Teaching and learning in the VLCC: actions, reactions and emerging practice in a very large computing centre

Kathy Buckner
Department of Information Management
Queen Margaret University College
Clerwood Terrace,
Edinburgh, UK
+44 131 317 3763
kbuckner@qmuc.ac.uk

Elisabeth Davenport
School of Computing
Napier University
Merchiston Campus,
Edinburgh, UK
+44 131 455 2723
e.davenport@napier.ac.uk

ABSTRACT

What happens to human computer interaction when the walls of a physical teaching laboratory are removed? We present the case of a very large (and new) computing centre (VLCC) in a technical university in Central Scotland. In this large multi-user computing space teaching is accommodated in a number of raked clusters or pods (local parlance), that are scheduled to function periodically as classrooms. Using a 'social computing' framework, we present observations and findings from a study that reveals how habits and perceptions from a previous habitat initially affect practice in a radically different environment, but are modified as practitioners adapt to the environment.

Keywords

Learning and teaching strategies, adaptive practice, socio/technical analysis, social computing.

INTRODUCTION

We present the case of a very large multi-user computing centre designed as a high-density open teaching environment for computing students. This consists of 18 clusters or 'pods' of 24 tightly packed machines, back to back on two rows of twelve, and each pair of pods is bounded by a waist high surround, and accessed by means of a system of intersecting aisles (see Figure 1). There are no walls or other form of physical boundaries between pods although those on upper tiers are separated from those on the lower tiers by height and thus a 'virtual boundary' is formed (see Figure 2). The facility is open 24 hours a day, and at full capacity can house 500 individuals. The space was opened in Summer 2001.

The design rationale of the space was industrial rather than pedagogical: the centre was to function as a multi-purpose unit, with high-density seating, high turnover, and low maintenance costs. The affordances for interaction in the space were, by design, minimal, in the interests of adaptability. The rationale was reflected in the local nickname used in the early days to describe the facility, the 'Barn', with its connotations of battery hen farming. Initial perceptions by faculty members of the intended purpose of the facility were confused, with some staff suggesting that the initial purpose was as an open access IT resource centre and not a teaching resource.
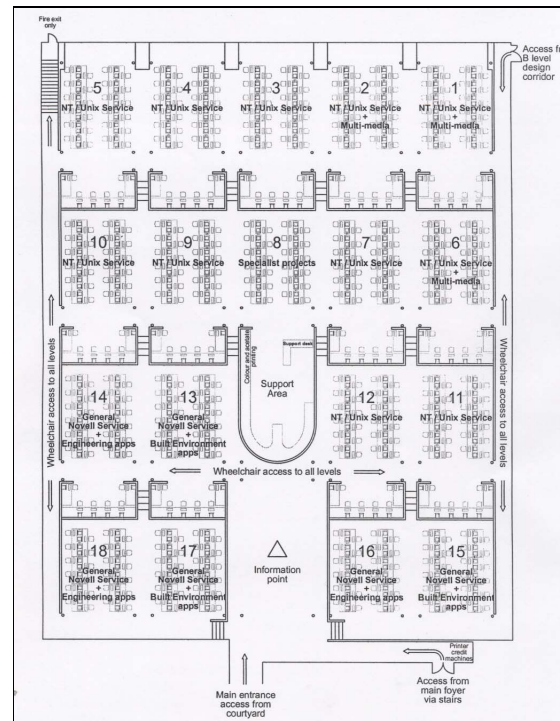

Figure 1: Configuration of VLCC

The space provides an opportunity to explore different facets of cognitive and physical ergonomics. For the past nine months, the authors have been involved in a longitudinal study of work practice in the VLCC. The paper presents findings from the first phase of the project (co-extensive with the first semester of teaching) in the centre, and the second, co-extensive with the second semester. The initial phase of the project took the form of a 'covert' study of the 'Barn' at work, one as a student enrolled on a part time course; the other as a faculty member who does not teach in the facility but is interested in the views of those who do, discussed in the corridor, tea-room, and on a number of discussion lists and e-mail exchanges. The authors have experience of designing electronic learning platforms that can compensate for the loss of face-to-face affordance (Buckner and Davenport, 1997). In the second phase,

observation was overt, and four teaching colleagues agreed to collaborate as 'key informants'. They have supplied examples of coursework, and retrospective accounts of their semester's work.

