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Why hasn't technology disrupted academics' teaching practices? Understanding resistance to change through the lens of activity theory

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Abstract

The advent of the Internet heralded predictions that e-learning would transform and disrupt teaching practices in higher education. E-learning also promised to expand opportunities for lifelong and flexible learning, and offered a panacea for practical issues such as decreased funding and increasing student numbers.

The anticipated disruption to teaching and learning has not come to fruition however. Although technology is now common place in most higher education institutions – most institutions have invested in a virtual learning environment (VLE) and employ staff dedicated to supporting e-learning – there is little evidence of significant impact on teaching practices and current implementations are accused of being focused on improving administration and replicating behaviourist, content-driven models.

This paper discusses a preliminary analysis, rooted in Activity Theory, of the transformation of teaching practices, which did or did not take place in our university following the institution-wide deployment of a VLE. In particular, factors limiting a full uptake of the VLE more advanced functionalities by the wider university community are explored.

Keywords: Activity theory; Disruption; Functional organs; VLEs; Higher education; Teaching practices

1. Introduction

The advent of the Internet heralded predictions that e-learning would transform and disrupt teaching practices in higher education. In line with Clayton Christensen's (1997) concept of disruptive innovation, e-learning technologies were to be embraced by educators "who in the past hadn't been able to do [something] themselves for lack of money or skills", who "welcome a simple product", which will enable them "do more easily and effectively what they are already trying to do" (Christensen, Aaron, & Clark, 2002, p. 30–32).

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E-learning also promised to expand opportunities for lifelong and flexible learning, and offered a panacea for practical issues such as decreased funding and increasing student numbers.

According to the Oxford English Dictionary, however, *to disrupt* is also to "*(1) disturb or interrupt and (2) seriously alter or destroy the structure of*". It is this latter meaning that we use throughout this paper: we understand *disruption in education* as a serious transformation or alteration of the structure of teaching and learning activities taking place in formal education, with a particular focus on those transformations arising from an institution-wide deployment of e-learning technologies. Kellner (2004) argues that e-learning presents unique opportunities for a 're-visioning' of education in order to realise the type of "dialogical, democratizing and experimental practice" envisioned by John Dewey (1916) and Friere (1972). Others have claimed that e-learning could radically impact on university pedagogy. For example, Burbules and Callister (2000, p. 277) highlight that e-learning can create learning opportunities that "can only exist online, not in 'real' classrooms", such as interaction with three dimensional "virtual worlds".

Yet, the anticipated disruption to teaching and learning has not come to fruition (Selwyn, 2007; Keller, 2005; Kirkup and Kirkwood, 2005; Tearle, 2003). Although technology is now common place in most higher education institutions there is little evidence of significant impact on teaching practices, and "e-learning is still marginal in the lives of most academics" (Conole, 2004). Reporting on the state of web-based teaching and learning at University of Helsinki, Löfström and Nevgi (2007) observe that, despite the university's strong emphasis on web-supported teaching and learning, "the degree to which ICT is utilised in individual courses varies substantially" (Löfström & Nevgi, 2007, p. 317). Selwyn (2007) describes the use of technology in higher education as "sporadic, uneven, and often 'low level'" and points to the "growing need for the education community to account for the distinct 'digital disconnect' between the enthusiastic rhetoric and rather more mundane reality of university ICT use" (Selwyn, 2007: 1). According to Laurillard (2007),

"[. . .] we tend to use technology to support traditional modes of teaching – improving the quality of lecture presentations using interactive whiteboards, making lecture notes readable in PowerPoint and available online, extending the library by providing access to digital resources and libraries, recreating face-to-face tutorial discussions asynchronously online – all of them good, incremental improvements in quality and flexibility, but nowhere near being transformational." (Laurillard, 2007: xv)".

