‘Disruptive technologies’, ‘pedagogical innovation’: What’s new? Findings from an in-depth study of students’ use and perception of technology

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Introduction

Technologies have long been valorised as offering the potential for ‘pedagogical innovative’, as acting as a ‘catalyst for change’, or as ‘disruptive technologies’ (Sharples, 2003). But a recent review of international e-learning policy directives (Conole, forthcoming) points to a different picture, with a mismatch between rhetoric and reality. However, Conole and Dyke (forthcoming) argue that:

> There is a growing belief that we are entering a new phase in the development of technologies, instantiated in what is being referred to as ‘Web 2.0’. This change reflects the shift away from information and content towards the communicative affordances (Conole and Dyke, 2004) of technologies.

This suggests that perhaps we might now be at a turning point. This paper describes some of the findings which have emerged from the JISC-funded LXP project, an in-depth case study exploring students’ experiences of e-learning. The project provides empirically grounded evidence of students’ actual use of technologies.

Related studies

The project aimed to collect learner stories on their experiences with e-learning. A previous detailed review showed that the learner perspective on e-learning had been largely overlooked (Sharpe, Benfield et *al.*, 2005) but that knowledge of how learners use and experience e-learning/technology in their learning activities was crucial for the development of tools, pedagogy and teaching practices. They concluded that there was a scarcity of studies focusing on the learner voice (beyond that of simple course evaluations), far more emphasis appears to have been given to the practitioner perspective and to course design.

The ‘Learner Experience of e-learning’ or LEX project was carried out in parallel to this LXP study and was funded under the same JISC programme. The aim was to ‘investigate learner’s current experiences and expectations of e-learning across the broad range of further, higher, adult, community and work-based learning (Creanor, Trinder *et al.* 2006). The study focused on three main questions: characteristics of effective e-learners, beliefs and intentions, and strategies for effective e-learning. The findings led to the development of a conceptual framework which mapped five high level categories (life, formal learning, technology, people and time) against five influencing dimensions (control, identity, feelings, relationships and abilities).

The SOLE project represents an important landmark in terms of being one of the first to evaluate students’ experiences of e-learning (Timmis, O'Leary *et al.* 2004; Timmis,

O'Leary *et al.* 2004). Of particular interest and relevance is the description of discipline differences highlighted in the report.

Kirkwood and Price (2005) report on data spanning five years from evaluation data on students' attitudes to and experiences of technologies. In terms of access to and use of ICT they suggest that there has been a fundamental shift in students' access to ICT – arguing that this reflects not only attitudinal changes but the changing needs of society. Their meta-analysis shows that student access to, experience of and attitude towards technologies varies across subject disciplines and argue that:

> Although students' access to computers and to the Internet is no longer considered an obstacle in some subject areas, there are still concerns in others (e.g. health and social welfare). They also provide valuable insights into how students are using ICT in their studies, which mirror the findings reported here. For example the high use of generic software such as Word for preparing assignments and students' habits in terms of using the internet to search for information and using a range of technology tools to communicate with peers and tutors.

Their conclusion echoes the conclusions inherent in many other research studies into the use of technology for learning and is an important factor in terms of reading and interpreting the findings reported here:

Research methodology

The main research questions addressed were:

- How do learners engage with and experience e-learning?
  - What is their perception of e-learning?
  - What do e-learners do when they are learning with technology?
  - What strategies do e-learners use and what is effective?
- How does e-learning relate to and contribute to the whole learning experience?
  - How do learners manage to fit e-learning around their traditional learning activities?

Data was collected in conjunction with four of the HE Academy subject centres:[1]

- Medicine, Dentistry and Veterinary Medicine
- Economics
- Information and Computer Sciences
- Languages, Linguistics and Area Studies

Data collection consisted of three main sources: an online survey, audio logs and interviews. The online survey[2] was used to gain a wider contextual understanding of learners' experiences, whereas the case studies of individual learners (via the audio logs and interviews) described the nature of the e-learning activities carried out by the learner. The combination of methods allowed for rich empirical data, as well as for the triangulation of interpretations of the data. The participating institutions involved in the in-depth case studies provided a range of contexts across the UK – from old and new institutions, to those located within a metropolitan area or a regional locality. The survey

[1] http://heacademy.ac.uk

[2] http://www.geodata.soton.ac.uk/eLRC/learner_survey/

covered a broad spectrum of technologies and contained a series of matrices of technologies against types of learning activities. These matrices drew on the media types table originally developed by Laurillard (2002) and the definition of learning activities developed in the DialogPlus taxonomy (Conole and Fill, 2005, Conole, forthcoming) of learning activities as a basis for categorising types of technology and their use.

