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## Academic Use of Digital Resources: Disciplinary Differences and the Issue of Progression revisited

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### ABSTRACT

This paper examines the use of digital resources by academic staff in a single UK University and its influence on academic practice over a two to three year period. The paper describes two linked studies that address several of the themes regarding the impact of electronic resources identified in this special edition. In particular it provides findings that contribute to our understanding of changing roles and practices in academic teaching (Oliver this edition). The themes explored in this paper include the way disciplinary differences affect the use of digital resources, and how academic progression is understood by academic staff in different disciplines, and its role in informing staff choices in deploying digital resources for student use. The paper also addresses the issue of changing academic practice and the adoption life cycle in relation to use of digital resources.

### Keywords

Digital resources, Disciplinary differences, Teaching and learning, Distributed learning environments

### Introduction

The explosive growth of the Internet and the Web has led to a growth in speculation about the ways in which networked and e-learning will affect academic practices and the university as an institution (Steeple and Jones, 2002; Brown and Duguid, 2000). Increasingly researchers have become aware of the ways the university and the practices of university staff can resist such changes and provide a 'resourceful constraint' to the changes surrounding the introduction of networked learning (Cuban, 2001; Brown and Duguid, 2000; Cornford, 2002). Within this changing environment the take-up and use of digital resources by academic staff will be a critical factor in the success of attempts to integrate networked technologies into university teaching. There has been little research work to date that investigates the ways in which academic practice varies in relation to digital resources although there is a significant tradition of research concerned more broadly with disciplinary differences amongst academics. Two key issues are identified. Different discipline and subject areas show significant divergence in the types and uses of digital resources and academic progression seems to affect the use of resources within the different disciplines. The research supports the view that disciplinary and subject differences reported in other contexts have a significant influence in relation to the use of digital resources.

This paper reports findings from two independent but linked studies. The first study took place in 2002/2003, and was conducted in the context of a broad formative evaluation of the Joint Information Systems Committee (JISC)-Distributed National Electronic Resource (DNER <http://www.cerlim.ac.uk/edner/welcome.html>), now known as the Information Environment. The second phase took place in 2005, and was conducted under the aegis of a European network of excellence, Kaleidoscope, as part of the project *The impact of technology-enhanced learning on roles and practices in higher education* (Oliver et al., 2005)

The earlier research was based on interviews conducted with academic staff at a single University who had been identified as making significant use of digital resources in their teaching, and has been reported in two conference papers (Jones et al., 2003; Jones et al., 2004). The focus for this first stage of research was an evaluation of a large-scale national programme intended to supply digital resources for use in Higher Education. The policy assumptions that informed the projects in this programme have been reported elsewhere (Goodyear and Jones, 2003). The results of the first phase research were a set of categories describing the variation in how academics perceived digital

resources used for teaching and learning and an assessment of the disciplinary and subject differences in the ways that digital resources were used.

The second study added a longitudinal element to the original research by returning to some of the staff interviewed for the earlier work and re-interviewing them about the changes that had taken place since the original interview. Our principal consideration was whether since the first study there had been a move toward mainstream activity in the use of digital resources for teaching and learning. We examined the ways in which academic approaches to the use of digital resources have changed over the past two or more years and the ways in which the academic experience of digital resources had altered. The research also touches upon the policy push in this area and the ways in which technology is impacting on practice and the ways academic engagement with technology is related to approaches to teaching.

## Disciplinary differences

Previous research has identified disciplinary differences as a significant influence on the ways in which academic work is organized (Becher 1990; 1994; Neumann, 2001; Becher and Trowler, 2001). Disciplines have been shown to influence the relationship of academics to knowledge, the relationship of students at undergraduate and post-graduate levels to teaching staff and the type of knowledge that students are expected to gain about their subject or discipline area. Discipline and subject differences have also been taken into account by the relational tradition of research, which assumes that disciplines are a contextual influence affecting teaching and learning (for a summary of this research see Prosser and Trigwell, 1999).

Research investigating disciplinary differences has not been fully developed to explore whether such disciplinary and subject differences affect the ways in which digital resources are conceptualized and used, or whether disciplinary differences combine with student academic progression to affect staff and student use of digital resources.

The research related to disciplines simplifies academic practice in a variety of clusters or groupings. Becher (1994), for example, uses a four-fold taxonomy.