Figure 2: Showing tiered aspect of the VLCC

SOCIAL COMPUTING

Shifts in pedagogic practice involve more than individuals, and we wish to explore the organisational implications of the new space. What kind of social order can support learning and teaching in this parsimonious environment? How is order established and maintained at different levels of organisation: the laboratory space, the course, the departmental infrastructure committee, the faculty teaching and learning team? What is the pattern (if any) of impact and diffusion? Are there shifts in the configuration of social and technical elements of interaction? To address such questions, and account for our observations, we turn to a body of work on social computing.

'Social computing' is a label for studies of organisational computing that focus on questions of social order and social learning, and how these are achieved and maintained (Dourish, 2000; Dourish, 2002). It brings together work in a number of overlapping domains (Social Informatics, Social Studies of Science, Social Shaping of Technology, Human Computer Interaction, Computer Supported Cooperative Work) that provide a socio-technical account of the workplace. The concept is not new: in 1982, for example, Kling and Scacchi described the 'production lattice' that shapes technology as a 'web of computing' in a seminal study of systems implementation in local government (Kling, and Scacchi, 1982). Kling's subsequent work has addressed socio-technical order across different levels of organization under the rubric of 'social informatics' (Kling, 1999).

Recent work within the social studies of science domain on infrastructure (Star and Ruhlehder, 1994), specifically on 'boundary objects', and their political implications/etiologies, is pertinent to our project, as it may help explain the emergence of templates for coursework specification. Closely related to this domain is work on social shaping of technology (Mackenzie and Wajcman, 2000; Williams, 2000).Within this field, a

number of studies of technological transformation in the workplace (reviewed in McLoughlin, 1999) provide insights into the political economy of project work that have informed our approach. For over a decade, Suchman and others have described the contexts where such work is done (under the rubric of 'workplace studies'; see, for examples, the contributions to Luff, Hindmarsh & Heath, 2000). Many of these studies describe local 'everyday' or 'mundane' activity, or the 'articulation work' (Gerson and Star, 1986) that supports or inspires action at other levels of organisation. Possible instances of this in our project are cases where an *ad hoc* solution to a teaching problem by an individual is adopted as good practice by others.

Dourish, in a recent monograph on embodied interaction (Dourish, 2000), a key factor in social computing, suggests that understanding of this phenomenon demands a 'concern with the mundane aspects of social life, the background of taken-for-granted everyday action'. The focus of attention becomes how orderly social conduct emerges from the detail of each setting in which it is undertaken, and how orderliness is achieved in the face of the endless contingencies to which it is subject' (p. 96). 'Mundane' practice is thus an expression of shared order, articulated in generic activities, ordered by protocols, procedures, documentary genres and other artifacts. Analysis of a growing corpus of micro-level studies reveals a number of 'typical' loci - the helpdesk, the schedule, the classroom, team building. Ackerman and Halverson (1999), for example, provide a detailed account of a helpdesk in an insurance office, where 'work' is both shaped by what the environment affords, and shapes that environment as novel solutions to caller's problems are embedded in the practice of the group. A comparable study is described in Wenger's monograph (Wenger, 1998) on communities of practice; this also illustrates the interplay of group environment and individual action. Within the VLCC 'communities' of students have emerged and we have also observed the emergence of a small community of early adopters to technological change who have collaborated to introduce modified teaching practice which could be used in other contexts.

As we indicate above, there was much discussion on email and in meetings in the early stages of the project among School of Computing faculty about anticipated problems with the new facility, much of it premised on current practice in a traditional classroom. Many of the problems and solutions that emerged in the first semester of teaching reflect the habits of the earlier habitat – hence the title of the report on Phase One, the 'phantom wall syndrome'.

The layout of a traditional classroom (the norm in many of the teaching laboratories that the VLCC replaced) provides affordances that shape the learning and teaching behaviors of students and instructors on what may be broadly described as a one to many basis

(Tanner, 2000; Emmons and Wilkinson, 2001). These include:

Clear 'lines of sight' that focus student attention on the lecturer or instructor.