The authors' own context is typical of many universities and our experience of ICT implementation across our institution shares many of the characteristics outlined above. Innovative uses of learning technologies have formed part of the university's strategic aspirations since the mid eighties, when a number of 'early adopters' started to experiment with e-learning technologies. However, such strategic aspirations were soon restricted to the deployment, following an initial pilot phase, of an open source VLE at the turn of the millennium. Moodle is now widely used by staff and students. Using activity theory – and more specifically the theory of expansive learning (Engeström, 1987) as well as the notion of functional organs (Kuutti, 1996; Kaptelinin & Nardi, 2006) – as the main interpretive framework, this paper seeks to identify and to explain the extent to which teaching practices within our institution have been disrupted since the introduction of Moodle, as evidenced by usage data and the preliminary results of a survey carried out at the end of the academic year 2005–2006.

2. Understanding disruption through the lens of activity theory

While authors such as Selwyn (2007) adopt a critical theory perspective and consider "the wider social relations underpinning the integration of computer technologies in universities" in their attempts to explain "the restrictive and decidedly nontransformatory nature of formal use of ICT in contemporary higher education" (Selwyn, 2007: 2), others call upon activity theory as a framework either to design technology-rich learning environments (e.g. Jonassen & Land, 2000; Blin, 2004), to enhance evaluation practices of learning technologies (e.g. Scanlon & Issroff, 2005, p. 430; Hémard, 2006), or to understand the "variability in adoption patterns when it comes to the activities and purposes for which ICT is being used" (Kirkup & Kirkwood, 2005, p. 186). According to Kaptelinin and Nardi (2006), whose take on activity theory has been influential in the domain of Human Computer Interaction, activity theory is a conceptual framework that enables "to bridge the gap between motivation and action [and] provides a coherent account for processes at various levels of acting in the world" (Kaptelinin & Nardi, 2006, p. 62).

Originating in Marxist philosophy and in Vygotsky's cultural-historical psychology (Chaiklin, Hedegaard, & Jensen, 1999), cultural-historical activity theory draws on Vygotsky's (1978) concept of mediated action and on Leontiev's (1978) hierarchical structure of human activity. Within a Leontievian perspective, activities are collective and motivated by the need to transform an *object*, which can be material or ideal (e.g. a problem or idea), into desired outcomes. This motive gives sense and direction to actions or chains of actions, which are carried out by the *subjects* (individuals or groups) and which are oriented toward specific or finite goals. Actions, which are intentional and carried out through a series of routinised and automated operations, are mediated by *tools*, which can be material (e.g. books, computers, machinery, etc.) or psychological (e.g. language, sign systems, models, etc.). Engeström's (1987) notion of activity systems is an expansion of Leontiev's (1978) triadic model – subject – tools – object. It now includes the *community*, composed of participants sharing the same object or motive, as well as the *rules* and *division of labour* governing the community and mediating the individual and collective actions carried out by the participants (Engeström, 1987). Activity systems are characterised by contradictions (or systemic tensions), which trigger innovation and change and are source of development (Barab, Barnett, & Squire, 2002; Engeström, 1987, 2001; Helle, 2000). The term contradiction is not to be understood as problem, obstacle, conflict, or communication breakdown. Rather, "contradictions are historically accumulating structural tensions within and between activity systems" (Engeström, 2001, p. 137). According to Kuutti (1996), "activity theory uses the term contradiction to indicate a misfit within elements, between them, between different activities, or between different developmental phases of a single activity" (Kuutti, 1996, p. 34). In the context of work practices, contradictions, "manifest themselves as problems, ruptures, breakdowns, clashes" (Kuutti, 1996, p. 34), or as disturbances, which "interrupt the fluent flow of work" (Helle, 2000, p. 87–88).