Disciplinary Groupings	Nature of knowledge
Pure Sciences (e.g. Physics) “Hard Pure”	Cumulative; atomistic (crystalline/tree-like) concerned with universals, quantities, simplification; resulting in discovery/explanation
Humanities (e.g. history) and pure social sciences (e.g. anthropology) “Soft Pure”	Reiterative; holistic (organic/river like); concerned with particulars, qualities, complication; resulting in understanding/interpretation.
Technologies (e.g. mechanical engineering) “Hard Applied”	Purposive, pragmatic, (know-how via hard knowledge); concerned with mastery of physical environment; resulting in products/techniques.
Applied social sciences (e.g. education); “Soft Applied”	Functional; utilitarian (know-how via soft knowledge); concerned with enhancement of [semi] professional practice; resulting in protocols procedures.

For practical and policy purposes subjects and disciplines have also been divided up in a variety of ways, for example The Learning and Teaching Support Network, a part of the Higher Education Academy in the UK has 24 different subject centres. The detail of these divisions does not concern us here but the boundary of a discipline or subject is not easily described: as Becher has noted, disciplines themselves are composed of a “constantly changing kaleidoscope of smaller components” (1990, p.333).

## The studies

The first phase of research was conducted at a single university in the North West of England. The university was a regional research and teaching institution. Nineteen academics were interviewed across a range of disciplines. The

interviews did not attempt to be representative of current academic practice, but to illuminate the issues that might have a bearing on how academics currently approach the use of digital resources. The nineteen members of staff had been identified as advanced users of digital resources in their teaching by either the relevant subject librarian or the learning and technology central support team, in many cases by both. The aim of the research was to identify the conceptions of digital resources held by advanced users of digital technologies for teaching and learning.

In the second phase we re-contacted the original 19 interviewees to try to arrange a second interview and we were successful in obtaining nine interviews with original participants. There were some inevitable losses from the original interviewees as some had changed jobs, left the institution or changed their role within the institution. Of those contacted, but not interviewed, one had left and four had changed role. Of those who had changed role they had either moved to a research-only role or taken a managerial role and were no longer involved in teaching. The remaining (5) either declined to participate or could not be contacted during the period of the study.

At the time of the initial research the large-scale use of digital resources for teaching was limited and relatively recent. Returning to staff who had been identified as advanced users at the stage of early adoption might provide some interesting clues to:

- the ways in which academic practice has altered with the increasing supply of digital resources
- changes to the academic experience of using digital resources
- the move into more mainstream institutional support of academic use of digital resources by libraries and central support staff.

## **Method**

Overall the research adopted a broadly phenomenographic approach and aimed to build upon earlier work in that tradition concerned with academic staff and their approach to digital resources (McDowell, 2002) and teachers' conceptions of teaching (Prosser and Trigwell, 1999). The methods were centred on interviews with an element of stimulated recall to focus the interview on specific phenomena rather than general opinions. Stimulated recall in this context meant that staff were interviewed in their own office with access to a networked computer. The interviewees were encouraged to make use of available documentation, display the digital resources they used and to access the courses in which they used digital resources. The interviews were conversational in style and began with a request from the interviewer for the member of staff to describe their personal use of digital resources in their teaching.

Interviewer: So if you could just start by telling me a little bit about your teaching and what you use, what sort of digital resources you might use?

The interview continued with the interviewer asking the respondent to amplify and clarify areas of interest that had already been addressed by the respondent rather than using any kind of schedule. The interviews were conducted in the member of staff's own office and a computer was always available. The availability of the computer allowed the member of staff to show relevant resources including departmental, course and personal areas that they used for teaching purposes. A section of the interview towards the end was reserved to allow the interviewer to show a number of relevant sites to the interviewee. The interviews were varied in length but lasted between 30 minutes and 1 hour in all cases. The interviews were later transcribed, analyzed and coded using an iterative approach to generating categories of description.

## **Results**

### **Themes from the research**

This section examines issues that arose from an analysis of the rich data contained in the interviews. The section contains data from the two phases but it is organised according to themes that emerged during the first phase of research.

### *Disciplinary and subject approaches*

The interviews suggest that the use of digital resources is significantly related to the subject and discipline area being taught. However the picture is complex and seems to be affected by a number of cross cutting pressures. In the account that follows we will try to represent this complexity by taking a number of different influences and indicating how these different pressures organise into disciplinary and subject patterns.

The complex picture can be simplified into two main types of use related to subject and discipline (Jones et al., 2004).

In Physics, Engineering and Mathematics the use of digital resources was closely related to the use of specialist software. In all cases the staff in these subjects expressed an interest in the use of images, including moving and 3D images and simulations. This was particularly so in the case of Biological Sciences. Mathematics and science based subjects more generally were also distinct in that they did not direct students toward journal use of any kind until the final stages of an undergraduate programme whereas social science and arts students were more likely to be directed toward journals and e-journals throughout their degree.