The case studies focused on the actual learning experiences. Based on the results of the survey and students availability, a selection of learners from across the subject centres were selected for in-depth case studies on their e-learning activities and experiences. Students were asked to provide regular audio log diaries to demonstrate the different ways in which they were using the technology and a semi-structured interview was carried out to help contextualise and extend the findings emerging from the audio logs. Each student received fifty pounds as a token of gratitude for participating in the study[3].

Audio logs were chosen because such diaries can provide rich data about day-to-day events, as they happen, and contain a realistic account of the activities undertaken by the learners. Previous research suggested that working with written diaries was useful but that these written diaries are often incomplete and participants usually find keeping diaries time consuming (Timmis *et al.*, 2004).

Table one gives the breakdown of the data collected. After the data had been cleaned up a total of 427 valid entries were received from the online survey. The survey was sorted according to subject centre and divided into qualitative and quantitative responses. SPSS was used to analyse the quantitative data; qualitative analysis was divided up into appropriate sections and manipulated in Excel. First a broad descriptive analysis was carried out across all the available data to see if some general patterns emerge. These patterns were then further analysed to see if there are differences between the participating subject centres. The qualitative data was then organized and coded according to emerging patterns and the results ranked, proportioned or directly quoted to support the quantitative findings. Eighty-five distinct audio recordings were collected. Audio recordings were sorted by subject centre and individually coded indicating the subject centre/institution, individuals and the number of the message dropped. Audio logs were ordered and anonymised and a separate look up coding table created. A total of fourteen interviews were collected. Background information and notes were collected during each interview and the sessions were audio recorded.

After gathering data at the level of individual students, the research team used several analytical methods to analyse each case study individually followed by an overarching study across the cases (study of cases). The central purpose of analysing the qualitative data was to extract, generalise and abstract from the complexity of the data, evidence concerning e-learning activities and experiences in order to answer the main research questions. Relevant extracts from the interviews were transcribed and used to complement and extend the survey and audio logs findings. Importantly these extracts were used to provide more in-depth information about the strategies that the students

[3] University of Ulster, Magee Campus gave students a mini iPod for participating in the study, the cost of which was covered internally by Magee.

used and how the technologies influenced their approach to learning and the impact this had on their daily lives.

Table 1 Breakdown of data collected

Phase one – context	**Phase two – case studies**	
Survey	**Audio logs**	**Interviews**
Economics: 128	Economics: 3	Economics: 2
Languages: 92	Languages: 47	Languages: 3
Medicine: 31	Medicine: 16	Medicine: 5
Computing: 158	Computing: 19	Computing: 4
Other: 18		
427	**85**	**14**

Case study narratives

This section summarises and discusses some of the overarching themes which emerge from the interviews and the audio logs, concentrating where appropriate on how the technology use evident in these in-depth case studies highlights commonalities and differences in subject domains.

Across all the subjects represented in the case studies the students made extensive use of personally owned technologies including mobile phones, laptop computers, personal digital assistants and USB memory sticks. PC use was divided between student-owned computers used in the students' own room and university-provided workstations. Most of the students did not have personal printers and brought files on USB sticks into the university to print.

The findings indicate that although there was a degree of commonality in terms of the general hardware and software used subject centres, how they were used and the frequency of use, differed. Students reported using technology primarily for:

- researching and retrieving information
- communicating with fellow students, friends and academic staff
- processing and manipulating data
- saving, storing and sorting information and data
- preparing assignments and presentations.