Activity systems move through relatively long cycles of qualitative transformations. For Engeström (2001),

"An expansive transformation is accomplished when the object and motive of the activity are reconceptualized to embrace a radically wider horizon of possibilities than in the previous mode of the activity". (Engeström, 2001, p. 137)

2.1. Disruption in higher education as expansion

The analysis of activity systems (Engeström, 1987, 1999) conceptualising the activities relating to teaching and learning in higher education can help us to understand these activities as they unfold (Kirkup & Kirkwood, 2005, p. 189). In particular, it enables us to understand the underlying systemic tensions that manifest themselves through conflicts, breakdowns or simply through the non-adoption of ICT. Furthermore, when the introduction of a new object or of a new tool, such as a VLE, results in a serious alteration of the internal structure of the teaching activity system, we can infer that the activity system has been disrupted. If this disruption manifests itself through the construction and adoption of new curricula, assessment procedures, teaching methodologies, resources and tasks, we can infer, in line with Engeström's theory of expansive learning, that this disruption is expansive. If on the contrary, the introduction of new technologies does not result in the expansive transformation of the internal structure of the teaching activity but rather in the rejection of the new element, the activity has not been disrupted in the previous sense. It has merely been momentarily disturbed or interrupted (see the first definition of *disruption* from the Oxford English Dictionary recalled earlier): teaching practices remain unchanged. By focusing on the emergence of contradictions and on the way these are (un-) resolved, activity theory thus allows us to gain some explanatory insights in phenomena of resistance to educational innovation and barriers to pedagogical transformation resulting from the introduction of technology.

Understanding the formation and resolution of contradictions is therefore central to our understanding of disruption, or lack of, in higher education. Obstacles to the successful implementation of technology in education, such as those outlined by the studies mentioned earlier in this article, can be seen as manifestations of deeper systemic tensions within or between elements of activity systems as well as between interacting activity systems. Kirkup and Kirkwood (2005, p. 195), for example, highlight some of the contradictions arising from the adoption of an "electronic tutor-marked assignment (ETMA) system" by the Open University (OU). Focussing on the 'new' student assessment activity, whose object is defined as the provision of improved quality feedback and the allocation of fair grades, they identify contradictions firstly between the subjects of the activity (i.e. the tutors as providers of feedback and grade) and the mediating tools (e.g. the ETMA system) available to

them, and secondly, between the same subjects and the rules imposed by the OU regulations, procedures and established marking practices (e.g. marking guides, deadlines, previous experience of hand marking, etc.):

> "The marking/commenting tool itself was causing problems for tutors because it introduced technology related activities that were time-consuming and ponderous to use. The tools were not obviously improving that aspect of teaching for the tutor. The ETMA system modified the nature of the task and conflicted with well-established practices. Tutors were willing to change their previous practices of handwritten marking, with its familiar system and technology (paper, pen and post) despite the fact that it was faster and simpler to use, because they could see the improvement in quality of feedback for the student. However, it was harder for them to feel that the extra time and new learning demanded by the ETMA system was producing enough extra advantage, and the ETMA system remains unpopular with some teaching staff." (Kirkup & Kirkwood, 2005, p. 195).

The above example illustrates how a new tool, imposed from the outside, modifies to some extent the internal structure of an established activity, here through the increased amount of time that has to be devoted to an 'old' practice, and may encounter some resistance from the subjects of the 'old' activity. What seems to influence the nature of the transformation and its level of expansion is the relationship between the *subjects* of the activity under consideration and its *object* as it is mediated by the new tool. In the above example, subjects (i.e. the OU tutors) value the potential of the new tool in improving students' learning experience and outcomes. Yet, some tutors resent the introduction of the ETMA system and are not yet in a position to transform their own practice with a view to resolve or eliminate these tensions.

Although their work is not located within an activity theoretical framework, Brill and Galloway (2007) provide some possible explanations for such a lack of expansive transformation in higher education by considering "larger barriers that may serve to work against [technological] innovation" (Brill & Galloway, 2007, p. 104), such as "the emphasis on research productivity in tenure and promotion guidelines" (*ibid*). Indeed, academics simultaneously engage in interacting, yet at times conflicting, activities, such as 'teaching', 'research' and 'administration'.

Exploring the potential of activity theory in the evaluation of learning settings that integrate ICT, Scanlon and Issroff (2005) also consider the larger higher education context and in particular its recent transformation as a result of globalisation. According to them, the increasing influence of market forces on higher education points to a fundamental contradiction:

> The primary contradiction in higher education activity [in the UK] takes the form of the student as person to be educated versus student as source of revenue and profit. (Scanlon & Issroff, 2005, p. 433).