In social sciences such as Politics, Languages and Applied Social Sciences the staff interviewed were most interested in the use of particular types of Web based materials. These subjects needed access to the most current up-to-date material often from Government or specific agency sites. Some of the humanities such as Languages were also interested in access to news media such as local language newspapers.

All of the interviewees in these subjects expressed an interest in using digital searches for materials that could be accessed either digitally or using traditional methods but History and Law stood out as subject areas that most emphasised this type of use and had large databases of non-copyright material available for teaching. This contrasted with music, which was constrained from using the large amounts of available digital material for teaching by copyright restrictions.

This broad disciplinary pattern appears to be related to core aspects of the type of knowledge students are being introduced to. In many natural science based subjects mathematics was a core competence.

“...personally I make fairly extensive use of certain mathematical packages which I use for my teaching..” (Physics lecturer)

Interviewees in these subjects also suggested that students were engaged in mastering a relatively stable and accepted taught canon in their studies and consequently they could use materials from text book sites.

“quite a few of them are links to text book websites where there might be animations or other resources, there are also some sites that are based on structural databases so there are some databases of protein structures so if we are going through talking about DNA binding proteins you can click to a link that is one of these 3D structure databases.” (Biology lecturer)

The ability to make use of standard commercially supplied materials was also present in subject areas such as Law, which had large amounts of resources available in digital form.

“..one of the main digital resources in Law and this is generally the case and not just on my courses, is on-line databases of reported cases and unreported cases but they tend to be from commercial providers..” (Law lecturer)

On the other hand many of the social science and humanities based lecturers placed an emphasis on the ability of their students to assess different approaches and engage in discussion of the relative merits of what could be fundamentally different ways of seeing a single subject or disciplinary area. Another requirement, mainly in the social sciences but including a language lecturer, was for up-to-date materials for their teaching.

" I mean, things in Spanish change very, very rapidly and what we teach from year to year sort of changes as well" (Language lecturer)

" we are encouraging students to look at, to look in detail at what is going on in contemporary conflicts .... if it was the Kosovan conflict we would encourage them to look at what the Foreign Offices view is, what the Russians view is, what the American view is and you often can't do that

from resources in the Library because they are bound to be several years out of date" (Politics lecturer)

Some of these subjects did not have an agreed and stable canon for teaching, or rather if there was one it was based on the application of agreed principles and academic practices to current issues. These issues were also ones that, at times, courted controversy and were not of the kind that could be easily set out in a standard text.

"The other thing I encourage students to look at which I think that the web becomes particularly useful for is websites that have been put up by people who are wanting to write their personal experience of illness because then they are getting perspectives that are different to what would be presented in the sort of academic press or just general news and that, I mean that was when I mentioned anorexia last year, there was quite a wide range of sites which were called, which came under a heading of "PRO-ANA" and these were sites put up by people with anorexia advising other anorexics on how to diet." (Social Science lecturer)

In languages similar issues arose in terms of the content of web resources that students accessed:

"...to take an extreme example, Spain still has a fairly restrictive Abortion Law so if they are doing a project on Spanish Abortion Law then they would come across obviously extremist groups, they come across Catholic groups, they come across Government web pages, so it is just, I suppose, teaching them to identify or making it clear that they have to identify the source of the information and from that to actually say 'ok well this is a Catholic group, the Catholic obviously have, they have this particular stand point on abortion, therefore the information I am getting is liable to be biased in that particular way'" (Language lecturer)

A concern for all lecturers who used external resources was the persistence of links. A common strategy was to recommend materials held on relatively reliable sites, such as government web sites and the sites maintained by large businesses, charities and NGOs. Despite the use of reliable source sites a major issue for some lecturers remained the continuity of links. The following example is of a lecturer who in the first phase reported pointing to links who has begun to bring documents into the University VLE in order to ensure secure access:

"...if there are documents that are usually, usually sort of on the Department of Health website that are relating to the Social Work course then I'll quite often take them off and put them on the noticeboard so that they're easy for the students to access" [...]

"...I mean it's felt for me- like that's a way of er making it a little bit safer, some of those documents might change, they may move sites, may move address ..." (Applied Social Science lecturer)

This finding that the problem has persisted over two years, is significant in that it points to a need for more secure management of certain digital resources especially 'ephemera'.