Researching and retrieving information

All students extensively used the web for research purposes and for extending their understanding of concepts by complementing core course material. Search engines and general information sites such as Wikipedia were frequently mentioned. Several reported that searching with Google was their first action when trying to get information for an assignment. Only one student mentioned Google Scholar specifically. All found Google easy to use and most considered it 'very useful'. However, there were examples in both the interviews and the audio logs where search engines failed to provide useful information. Nonetheless this did not appear to have dented the students' overall enthusiasm for it. All students reported using specific websites, and in particular subject specific sites.

> The first thing i do when given any piece of word is type it into a search engine! this gives me the opportunity to see how different people interpret the title. from there i can focus on one main idea and use the electronic resources to support my initial findings or indeed rule them out. e-mail is always vital with communicating with different mediums. teachers for support.[W29]

The rapid positioning of Wikipedia as an important authoritative text, despite its relative newness as a resource, is an important indicator of the nature of the way in which students are now using technologies with peer review and sharing of 'what counts as good' being an important scaffold in helping students to make meaning of a complex and constantly changing information landscape.

> I search for what I need using Search Engines and Wikipedia, and build up a list of things that I need. I reference those through to Word, and send the file to my peers through IM, where I get feedback and additional info. on what's going on and how the things I'm researching relate to the current area of study.[W337]

Despite this openness to exploring new sources of information, participants also discussed how difficult it could be to assert the creditability of sources found on the web. Students have learnt to double check source material or hone their searches into reliable sites that they learnt to trust. For example students discussed how they cross-referenced and validated material found on the web with other sources (e.g., text books and lecture notes). Such methods of accreditation and cross-referencing indicate that students mix and match information sources, combining old and new methods. Given how rapidly information and understanding changes in the areas the students were studying, for many the internet provided the most up-to-date information. Printed textbooks for example were considered by some to be out dated and difficult to digest but still tended to be used as a baseline measure. On the other hand online textbooks and sources were preferred particularly in medicine and computing science because they were easy to search, tended to provide byte sized, digestible chucks of information and were more interactive.

Other websites visited often related specifically to the subjects being studied – for example investopedia.com (business studies), zdnet.com (computer science) and gpnotebook.co.uk (medicine). Therefore not surprisingly subject differences were evident between the different subject disciplines, with medical, language, economics and computer science students all referring to particular discipline-specific sites depending on their area of study and course requirements. Many students during the interviews discussed how during their university career they have learnt to refine their web searching skills. This was something that was not necessarily taught by the university but something they learnt informally through trial and error. The level at which different subject disciplines and their tutors recommended using the web for research varied greatly. Whether the web was recommended or not appeared to depend on individual departments and tutors: some would provide hyperlinks to sites they approved; others would not. Links to particular sites were also passed between students or picked up form other professionals working in the field, particularly when they were on placement.

Online library services were mentioned by medical and modern languages students but not by computer science or business students. Students recognised the value of library catalogues in terms of being able to see which books were available and being able to

reserve them in advance. Some difficulties were reported using catalogues and students were frustrated when they found that a paper they wished to refer to came from a journal that their university did not subscribe to.

Information retrieval from the web was primarily for text-based materials but students also reported searching for images (to include in presentations), as well as downloading relevant podcasts. One medicinal student reported studying e-modules on health topics from the British Medical Association (BMA), while another referred to using online course materials and lecture notes from another university. This latter point indicates how students now draw on an international pool of materials to support their learning. Gleaming the best of material from around the world, they mix commercial, academic and popular information sources together so as to gain a better understanding of their area.

Communication

Use of communication technologies to support their studies was extensive. Students in all subjects used mobile phones; phoning and texting each other frequently to discuss issues related to their learning, most commonly in connection with assignments. They also used MSN Messenger and other instant messaging software (e.g., ICQ, QQ), particularly when communicating internationally. All students expressed positive feelings about the communication technologies they used, though some found the frequent interruptions which arose as a consequence of this constant communication disruptive to study.

Email was used by all students and was the main technology used for communicating with tutors. Students expected and generally received quick responses to their emails and appreciated the channel of communication email provided, suggesting a shift in expectation to more rapid response times. Interestingly the overseas language students noted how in the UK it was much more common practice to email your tutor to discuss issues or arrange meetings. Although they used email in China and Turkey, it was more common to speak with your tutor face-to-face.