In an increasingly competing market, higher education institutions in the UK, and to some extent in Ireland, often see the implementation of e-learning as potentially increasing their 'market share'. Scanlon and Issroff (*op. cit.*) argue that the impact of this transformation on students' perceptions on learning technologies, and consequently on the way they use them, needs to be further examined if we want to properly evaluate the integration of learning technologies in education settings. In their study of a multimedia anatomy laboratory, they observe a "mismatch between desired outcomes of the students and those of the tutor" (Scanlon & Issroff, 2005, p. 434), and thus a mismatch of views not only on the alleged efficiency of learning technologies, but also on the way they should be integrated into the curriculum:

> [...] the students' rules about education lead them to a set of expectations about the ways in which they could learn efficiently. This is in contradiction with their experience of the multimedia in the laboratory. The move away from traditional teaching methods towards self-directed learning with learning technologies also contradicts their understanding of the division of labour within educational settings.

The same might also be said of higher education teachers, who may feel somewhat alienated not only by the recent shift in universities senior management 'consumer and product' discourse (Scanlon & Issroff, 2005), but also by the transformation of the rules and division of labour that constituted their established practice. Such a transformation of an established practice can be triggered by the deployment of an institution-wide VLE.

2.2. The case of VLEs

The decision to deploy a VLE across a higher education institution is often a response to the – often conflicting impact – of both market-driven influences and a deep institutional or individual commitment to enhance students' learning experience and outcomes. Notwithstanding the importance of external influences and students' perceptions as discussed in the previous section, its successful implementation is likely to depend on the quality of the learning activities designed for the VLE and on their integration into the curriculum. The activity theoretical concepts and principles briefly outlined above can be illustrated through the modelling and representation of the activity relating to the design of a unit of learning delivered, either partially or in its entirety, via a VLE. Fig. 1 below represents the activity system relating to the activity of designing a unit of learning (e.g. a module or a sub-component of a module, an entire course, etc.) in our own institution, Dublin City University (DCU). A number of actions (e.g. planning learning activities, writing up and producing learning materials, organising content, assessing, uploading learning materials, etc.) are taken by the *subjects* of the design activity (e.g. individual lecturers or teams, support staff such as learning technologists), who are part of the wider academic *community*. These goal-oriented actions may be motivated by some wider policy (e.g. all modules must have a presence on the institutional VLE), by the need to provide a flexible learning environment in some faculties or departments (e.g. part-time delivery of programmes, distance learning, etc.), or simply by the commitment on the part of individual members of the academic community to enrich the students' learning experience. The mediators of the activity include *the rules and convention* underpinning the institution teaching activities (e.g. academic structures, marks & standards, etc.), the established *division of labour*, and the *tools and artefacts* available to the community. The latter include pedagogical philosophies and approaches, subject matter knowledge, 'learning objects' that have been developed previously (such as lecture notes, exercises, reading lists, etc.), and the technologies available to produce materials (computers, generic applications such as MS Word and PowerPoint, etc.) and to deliver them (email, web, VLE, etc.).

2.2.1. Semiotic vs. technological spaces

A VLE however does not only mediate design, teaching and learning activities: it also ''potentially supports and penetrates [them] at all levels'' (Kuutti, 1996, p. 34). Indeed, the potential role of technology in supporting activities as described by Kuutti (1996) can easily be transposed to VLEs (see also Blin, 2004). At the level of

