class will probably take 18 months to 3 years, I would think to do it fully, because many of the courses are so dependent upon it and courses have written it into their course materials and embedded it in a very detailed level. So there is a sense of being locked into it but there was also the sense of it being the market leader at the time so it wasn't a problem being locked into it. (Interview with a senior member of VLE Programme team)

The OU like many large organizations was not in the position of developing a 'green field' site, it had to deal with the inheritance, not only of a tradition and practice, such as that of 'hand crafting' course provision, but of having a stable and relatively successful system in place prior to the new developments.

A second feature of the temporal development was the shift from Phase 1 of the VLE Project into the development phase of the VLE programme. This was accompanied by the appointment of a temporary Director prior to the appointment of the full VLE Director for a fixed term linked to the VLE programme. It was in the period when the temporary Director was in place that the crucial decision to adopt Moodle was taken. This necessarily had two effects. Firstly the new Director inherited a major decision that would have a significant influence on later decisions and secondly the decision was taken outside the detailed procedure setting out the requirements that had taken place in Phase 1 of the OU VLE project.

So it was decided by this team... that we should put together a system using the tools that we had, and others that we could either build or buy depending on whether the market could provide a good example of them. And that we should pull those together with a web service orientated architecture. That decision we took and started to develop the plan to put it into operation. When certain of our staff were exposed to Moodle, which is the Open Source learning environment, and over the summer of 2005 we made the decision that we would incorporate Moodle, the Open Source Platform as the central core. (OU Senior Manager)

The account shows how a planned approach was replaced 'over the summer of 2005' i.e. just prior to the appointment of the new Director of the VLE programme. An added point of interest was the way in which Moodle became part of this decision making process. In the above account some staff were 'exposed' to Moodle. It is this process I wish to follow up.

Moodle was largely selected prior to the appointment of the new Director, although the final decision took place at a Steering Group in the first week after his arrival, and a key figure in this process was another new appointment to the University. University staff were exposed to Moodle because the University happened to appoint someone with prior experience and knowledge of Moodle. The new appointment had installed Moodle in another university before taking up his job at the OU. This was what one Manager had to say about the influence and impact of the two new appointments:

The Director was new to the University and this is a hell of a place to find your way round, and so being presented with a solution, being unfamiliar, not really understanding the peculiar power matrix. Two of the serious players in the project or university were in the same position... you know, there are coalitions that can be formed in the university but they are not obvious ones. So for instance xxxx came in and thought 'FirstClass this is rubbish' and put it Moodle Forums.

The point being made here is not critical of the process being described, it is simply trying to illustrate how contingent the decision making process is, even when the logic of the final decision is strong. Not one of the interviewees queried the decision to adopt Moodle, even though some saw strengths and weaknesses to it. The actual decision, however, took place in a less than systematic way. The infrastructure has arisen out of both a structured decision making process and the day to day contingencies of organisational life - appointments, internal politics etc.

Just as prior technologies have an impact so do decisions taken in this temporal sequence. As an example of the consequences of the decision one Senior Manager when asked about the weaknesses of the VLE made this comment:

Weakness ? ...the real weakness is probably in the underlying platform that we've chosen to use, Moodle. That's probably the biggest weakness, and I think we made the right decision to adopt Moodle when we did. There wasn't another way of doing it. We had looked at, er I don't know whether you've read the initial report of Phase 1 of the VLE, but one of the recommendations in that was that we should adopt a service oriented architecture as a way forward. When we started thinking about doing that we realised that in theoretical terms service oriented architectures existed, in practice they didn't, so it was a good theoretical construct but it wasn't applicable at the time. (Senior Manager)

The weaknesses of Moodle are of significant interest because they illustrate the way in which technological platforms can support or inhibit existing practices.