Omni-directional display space (the four walls, floor and ceiling) for support materials on whiteboards, blackboards, posters.

A clearly defined container that

1) insulates a class against outside distractions and disturbance;

2) encloses and bounds class interactions (peer to peer, and expert to student);

3) encourages a sense of identity in the class community by providing a recognized and regularly frequented space, or habitat.

The space and its activities constitute a well understood socio-technical pattern (Alexander, 1997). The affordance of the classroom supports a number of points of view constrained in a routinised way (Hillier, 1996). To learn and teach in this environment is to be familiar with the disposition of materials, technology and people: when to raise the eyes and check the projected solutions, or when to consult the notice boards on the walls. The genre repertoire is well established (Orlikowski and Yates, 1994). Take the walls away, and the socio-technical order is disrupted. A new set of micro-level knowledge management practices must be developed, and the genre repertoire re-freshed.

PHASE ONE: THE PHANTOM WALL SYNDROME

The VLCC presented a number of initial challenges: face to face interaction remained, but lines of sight and sound channels were radically different. Lack of walls opened up multiple (and distracting) points of view; and sound was difficult to project. In addition, the tight and rigid configuration of workstations meant that surface affordance was lost – it was difficult for learners to manage notes, handouts and other paper at their desks, or to re-orient resources for small group activity around the machines.

Initial Findings

Initial observations focused on sound, sight and identity formation issues in a post-graduate module called 'ITEC'. We present these in three sections: occupation and ownership issues, the ergonomics of attention, and changes in teaching and learning practice.

Ownership and Occupation
How do you know (as a student or a teacher) who is in your group? And who should be there? Identification of space ownership, based on timetabling of classes, was only established part way through the semester. Notices indicating "Class in Progress", were largely ignored by students who started to take ownership of 'their' space in a particular pod that became *their* area and had the comforting feel of being 'home', even though there were no walls. Members of faculty also began to identify particular pods as 'home' - noticeably the preferred pods

were those in the top right hand corner of the VLCC - with the 'corner' attribute being identified as a possible reason for this (see Figure 3).
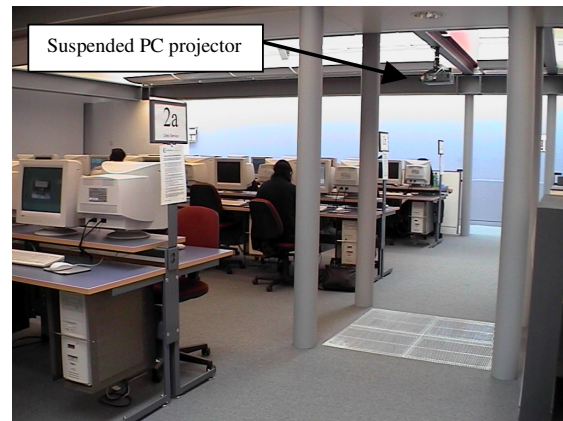

Figure 3: Corner pod with suspended PC projector

To an observer of the overall space in the VLCC classes in pods appeared to have the properties of fluids. Sometimes they appeared to resemble mercury: small groups of students sat together, gradually more students arrived and these small 'drops' merged together to form a single entity: the class. A dense wave of students arriving for a new session could push smaller pools of students out of a space. Attempts were made to solve emerging traffic flow problems by publishing 'rules' based on pedestrian flow modeling research undertaken by a member of faculty (Kukla and Kerridge 2000).

Members of faculty were able to achieve ownership of their allocated 'classroom' on arrival by announcing their presence - usually requesting anyone not in his/her class to log off and vacate the area. However, some found that maintaining 'possession' was a continual challenge with incursions of interlopers (with a reported 17 occurrences over a particular one-hour period) threatening to flood their teaching environment. Whilst this was an issue for some staff, others were more relaxed about the situation and happy to accommodate 'other' students in their cluster provided they were not interfering with the learning and teaching experience.