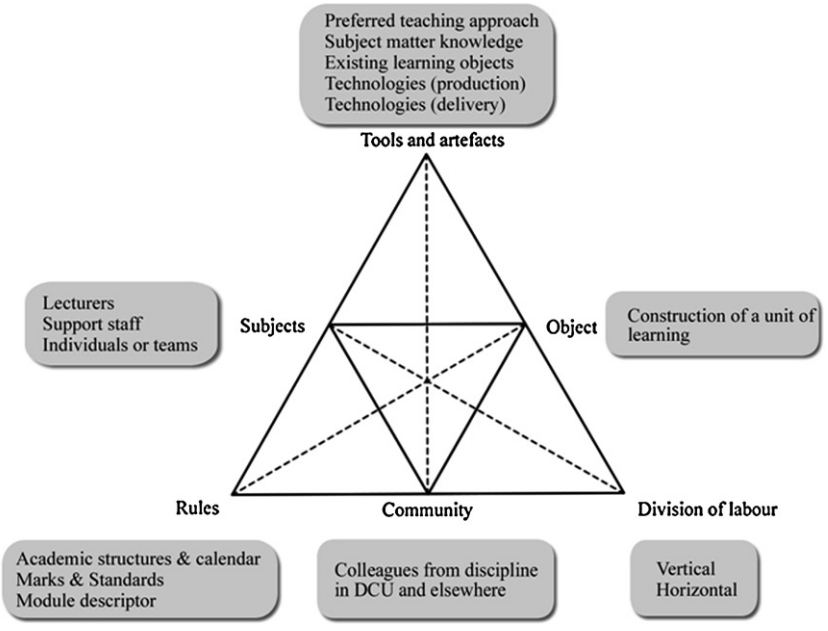

Fig. 1. Designing a unit of learning activity system.

operations for example, a VLE allows the automation and substitution of human operations (e.g. automatic enrolment of students in a particular course, automatic correction and grading of tests, distribution of learning materials depending on previous results, notification of grades to students, etc.). At the level of *actions*, the various component technologies of the VLE will enable the lecturer/designer to set up learning activities – which in turn will enable students to create, transform and manipulate content, either independently or collaboratively (e.g. quizzes, wikis, glossaries, discussion forums, chatrooms, etc.), to create resources (e.g. links to on-line resources, flash animations, audio and video files, and documents in various formats) and to organise them so that meaningful learning can occur. Finally, at the *activity* level, the VLE and its various component technologies "can be the principal enabler for an activity" (Kuutti, 1996, p. 35). By providing a set of options and templates, guidelines and internal rules, communication tools and databases enabling lecturers/designers to share learning objects and to collaborate, a VLE can thus be seen as a disruptive technology, which, according to Christensen et al.'s (2002) definition cited in the introduction of this paper, can potentially enable lecturers/designers to either do what they could not do before – because of their lack of skills or resources (creating interactive web content for example) – or to improve or develop what they were already doing.

The above discussion suggests that the VLE constitutes a 'technological' layer of the activity, with its own mediating artefacts, rules and conventions, and division of labour. Drawing on McAndrew, Taylor, and Clow's (2006) adaptation of the activity system representation for mobile learning, the design activity can therefore be conceptualised as unfolding in two different yet interconnected spaces: the *design* or '*semiotic*'*space*, which is the social and cultural context in which the design activity is taking place, and the*technological space*, which affords the actual realisation of the object of the design activity (i.e. the construction of a unit of learning within the VLE). Fig. 2 below illustrates the dialectical relationship between both spaces as they are constructed by the DCU academic community. Whereas McAndrew et al. (2006) have renamed the bottom nodes of the triangle from rules, community and division of labour to control, context and communication respectively, we have decided to retain the original activity theoretical formulation proposed by Engeström (1987). In our example, the *subject* of the design activity is both a 'semiotic' subject (i.e. a lecturer/designer) and a 'technological' subject (i.e. a user of Moodle). The *object* of a lecturer's design activity is also both semiotic and technological: s/he enters the design activity motivated by the need to construct a unit of learning that will transform his/her students knowledge and skills and by the will to deliver part or