There was surprisingly little mention of discussion forums. The language students appeared to use discussion forums most but the students interviewed stated that they preferred to read rather than post messages. Although they considered forums a potentially useful way of engaging with others, they complained that individuals often dominated discussions. They also found the time lag which occurred between messages being posted and responded to frustrating and felt that it was not always possible to engage with issues at a deep level. Other students interviewed also expressed the view that they did not find forums particular useful or inspiring. Of course usage will also be related to the ways in which the discussion forums are integrated and used within the course context. However this findings are interesting given that the students gave many examples of the alternative ways in which they were communicating with each other (via text, chat, etc.). This suggests that students are creating their own social network to support their learning, tailored to their particularly needs and using the technologies which suit them rather than being constrained in topic and technology via discussion forums.

Low cost communication technologies such as Skype, MSN chat and email were considered invaluable forms of communication and there was evidence of these being used in a variety of ways (student-student, student-friends/family, student-department/university or tutor). Skype, software which allows students to call people for free or at a low cost via the internet, was specifically mentioned by foreign students as a cheap, easy way to keep in touch with friends and family. For many students text messaging and the mobile phone, although popular, were regarded as more expensive options.

Students using blogs as a means of keeping up-to-date on new developments in their fields. The computer science students were required to keep a blog diary, acting as both a dissemination vehicle and a reflective tool. One of the overseas students kept a blog as a record of her experiences of studying in the UK. Other students (economics and languages) also reported reading blogs but did not discuss writing them. None of the blogging software used was provided or hosted by the universities.

Assignments and presentations

A high proportion of ICT-usage was in connection with assessed work. Students used Word (and Open Office in two cases) to write assignments as well as take notes. In three of the subjects students also reported using PowerPoint to prepare and give presentations to their class. All were positive about the benefits of PowerPoint and Word and some wondered how they had ever managed during A-levels without word-processing.

Students used Word for essay and report writing, while PowerPoint was used for either oral presentation, distributing online course material and/or revision. Other aspects of Microsoft Office, such as Excel, were used for carrying out audits and drawing graphs. Students cited few disadvantages to using word processing packages such as Word or Open Office. All students found them invaluable for presenting work, with foreign students specifically mentioning the grammar, spell checking and dictionary functionality of the packages.

Despite the commonality of such tools, the level of training provided by the subject disciplines varied with some providing little or no training on the use of tools such as PowerPoint which were nonetheless essentially a requirement in terms of students completing assignments. Some students mentioned that it would have been useful to learn about the more advanced features of such packages. As noted by some foreign students it is also possible that students, who did not carry out their A-levels in the UK, may not have had much experience on computers prior to coming the university in the UK and some form of continual computer support for such students may well be needed. Other students also discussed how packages such as PowerPoint helped in terms of presentation, helping to improve the look of work produced. This in itself of course does not mean that the quality is any good and neither does it demonstrate that the student has gained an appropriate level of understanding of the concepts being taught.

The medical students all made extensive use of the e-portfolio integrated into their VLE since this was an assessed part of their study. Most found it useful, recognising that self-assessment was likely to be an important part of their future post-university CPD. would become an important part of their future careers. Other forms of e-assessment noted by the students, included the use of multiple-choice questions for formative purposes. Mock online tests were cited by the economics, medical and computer science students. One medicine student described how online self-assessment was primarily used only in the first three years but felt that it should continue into their fourth and final year.

There was surprisingly little mention of subject-specific software. Traditional CAL-type software (such as e-tutorials and simulations) was noticeable by its absence. The medical students mentioned CD ROM simulations which had been used earlier in their course. They found these useful as they provided insights into the internal and complex workings of the body (e.g., heart, autonomy). However they also recognised their limitations and the importance of being exposed to real, authentic practical experiences. One language student encountered difficulty with some subject-specific software (Endnote, concordancing and textual analysis packages). She could see the value in their use, but found them time consuming and difficult to use.