### *Progression*

In the first phase of research all academic staff in all subject areas reported some degree of progression in the use of networked digital resources related to academic progression. The involvement of staff in teaching at first year undergraduate level varied but all interviewees reported some student use of digital resources from the first year. However even when all students were introduced to digital resources in their first year it was students in their final year or sometimes their penultimate year of study that made the most significant use of digital resources.

a) Interviewer: So that is the historical abstract

History lecturer: Yes. So we use this a lot. Students are introduced to this in the first year but I don't think they need it at that stage but I use all of this in the third year.

b) Interviewer: Would you direct students to e-journals?

Engineering tutor: It would depend on the member of staff, we don't do a lot of teaching by e-journals, that is more when you get on to the fourth year teaching and research where we will propose further material. (*Fourth year in this context is registration for a Masters in Engineering following directly on from three years of undergraduate work.*)

Staff also clearly differentiated between an introduction, often described in terms of basic information skills and sometimes left to librarians, and higher order research-like skills that were developed in the final undergraduate years or at postgraduate level. In some subject areas such as mathematics and sciences the use of journals and e-journals was largely reserved for final years students or postgraduates.

It was notable however that the availability of journal articles had changed significantly between the two phases:

“If students are doing projects they start to use the Library more and in the third year they start to use catalogues much more... but the actual electronic journals and electronic searching ... I think they will be reading more beginning the post-graduate level.” (Mathematics lecturer: phase 1)

Mathematical journals, amongst others, had been digitized and collected over most of the twentieth century. Use was still largely at post-graduate level, though this was changing for reasons connected to the provision of an historic archive of articles, and the library was now systematically involved in the subscription based supply of an extensive archive of journal articles. This was thought to be important because of specific disciplinary conditions:

“I mean mathematical papers do tend to have a very long shelf-life, especially the better ones and beginning students tend to read the old papers before they read the new ones.” (Mathematics lecturer: phase 2)

The second phase of interviews showed that there had been significant developments in the availability of resources and the way they were used in the different year groups. Another subject that stood out in this regard was History. In the first two years journal articles were noted to be important but by the third year the focus was moving to the availability and use of digital primary resources.

“Now essentially I think the first year students are going to be using access to printed materials like JSTOR, and probably that’s true of largely second year students as well, but once they move into the third year and they’re doing primary research, their own dissertation, and post-grad work thereafter, then the digital resources would become invaluable.” (History lecturer)

[JSTOR non-profit digital archive of scholarly journals: <http://www.jstor.org/>]

In both Mathematics and History the use of digital resources had been affected by the increasing supply of a wide range of materials.

The view of progression in the use of digital resources provided by academic staff may have been influenced by the main teaching load of the member of staff. Teaching staff with more responsibility for first year students were more likely to mention skills training as an issue, whereas staff concentrating on final year students were less concerned with general skills but had an awareness of the students’ need for highly specific resources. These findings are consistent with research conducted in the Open University, in which students at lower levels experienced difficulties due to skills deficits despite course guidance in information skills, whereas postgraduate students were reported to have more fully developed skills on entry (MacDonald et al., 2001). The most notable change reported by academic staff in the use of electronic resources was when students were undertaking projects and it was at this point in undergraduate programmes that they were also encouraged to make use of digital resources in particular e-journals and digital searching for additional materials.

The teaching focus shifted from information literacy to a tendency to concentrate on teaching research skills in the final year. Participants in our second phase report that while basic skills are still taught new students have increasingly sophisticated skills. This process of change amongst student cohorts led one lecturer to comment on a general tendency for new students to have all the basic skills whilst postgraduates have more problems:

...and the undergrads these days are actually doing a lot more. I mean they - the post-grads still have a little bit of problem, but the undergrads, I mean, on social work in particular we have students who are supposed to have the ECDL in order to graduate, and when we looked at erm the qualifications that they have in IT I'd say more than well, over, well over 50% of our undergraduates now come with erm something like, er, GCSE in Information Technology. (Applied Social Science lecturer)

### **Experiences of the digital resource adoption life-cycle**

In the second phase of research our academic sources were mature users, and there appears to be a life-cycle in academic use of digital resources. Our first phase selection of lecturers can be understood in terms of the Technology

Adoption Life Cycle as 'early adopters' (Rogers, 1995). In the time between the two phases of research one department had adopted a VLE across the department and the 'early adopter' found himself needing to learn a new set of skills and he felt he was being overtaken by the technology.

"I used to have responsibility for upkeep of the department website but since it's changed I just find the - I haven't got the inclination to learn a new set of software um, to do things in a different way, so the kind of sort of new DreamWeaver, website management,[.....] I haven't, I don't feel in any way motivated to learn to do it all again, even though I know it's better." (Applied Social Science lecturer)

This change coincided with his appointment to the position of head of department, and it is clear that these changes in his work role interacted with changes in deployed technologies.