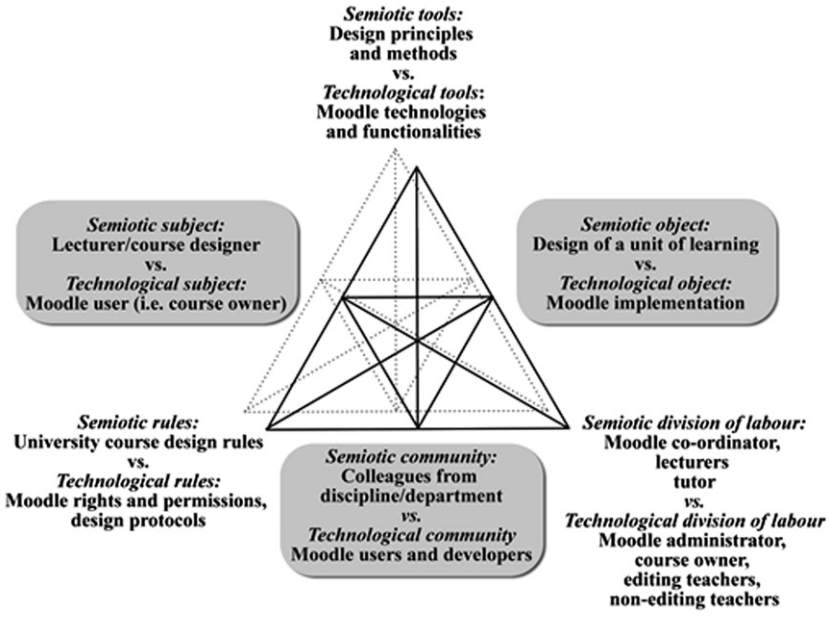

Fig. 2. Semiotic and technological spaces.

all of this unit of learning via Moodle. In doing so, the lecturer enters two distinct, yet overlapping, communities, both shaped by a partially shared object, governed by their own rules and division of labour. For example, the roles taken by different members of staff involved in the design and delivery of a module (e.g. module coordinator, lecturer, tutor) may or may not fully match, or may even be in conflict with, the roles assigned in Moodle (e.g. administrator, editing and non-editing teacher).

The dialectical relationship between nodes of the two spaces can be seen as a representation of what Engeström (1987) defines as *primary contradictions*. As noted by McAndrew et al. (2006), "there are also relationships between nodes of the triangle on each individual plane", or secondary contradictions in Engeström's terminology. McAndrew et al. *(op. cit.)* suggest that a breakdown in the technological plane may have 'catastrophic' results if the 'semiotic' user does not have the necessary technological know how to fix it.

2.2.2. Functional organs

The dialectical relationship between semiotic and technological spaces leads us to consider the concept of *functional organs*, which is viewed by Kaptelinin and Nardi (2006) as "a key concept of activity theory from the point of view of interaction design" (Kaptelinin & Nardi, 2006, p. 64). According to these authors, "functional organs combine natural human capabilities with artefacts to allow the individual to attain goals that could not be attained otherwise" (*ibid*). To create and use functional organs, individuals need a range of competencies:

> *Tool-related competencies* include knowledge about the functionality of a tool, as well as skills necessary to operate it. *Task-related competencies* include knowledge about the higher-level goals attainable with the use of a tool, and skills of translating into the tool's functionality (Kaptelinin & Nardi, 2006, p. 64–65, italics in original).

In addition, to create and use functional organs *efficiently*, individual subjects also need what Kaptelinin and Nardi call *metafunctional competencies*, which "enable [the subject's] understanding of how to use functional organs (such as knowing tricks and work-around), recognizing their limitations, and knowing how to maintain and troubleshoot them" (Kaptelinin & Nardi, 2006, p. 218).

The above competencies are also required of lecturers who want to efficiently integrate the institution VLE in their teaching practice. In most universities, such as ours, tool-related competencies may be acquired through participation in the broad range of training and development courses on offer to academic staff. Few courses, however, cater for the development of task-related and metafunctional competencies. Yet, both are necessary if lecturers are to move smoothly between the'semiotic' and'technological' spaces that they construct while engaging in a design activity for a VLE. While most academics may quickly be trained in the basic operations of a VLE (such as setting up activities and resources or creating content), few would have availed of pre-service teacher training courses and fewer again would have acquired some instructional design competencies before obtaining an academic post. Metafunctional competencies, on the other hand, are likely to be acquired through experience and interaction with colleagues and support staff. The role and impact of functional organs will be further explored in the following section.