Integrated learning

Students in all subjects reported using their institution's Virtual Learning Environment (VLE). Computer science students also mentioned that tutors often also had home pages where they posted course-related information and resources. Medicine students made most use of their VLE, which included support for e-portfolios; a mandatory course requirement of their course. Mostly students used their VLE to check information about their courses. The computer science students also specifically mentioned using alternative sources of information such as course websites set up and run by students. For some subject centres the VLE was essentially used as an online diary or as a means for the department and students to communicate course administration and timetable changes. While for other subject centres the practice of using the VLE was still under developed with mixed usage - some tutors use it, others don't. Across all subject centres students mentioned that the discussion forums on the VLEs were rarely used. These findings indicated that the way in which VLEs were used varies greatly not only between subject centres but also between universities and departments. More importantly use of the VLEs is dependent on the culture of usage – in terms of who is using and why. Successful usage is dependent on clearly shared understanding of which functions are being used and why, clarity of purpose/relevance of use and a critical mass of users. It is clear from these primary findings that more detailed research is necessary in this area.

The interviews and audio logs revealed a more detailed understanding of how particular technologies served the individual's learning style and needs. For example students who worked part-time, had children, lived some distance from campus or had heavy work placements, tended to value the online facilities such as the VLE. For such students the possibility of being able to download lecture notes or view course timetables was a real asset as it meant they did not have to travel everyday to the campus. This saved both time

and money and gave students more flexibility and freedom to arrange their learning around their individual lifestyle and working situation.

Despite the general consensus amongst the students that online course materials 'were a good thing', the importance of face-to-face contact with tutors was still considered necessary and important and was cited by a number of students in both the interviews and audio logs. The students interviewed discussed the need to personally meet with classmates and tutors to discuss work issues. Face-to-face contact was considered vital in building a sense of community or 'belongingness' to the class or study group. For many this could not be replaced by online environments. Also the issue about value for money and quality of experience was discussed. As one computer science student noted you pay a lot of money to come to university to interact with and be taught by academics and knowledge experts you do not want all this interaction to happen via the web or online as it does not provide the same quality, value for money or level of communication.

Overall students had no difficulties with any of the technologies and applications that they had selected for themselves. The computer science students were, perhaps unsurprisingly, the most adventurous in their use of technologies and acted largely independently of university-provided facilities. University provided facilities: VLEs, library services and subject-specific applications were all seen as having some problems, either with usability or, in the case of VLEs, incomplete implementation, especially in relation to discussion forums. The audio logs provided a picture of students relying heavily on a wide range of technologies and managing to integrate them quite effectively without any specific help from their institutions.

Factors influencing technology use

A number of factors were evident which combined to influence the way in which students were using technologies.

Environment: The data revealed that the students are learning in a complex and changing environment, using a plethora of technological tools to support their learning. The data supports the notion of the 'nintendo' (Morice, 2000) or Net-generation (Oblinger, XXX); boundaries between students; use of technologies for learning and gaming are blurred. The rich, interactive and engaging environment of games therefore has lead to an increased expectation of similar levels of quality for learning materials. There is evidence that there is a shift from passive to more interactive interactions across all aspects of their learning. PC ownership is hish and students have become accustomed to being able to access information or contact people on demand.

Thus the environment students are working in is complex and multifaceted. Technology is at the heart of all aspects of their lives – a key question for institutions is whether institutional infrastructures match students' rich technology-enhanced environment and perhaps more importantly whether courses are designed and delivered taking account of this. However a number of students mentioned that a downside of technology was that it was distracting; for some students a background of information and multiple

communications is part and parcel of their learning palette, others still need to create space, piece and quiet in order to learn.

Usability: Despite the many favourable comments about technologies there were still significant usability issues. What is difficult to gauge from the data is the extent to which these are a consequence of the level of maturity of particular tools or of the level of competency of using the technologies. Students are critical of software which appeared 'old fashioned' or badly designed websites. They find having to browse through structured websites frustrating, being used to the (deceptively) simple and apparent effective results available through search engines.