In another example an engineering lecturer talks about the departmental intranet he runs:

"I'm [intranet manager] because I started it. There's not the same amount of time or input required any more to what there used to be when I first started with it. So the system has now stabilised and I think in some ways that's maybe one of the reasons why I'm reluctant to look at changing it or going to a different system because there might be an overhead again with the set up and getting things running...." (Engineering lecturer)

Other participants who were early adopters are now in a stable situation having adjusted to the use of digital resources with no major changes expected. These cases may point to a ratchet or lockstep approach to change in which lecturing staff make significant changes but then settle into a new routine. Some staff when asked about change reported a perceived stability for example:

"Not a great deal to be honest with you er, in other words we're still using the resources that were provided by the the unit, umm, I think that OK we experimented with a couple of other things, mainly videos online..." (Marketing lecturer)

These examples contrast with the idea of a technological 'revolution' and some approaches to change management that imply a continuous or smooth change process moving in one direction. Instead our findings suggest that many staff are concerned with achieving a stable state, with periods of change activity followed by plateaus or even a stepping back from technological change. This finding of discontinuous change, liable to periods of stability or reversal is an area that warrants further research as it may have significant practical implications.

## Conclusions

This paper confirms the view that discipline and subject area is a significant factor affecting the use of digital resources in teaching and learning in Higher Education. These findings touch on a large volume of work concerned with subject and disciplinary differences in teaching. For example Becher and Trowler, (2001) comment that:

" the ways in which particular groups of academics organise their professional lives are related in important ways to the intellectual tasks on which they are engaged." (p23).

Unsurprisingly perhaps this subject and task differentiation appears to carry over into the use of digital resources for teaching and learning.

In particular there appear to exist disciplinary differences in the way that digital resources are being integrated into teaching and learning within the disciplines. A strategy for the development of digital resources will need to take account of these variations and the variation that also exists in terms of level of study.

However our evidence suggests that the factors affecting this variation may not be quite the same as in other areas of disciplinary difference. The grouping of disciplines does not fully conform to the type of taxonomy that has been used to discuss disciplines more generally. The divide between hard and soft disciplines does seem to remain. It is the hard subject areas such as physics and engineering that display a distinctly different relationship to digital resources based on the need for mathematical skills and mastery of a canon within these subjects. The soft disciplines vary widely but arts, humanities and social sciences differ most notably from the hard sciences rather than with each other. The division between pure and applied subjects is not so clearly in evidence in relation to digital resources.



Issues of progression were evident in the use of digital resources in all discipline and subject areas. In the early years of study staff were interested in developing information skills among students. These differed in relation to discipline and science subjects were particularly interested in students making use of particular kinds of software for their work. In social sciences and humanities the students were introduced to a variety of materials, some of which were intended to show weaknesses or viewpoints not available in academic texts or validated resources. This use of resources was to help students learn how to assess different sources of information. These progression-related disciplinary differences touch upon the divergent ways different disciplines and subjects constitute knowledge. This was also evident in the students' use of electronic journals. Journal use of all types was not a central feature of undergraduate science subjects. In the arts, humanities and social sciences access to journals and e-journals in particular is being encouraged from the first year of undergraduate study. This is an area that shows significant change over the period of the two studies. The increased availability of digital resources in primary and secondary forms has clearly impacted on the usefulness of these resources at all levels of teaching.

The findings we have reported suggests a possible link to the theory of punctuated equilibrium in evolutionary biology and the way this theory has been used to explain technological change (Loch and Huberman, 1999). However this theory is primarily concerned with periods of stability and abrupt revolutionary change. In practical terms this approach to change can generate advice to managers on ways to advance or slow down the adoption of technology. Our findings suggest an ebbing and flowing of staff interest and engagement with change that is connected to the rapid and continuous nature of technological change. Engagement with one technology appears to be no guarantee that the next wave of technology will either be of interest or easier to master. This finding might be of interest for staff developers as it may suggest an iterative process that requires the identification of those staff most engaged with change at each point in time rather than once and for all interventions.

Cornford and Pollock (2002) following Brown and Duguid (2000) describe the university as a resourceful constraint. This study of subject and disciplinary variation indicates that the university's organisation of knowledge into discipline and subject areas influences the use of digital resources. The socio-cultural form of each subject or discipline has a history and a pattern of engagement with academic resources in teaching and learning. These ways of using resources carry over into the digital world. The study also shows a discontinuous pattern of change that may be an important issue for those involved in staff development.

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