3. The (non-)transformation of teaching practices: an exploratory study of Moodle@DCU

Innovative use of learning technologies has been integral to DCU's strategic aspirations since the mid eighties, when a small number of early adopters across all faculties began experimenting with web-based and multimedia technologies. In particular, some lecturers developed personal web sites, which included links to learning resources and activities. In the late nineties, the first VLE systems were introduced and piloted by the same early adopters: initially TopClass and subsequently WebCT, while a custom-built VLE was developed and deployed by one department. During the same period, all students were given access to personalised portal pages, which provided easy access to the appropriate timetables, module descriptors and examination past papers. Lecturers were given space on the university Intranet to upload teaching materials (accessible on campus only) and class email discussion lists allowed staff and students to communicate outside class (McMullin & Munro, 2004).

3.1. Moodle@DCU

By 2004 however, despite small-scale innovative use of e-learning by around 5% of the total number of academic staff, the predominant teaching paradigm was a traditional lecture- and tutorial-based model. In 2004, following detailed consultation with stakeholders both inside and outside the University, the open source VLE Moodle was introduced on an institution-wide basis, with a commitment to its central administration and support for use by all members of the University (McMullin & Munro, 2004).

A key motivation for the selection of the Moodle VLE was the flexibility offered by its open source development model, which would enable DCU to contribute to the future development of the software (McMullin & Munro, 2004). In particular, an open source platform was deemed to offer more flexible possibilities for integration with other DCU systems – such as registry, financial and library systems – than would be possible were a closed source environment deployed. An additional perceived benefit was that deployment of an open source platform would negate possible future exposure to 'vendor lock-in': a situation where the institution became dependent on a particular commercial vendor.

The pedagogical approach underpinning Moodle's design was also a significant factor contributing to its selection as DCU's institutional VLE. It was considered important that the design of Moodle was strongly influenced by an explicit pedagogical theory and orientation (social constructionism), a pedagogical approach deemed to be well aligned with DCU's teaching and learning aspirations.

Responsibility for the overall management and administration of the Moodle platform resides jointly with DCU's learning innovation unit (LIU) and computer services department (CSD). The CSD are responsible for hosting the platform and for technical support. The LIU are responsible for dealing with day-to-day technical and pedagogical enquires, and for provision of training in both technical and pedagogical aspects of the software. Formal training thus far has focused in the practical aspects of using the system, with provision of pedagogical advice offered via one-to-one consultations and school-specific workshops. Face-to-face courses offered include basic 'Getting started with Moodle' workshops, and workshops focused on particular activities, for example communications tools, quizzes and wikis. Online courses are also offered, for example an online tutoring course based on Salmon's (2000) 5 stage e-tutoring module.

Moodle allows specific roles – each with an associated set of permissions – to be assigned to each user of the system. During the academic year 2005/6 DCU employed version 1.5 of the Moodle platform. In this version, five user roles are possible: *Administrator*, *Course creator*, *Teacher*, *Non-editing teacher* and *Student*[1]. *Administrators* have 'super user' access: they can make global changes that affect the configuration of the whole site, have access to user details and can modify all courses. Administrative access is restricted to staff within the LIU and CSD. *Course creators* have limited administrative permissions, including the capability to create new courses on the system. *Teachers* can do anything within a course that they are assigned to, including modifying the course layout and structure, creating activities, adding content and grading students. *Non-editing teachers* can teach in courses and can grade students, but may not alter the course structure, or add/modify activities or resources. *Students* have no editing rights within a course.

Each module offered on a DCU programme of study is allocated a dedicated Moodle course. Prior to the start of each academic year, module co-ordinators are automatically made the teacher of the appropriate course(s). Where additional lecturers or tutors are part of the teaching team, the course owner can assign them as editing or non-editing teachers as is deemed appropriate. Staff are encouraged to participate in a DCU Moodle community, via a dedicated Moodle forum (i.e. ''Moodle Discussion'' course). However, participation thus far tends to be limited to a relatively small number of staff, often the same 'early adopters' of the previous VLE systems.