Accessibility: The importance of ensuring accessibility for all in terms of the use of technologies has grown in importance in recent years, in part because of the change in law with the introduction of the Special Educational Needs and Disability Act (SENDA) in 2002 (see Seale et al. (2006) for a special issue in accessibility and e-learning. A number of students mentioned the opportunities technologies provide in terms of accessibility. Technologies are being appropriated by learners to play to their strengths in terms of visual and auditory capabilities. Therefore students who have a preference for learning visually described how they used mindmapping and other visual software to support their learning; those who preferred to work from text, illustrated how they combine and annotate different explanations to create their own meaning, and those with a preference for auditory information download and listen to podcasts or create recording themselves.

Personalisation: Students clearly place greater value on technologies they have "discovered" or selected for themselves. Ownership, personalisation and appropriation of technologies is one of the overarching themes which emerge from the data. Personalisation and a sense of control come across as key factors of success in the use of technologies.

Discipline demands: Disciplines, by their nature, privilege some skills and ways of knowing over others (Oliver, Roberts et al. 2007, Hammond and Bennett 2002; White and Liccardi 2006; Oliver, Roberts et al. 2007, see also outputs from a discipline symposium[4]). Maths and Science are underpinned by Mathematics, so an ability to manipulate data and in particular numerical data is an essential skills in these subjects. Other subjects have a more subjective or relativist perspective, and others still are fundamentally built on dialogic principles. Use of subject-specific resources and web sites is evident across all the disciplines, but their use of tools varies and can be related to the nature of the subject discipline. For example the Economics students particularly mention using the BBC current affairs website and downloading podcasts, whereas e-Portfolios are specifically mentioned by the medical students because it is a requirement of their course. Access to up-to-date authoritative information on current events is a particularly valuable aspect of the internet and useful for students studying subjects such as economics, politics or sociology. Access to up-to-date, research data, through e-journals is valuable across all subjects, particularly for final-year and post-graduate

[4] http://www.heacademy.ac.uk/eLDisciplines.htm

students, but is especially useful in fast moving research areas such as Science and Medicine. In Computer Science there is a culture of publishing through mailing lists, blogs, wiki and other more 'immediate', technologically-driven and networked forms of communication. Practice-based courses have particular requirements; email, for example, emerged as an important means of maintaining contact during placements. E-assessment usage varied across the disciplines. The more 'qualitative', 'textual' or 'visual' the subject, the less appropriate e-assessment (in the form of binary-type MCQ questions) was deemed to be. This maps closely to findings from the e-assessment research literature (ref). The date highlighted some nice examples of students using e-assessment for self-reflection formatively. However there were a number of negative responses about the impersonal and restrictive nature of basic MCQ tests.

Learning strategies: Students demonstrated a variety of learning strategies in terms of how they used technology to support their learning. The following give some indication of the ways in which the students are using the technologies to support their learning and the different learning strategies they adopt.

> I often summarise revision notes using word processing - to see it visually organised helps me. Also, I record reading my revision notes aloud on a digital mini-disk player and then listen to them to revise. I find I remember things better through repetition of hearing and reading together.[AR208]

> Best example is revising for exam; I have my books open, my notes ready, and blackboard logged in. Once I attempt a solution, I check the right answers on blackboard. Before going to exam, After I've completely finished revising, I sometimes take the online Multiple Choice Questions…[AR98]

Support and community: Another striking feature to emerge from across the data is the extent to which students are capitalising on the social affordances of technologies, much heralded under the banner of Web 2.0 (Alexander 2006), in terms of peer support and communication – the picture emerges very much of a networked, extended communities of learners using a range of communicative tools to bounce ideas off each other, to query issues, to provide support, to check progress. This peer network is particularly valuable to students who favour a social approach to learning but it's almost universally important to some extent.

To what extent this social peer network replaces or complements existing support mechanisms is not clear. Students evidently do still use traditional support mechanisms - contact with tutor, study guides, additional institutional workshops and training – but it would be interesting to investigate further how much some of these are being replaced by students choosing to turn first to a fellow student for guidance.