The Ergonomics of Attention
A major shift has occurred in the positioning of teaching staff in the VLCC. As there is no 'front of class', it is difficult to secure the attention of students by establishing lines of sight or other traditional means Some attempts to use the perimeter walls as teaching artifacts emerged as term progressed. Suspended PC projectors appeared in pods at the far end of the Barn (see Figure 3), which were pointed towards the boundary walls, but these were not observed in use. No projection or other presentation facility e.g. whiteboards was initially placed in any other of the pods.

Staff have diverse methods of teaching and adapted in different ways to the open learning space of the Barn. Tutor 1, for example, took control by identifying the extent of the group: he asked students to raise their

hands if they were 'with him'. To indicate completion of essential tasks students were required to provide a visual signal by putting their hands-up – reinforcing the boundaries of the class group and assuring their attention. With nowhere to write (no walls with whiteboards, for example) the tutor wrote on a paper notepad produced by an assistant to demonstrate a particular task. Tutor 2 identified the boundaries of the group by handing out worksheets. These operated like a 'badge' – anyone with the right worksheet being in 'his' class.

The acoustics in the VLCC have been designed to absorb sound and there is rarely a disturbing amount of noise. Even so, noise travels more easily in this open environment than it would between adjacent closed IT workshops. For example, whilst Tutor 1 was trying to explain a point to a class of students there was a noise disturbance from a group of unsupervised students in another pod. Students on the periphery of Tutor 1's class were unable to hear him speak and stood up so that they can more easily hear. Tutor 1 was perturbed and after establishing the difficulty had to go into the other 'room' to request the students to be quiet.

Changes in Learning and Teaching Practice

Limitations in lines of sight, coupled with acoustic problems have caused some changes in teaching practice to be made. The most significant is that 'whole group teaching' has been largely abandoned. Tutor 2 only rarely (e.g. if a mistake needed to be rectified on an instruction sheet) attempted to engage with the whole class in the pod, rather support was provided at the individual or paired student level. Mixed mode teaching with short periods of time at computer workstations interspersed with 'mini lectures' had in the past been perceived as being effective mechanisms for maintaining interest and concentration. This type of teaching had been used, for example, to resolve frequently recurring problems or to provide reassurance on the stage they should have reached. This type of interaction has now had to be moved to traditional (non-IT) classrooms, as these are the only alternative available, although it is recognised that other 'studio classrooms' (Bazillion and Braun, 2001) would be more appropriate. Students have been forced to adapt to changing teaching methods. They have become more reliant on obtaining support and help from paid 'demonstrators' rather than lecturers or professors. They seek support and advice from their fellow students with collaborative learning becoming the norm rather than the exception.

PHASE TWO: ADAPTIVE PRACTICE

In Phase Two, observations from the student point of view continued, complemented with observations from the key informants. These indicate that practice has been modified to meet at least some of the challenges.

Ownership and Occupation

Ownership of teaching space continues to be a difficult issue for some members of faculty. However, new techniques have evolved to ensure appropriate configurations within the pods. Tutor 3, for example, now 'trains' his early arrivals to sit in the 'best seats' knowing that late arrivals will follow the flow and seat themselves nearby. He observes that once the early arrivals are properly 'trained' he no longer has to arrive in advance to direct them to the positions he prefers them to use. For some members of faculty adapting their practice has helped to ameliorate some of the difficulties encountered in the early stages of use of the VLCC.

The Ergonomics of Attention

The locus of attention in the classroom appears to be changing as staff and students get more used to working in the VLCC. The 'front' of the class is now seen by some as being at the entrance to the pod - from where they can also protect their space (see Figure 4). For others, the 'front' has far less relevance than it had in traditional teaching spaces as we shall see in relation to changing teaching practice.

Acoustic distractions have also pushed some tutors to change practice as colleagues have criticised them for projecting their voices too much and causing interference in other classes.

As the difficulties of working in undelimited spaces became apparent they were drawn to the attention of management. The lack of writing and projection facilities was 'solved' by the introduction of traditional artefacts (or 'comfort blankets') eg PC projectors and whiteboards. However, observation suggests that there has been very little use of these tools. We might surmise from this that traditional artefacts, which work well in traditional spaces, do not necessarily present an appropriate solution to the problem, caused by the change in environment, when imported into non-traditional, open teaching spaces. It might also suggest that the problem of 'writing' and 'presenting' is not the 'real' or whole problem.