Where Moodle was deficient was in the actual tools within it, as the functionalities of the tools were very basic. It was also very much designed for - in effect - classroom online. It's a single academic teaching to a cohort of students. Everything's based around the course rather than the individual student. So it's teaching to a cohort rather than to an individual, so a lot of the work has gone in developing, for example, a much more sophisticated roles and permissions capability. There really are only 3 roles administrator, instructor, and student, but we have multiple roles and we want people to play the way we've used conferencing. For example, the First Class system where a tutor might want to group a number of students together, multiple ways of aligning students together, and we have got 8 different models that the conference infrastructures within First Class [allow], that course teams part pay for and get set up, so it was really extending that - which allowed it to fit better to our other teaching model. (Senior Manager LTS)

The new infrastructure had inscribed into it a notion of how teaching and learning would be done. This model, described in the quotation as 'classroom online' not only inscribes a teaching and learning model it inscribes an organizational model too. The Open University not only has course structures, though that is the traditional OU way of organizing work, it also has programme level structures and these are being developed as a way to integrate courses and the student experience. The basic form of Moodle had a limited repertoire of roles and permissions that neither reflected the way in which Open University courses routinely organized themselves nor did it fully support the organizational structures that linked those courses into coherent programmes.

Concluding remarks

Universities can be criticized for setting up walled gardens, areas cut away from the mainstream of technological change. It is also suggested that some technologies are unable to be contained in this way and that they threaten to breach the walls that universities put in place around them. Much of this discussion can have a flavour of radical innovation, the university is portrayed as slow and cumbersome, whilst the new wave of technology is wild and spontaneous. This paper suggests that any such view misses some significant and recurrent features of social and educational practice. A core function of a university is to provide credentials and to stand behind those credentials by having warranted procedures (Brown and Duguid 2000). The university even in times of rapid technological change stands for a certain kind of institutional security and the waves of technological pressure may result in changes but these changes will be adapted, adopted and ameliorated by the active agency of university organizations engaging with the new technologies as co-creators not as simple recipients of technological imperatives.

Web 2.0 technologies are currently identified as technologies that imply a different relationship between institutional boundaries and wider social forms. This paper has investigated the use of the term infrastructure to understand these broad questions about the relationship between pervasive technologies and institutional forms. The concept was clarified in relation to the idea of infrastructure as something

that fades into the background, only an infrastructure in so far as it is largely invisible. This was contrasted with a relational view of infrastructure which suggested that infrastructures were only infrastructures in relation to social purposes. An infrastructure for learning for example would only become such when it was incorporated into learning practices. In this view infrastructures are not to be understood as simply structures because they are processes occurring over time. Infrastructures were also located within specific settings as work-oriented infrastructures and learning infrastructures. In terms of learning infrastructures a case was made that we needed to be cautious because learning infrastructures were often constituted from elements that were neither designed for nor assigned to learning as such, and an infrastructure for learning may incorporate aspects used for learning whilst not being particular identified with learning. The idea of learning infrastructure proposed here is a relational and socio-technical view:

A learning infrastructure is a socio-technical arrangement, over a period of time, of technologies and artefacts intertwined with social and organisational practices that is enacted for the purpose of learning.

This view of infrastructure was then illustrated by research focusing on the deployment of the Open University VLE. A large infrastructural project that developed and deployed a range of new technologies, including Blogs, wikis and an e-portfolio and adaptive assessment system across the Open University.

The Open University VLE programme illustrates some of the reasons why universities are likely to be reluctant to take down the walls around institutional provision of the learning infrastructure. Issues of security and equality alongside standard concerns about cost and uniformity inform the way technologies are both developed and deployed. There is no one authoritative voice in this process and whilst the process of infrastructural development and renewal can seem to be the outcome of a plan the process is one that is negotiated between powerful institutional interests that have their roots in different roles within the university. Negotiation is not only between units and the process of decision making is also affected by the sequence of time in taking decisions, for example by who is in post when key decisions are taken. Decisions taken in terms of the technological solutions for infrastructural development have definite consequences in terms of the affordances and constraints that deployed technologies have in relation to local practices. The strengths and weaknesses of an infrastructure seem to reside in a complex interaction of time, artefacts and practices.

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