Institutional infrastructure: One surprising result was that many of the students showed a marked lack of enthusiasm for VLEs. Only one person mentioned a VLE as one of the four technologies they like to use most, and ten listed a VLE as a dislike. This could be interpreted as the institutional VLE being just taken for granted, or that it is seen as having relatively little value. However it is more likely to be because in those instances the VLEs are being used primarily as repositories for materials rather than being used in

more imaginative ways to support learning. A key issue appeared to be VLEs which were badly designed or structured, with students in the interviews, audio logs and survey venting their frustration at being unable to find information from course websites. Another issue was where VLEs were set up but not really embedded into the culture of the course, so that uploading of materials or course administration was ad hoc and sporadic, contribution to discussion boards was unstructured or infrequent.

Changing practice

The above findings suggest a shift in the way in which students are working and suggest a rich and complex inter-relationship between the individuals and the tools. The follow eight factors emerge from the data in terms of the changing nature of the way students are working.

1. *Pervasive:* Students are using technologies extensively to find, manage and produce content. They use technologies to support all aspects of their study.
2. *Niche, adaptive, utilitarian use:* There is increased evidence of the use of free self-assessment quizzes to test knowledge. They also take part in a wider community of peers, possibly because of the different communication tools they are using. They are members of a range of communities of practice - to share resources, ask for help and peer assess.
3. *Personalised:* They appropriate the technologies to suit their own needs. They use the computer, the internet and books simultaneously. Their learning is interactive and multifaceted, and use strategies such as annotation and adaptation of materials to meet their learning needs.
4. *Management:* Students are sophisticated at finding and managing information (searching and structuring). They see the PC as their central learning tool. They are used to having easy access to information (for travel, entertainment etc) and therefore have an expectation of the same for their courses.
5. *Transferability:* There is evidence of the transfer of practices of the use of technologies in other aspects of their lives to the learning context: for example MSN chat, Amazon, ebay and Skype.
6. *Time:* The concept of 'time' is changing – both in terms of expectation of information and results on demand. There is evidence of a fragmentation of the learning timetable.
7. *Changing working patterns:* New working practices using an integrated range of tools are emerging. The use of these tools is changing the way they gather, use and create knowledge. The value and perceived intrinsic worth of knowledge is also changing. There is a shift in the nature of the basic skills with a shift from lower to higher levels of Blooms taxonomy, necessary to make sense of their complex technological enriched learning environment.
8. *Integrated:* Students are using tools in a combination of ways to suit individual needs. There is evidence of mixing and matching. They are comfortable with switching between media, sites, tools, content, etc. They said that technologies provide them with more flexibility in terms of being able to undertake learning anytime, anywhere.

Conclusion

Students found that technology opened up a variety of possibilities in terms of enabling them to engage in a range of different learning processes suited to their individual needs

and preferences. Various digital technologies emerged as central to the students' everyday practices allowing them to communicate, keep updated with administration, manage learning materials, process, and create and revise work. Discussing some of these issues one computer science student during the interview noted:

> ….it (ie technology) basically opens up a whole world of learning for everybody, you know. You can find, up, read up, on anything you want, like in a university context, you can have all your notes and everything all on one machine…..

In this respect technology is not simply an 'add on', it is central to how the students organise and orientated their learning lives by providing alternative routes to engagement, responsive and immediate modes of interaction and communication and flexibility, which allows home, work and university life to become manageable.

There were a number of both expected and unexpected findings arising from the data, which will be discussed in the paper. The overarching picture which emerges is that students are:

- Are comfortable with technology and see it as integral
- are on the whole sophisticated users – using different tools for different purposes, critically aware of the pros and cons
- have specific expectations – the internet is their first port of call for information and they expect access to up-to-date/ relevant information and communication (with peers, tutors, etc) on demand.

Students were using technologies to support all aspects of learning; directed study, resource discovery, preparation and completion of assignments, communication and collaboration, presentation and reflection. In addition the study revealed that their use of technologies for learning is intermingled with use of these tools for social and leisure activities. The data shows that students are using a range of different types of e-learning strategies, appropriating the tools to meet their own needs.

The findings have profound implications for both the technical infrastructure institutions provide for students and the ways in which we support their learning through use of technologies. They point to a mismatch between our current offerings and student use and a further mismatch between institutions' perceptions of student use of technology and actual use.

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