Tutor engaged in dialogue near entrance to pod

Figure 4: Showing tutor (standing) at entrance to pod

Changes in Learning and Teaching Practice

The changes in practice in relation to ownership and attention, which we have observed, can be interpreted as

being the outward and visible signs of changes in teaching practice.

Early adopters of the new teaching space have adapted their teaching practice to better suit the environment and the constraints it presents. For example, Tutor 1 now provides comprehensive, structured materials for each week which, to a great extent, can be worked on (using supplementary web-based resources) independently by students. He organises the students into small (3 or 4 students in each), collaborative groups whereby he positively encourages peer to peer activity. Each group is seen by either the member of faculty or by 'cherry picked' demonstrators during the course of the one or two hour session with records being maintained to ensure that there is engagement with all the groups each week. Student support is therefore provided by the scaffolding (Vygotsky, 1978) of the networked learning environment, through faculty and demonstrator interaction, and by engagement in problem solving and practical application with their peers. Tutor 1 is not alone in adapting practice to the environment - others have also indicated a tendency to moved away from 'mini-lecture followed by practice' mixed mode teaching to individual and group tutoring.

DISCUSSION

Our small-scale observations in phases One and Two suggest that social ordering is manifest in relation to the VLCC at a number of different organisational levels. It is most evident in the highly localised strategies used to 'mark' and 'occupy' the physical teaching space of the pod, and in tactics developed to manage attention and interaction inside each pod. Much of the initial 'ordering' has been pragmatic. Traffic protocols, an early innovation, were rapidly implemented as a *sine qua non* for scheduled teaching to take place without congestion and disruption. Many of the tactics relating to ownership and identity exploit the physical affordance of the space – presence can be established by standing where students or other class members can see you, and by waving. Only novices use formal signage systems (the floorplan or the timetable); others (as we note above) identify their pod because of its locality and because they recognise the colleagues who are there. We have found tactical management of presence by teaching staff, with a shift from an upfront position as the focus of class attention to a 'genius loci' role that allows students to identify a space by the teacher who is present. One colleague's description of his role is akin to that of a *maitre d'*, welcoming students at the entrance to the pod, checking on their well-being…Another lecturer feels that this 'café' ambiance will foster peer to peer learning, and is modifying his CBT materials (and the associated interaction protocols) accordingly.

Meta-level 'ordering', at this stage, also appears to be piecemeal. 'Incidents' and 'needs' are reported to a number of committees and fora (such as the Teaching and Learning Team, Teaching Management Team, Staff Student Liaison Committee, Infrastructure Committee).

The responses and solutions that emerge may be more or less effective. In the case of the projectors and white boards that is mentioned above, lack of uptake may be due to the location of these in pods at the edge of the cluster that were not scheduled for the class tutor involved, or may be due to a timelag between demand and delivery that allowed an alternative practice to emerge, such as adapting course materials to shared file delivery on the desktop instead of front of class projection.

We suggest that the VLCC has led to shifts in socio-technical order, some of which are perceived as significant, and worthy of discussion at planning level. Dissemination and adoption of good or innovative practice by others is of critical importance to ensure a high level of quality of learning and teaching. The Learning and Teaching group within the School of Computing are engaging members of faculty in 'show and tell' sessions at which innovative methods used in the VLCC can be shared and discussed more widely.

CONCLUSIONS

The open space of the VLCC has raised a number of teaching and learning interaction issues. Some of the problems anticipated by faculty on the basis of previous practice in traditional 'walled' environments have been apparent. The 'solutions' in the first two phases revealed in some cases a strong adherence to the earlier habitat with attempts to sustain lines of sight, sound channels and class identity with varying degrees of success. In other cases, however, innovative practice emerged: an example is the 'café' model of classroom management that replaced the 'factory' model of the old regime. The VLCC offers its own affordances: as it has been designed as a large public arena, physical signals and cues can be exploited: examples are the flocking and herding behaviors described above.

Individual students working on personal assignments find the space congenial, and group norms have emerged that moderate noise. Visitors have compared the 'hum' in the space to that of an expectant audience in a cathedral or opera house, or to the noise of a hive. The lack of formal interaction design has allowed local innovation (at the level of the pod or course) to flourish. In the next phase of the project, we will explore these innovations and examples of resistance in greater detail, from the perspective of three levels of social order. The first is that of the learners on a specific course; the second is that of teachers, and the third is the meta-level of departmental decision-making. Members of faculty are having to adapt their teaching practices to the new environment through the development of new learning resources, changes in mode of interaction with students and selection of alternative environments for some forms of interaction. Students are having to adapt their approach to learning as more information, content and instruction is delivered as electronic or printed text. The effective management of such change is crucial if a large learning environment such as the VLCC is to be universally accepted.

Our initial small scale covert study has been, inevitably, partial. Our impressions that the VLCC has produced innovation need to be qualified. Like any playground, it will support both good and bad behaviour. Like any other 'new' open plan office initiative, the VLCC has led to changes in practice. Whether these are 'sticky' and substantial remains to be seen.

ACKNOWLEDGEMENTS

REFERENCES

Ackerman, M., & Halverson, C. (1999). Organizational memory: processes, boundary objects, and trajectories. In R. Sprague (Ed.), *Proceedings of the 32nd Annual Hawaii International Conference on System Sciences (CD ROM). Los Alamitos: IEEE.*

Alexander, C. *et al.* (1997). *A Pattern Language.* Oxford University Press: New York.

Bazillion, R. J. & Braun, C.L. (2001) Classroom, library and campus culture in a networked environment *Campus-Wide Information Systems*, 18(2). 61-67.

Buckner, K. and Davenport, E. (1997). Evaluation of a networked learning environment: training and transferability issues. In *Proceedings of the Second Nordic-British Conference on Library and Information Science Education, Edinburgh, March 1997.* London: Taylor Graham, 5 - 18.

Dourish, P. (2000). *Where the action is.* MIT Press.

Dourish, P. (2001). Seeking a foundation for context-aware computing. *Human-computer Interaction*, 16, 229-241.

Emmons, M. & Wilkinson, F. C. (2001). Designing the electronic classroom: applying learning theory and ergonomic design principles. *Library Hi Tech* 19(1) 77-87.

Gerson, E., & Star, S. (1986). Analyzing due process in the workplace. *ACM Transactions on Office Systems*, 4(3), 257-270.

Hillier, B. (1996). *Space is the machine.* Cambridge University Press: New York.

Kling, R. (1999). What is social informatics and why does it matter? *D-Lib Magazine*, 5 (1), 25.

Kling, R. and Scacchi, W. (1982). The web of computing: computer technology as social organization. *Advances in Computers*, 21, 2 – 90.

Kukla R. & Kerridge J. (2000) *Developing the Behavioural Rules for an Agent-based Model of Pedestrian Movement,* 25th European Transport Congress, 2000, Cambridge, UK, 01/09/2000-01/09/2000.

Luff, P., Hindmarsh, J. and Heath, C. (2000). *Workplace studies: recovering work practice and informing system design.* Cambridge: Cambridge University Press.

Mackenzie, D. and Wajcman, J. (2000*) Social shaping of technology.* 2nd edition. Milton Keynes: Open University Press.

McLoughlin, I. (1999) *Creative technological change: the shaping of technology and organizations.* London: Routledge.

Orlikowski, W., & Yates, J. (1994). Genre repertoire: the structuring of communicative practices in organizations. *Administrative Science Quarterly,* 33, 541-574.

Star, S., & Ruhlehder, K. (1994). Steps towards an ecology of infrastructure: complex problems in design and access for large-scale collaborative systems. In R. Furuta & C. Neuwirth (Eds.), CSCW94: *Proceedings of the conference on computer-supported cooperative work (pp. 253-264). New York: ACM.*

Tanner, C.K. (2000). The influence of school architecture on academic achievement. *Journal of Educational Administration.* 38(4) 309-330.

Vygotsky, L. S. (1978). *Mind and society: The development of higher mental processes.* Cambridge, MA: Harvard University Press.

Wenger, E. (1998). *Communities of practice: learning, meaning and identity.* New York: Cambridge University Press.

Williams, R. (2000) Public choices and social learning: the new multimedia technologies in Europe. *The Information Society*, 16 (4), 251-262.