A Moodle course is generally created by combining two content types: resources and activities[2]. *Resources* include digital files such as web pages, PowerPoint slide shows and word processing documents, Flash animations, video and audio files. Most resources are externally created and either uploaded to, or linked to from the VLE, although two resource types can be created directly via the Moodle interface: text files and html files.

[1] Subsequent versions of the Moodle platform provide a more flexible facility for assigning specific permissions to particular users in defined contexts.

[2] The Moodle terminology ''activity'' is not related to the activity theory framework employed in this study.

Activities are generally created via the Moodle system itself and provide affordances for learner–learner or teacher–learner interaction as well as for manipulation and transformation of content. Examples of activities include assignments, discussion fora and chat rooms, wikis, glossaries and quizzes (including the possibility of importing HotPotatoes exercises).

The above resources and activities are organised differently depending on the course format chosen by the course owner. The Moodle platform deployed in DCU in 2005/2006 (Version 1.5) offered three main course formats. The *social format* is generally used for courses focused on dialogical activities, as well as for non-teaching activities, such as committee work and user support, and places a discussion forum as the main component of the course. The *weekly format* allows content and interaction to be organised on a weekly basis, thus matching the academic calendar (i.e. all DCU modules are 12 weeks long) and the weekly face-to-face course structure and content. Resources, such as lecture notes and additional reading material, along with activities, such as self-assessment quizzes or graded assignments can be added to reinforce or verify the knowledge and skills covered in lectures. The *topic format* enables a more flexible organisation of the course and is particularly well suited to problem or project-based approaches to teaching and learning, which both place the realisation of a given task at the core of the learning activity as opposed to the understanding and assimilation of a pre-defined content.

A number of *rules* are imposed on users of the system. For example, there is a limit on the size of files permitted to be uploaded to the system (this limit may be negotiated with the administrators on a case-by-case basis). From the administrators' perspective, the rationale for this restriction is driven by a number of factors, such as the need to make the most efficient use of finite storage space and bandwidth constraints, which often result in students experiencing difficulties in downloading large files[3]. This seemingly well grounded decision is however perceived as a hindrance by staff who wish to upload pedagogically useful, but large files – such as video or audio files – without first having to obtain 'permission' from the Moodle administrators as evidenced by the discussions that have taken place on the "Moodle Discussion" course.

Rules also govern the HTML code to be used across the platform. During the initial deployment phase it was considered that the 'HTML Editor' packaged with the Moodle platform generated HTML output that was inaccessible by users with disabilities, in particular users of screen reading software. The Moodle administrators therefore decided to disable the HTML editor functionality. However, this decision prevented staff and students to easily create web pages or format discussion postings via the system. In 2006, and following a lengthy and lively on-line debate, a version of the html editor was made available, with limited functionality, in conjunction with guidelines for its appropriate use.

The previous two examples suggest that, although the university-wide deployment of Moodle provided academic staff with opportunities to enhance and to transform their teaching practice, it also introduced some constraints and limitations on staff and students' ability to use the platform in creative and efficient ways. Although only a small minority of staff voiced their resistance to such rules and procedures, and thus highlighting a systemic tension between what they perceived as the object of the learning design activity and the rules imposed from the outside, other factors are likely to have had a significant impact on staff experience and use of Moodle. The following sections report on an exploratory study whose aims were firstly to identify whether some patterns of "Moodle behaviour" were emerging, and secondly, to further uncover some of the systemic tensions that had surfaced through postings on the Moodle Discussion course or personal communications between early adopters and the support team.

3.2. Data collection and analysis

Two data sets from the academic year 2005/6 were available to the authors. Firstly, numerical information on the type and number of activities and resources employed by the overall academic community in active courses was extracted from the VLE database. A Moodle course is deemed to be active if it contains at least one resource or one active discussion forum (i.e. with at least one forum posting). During the academic year

[3] Access to broadband in Ireland is limited. According to the Commission for Communications Regulation (COMREG) 2007 report, Ireland has the sixth lowest penetration of broadband out of the twenty-two E.U. states. Only 50% of Irish households have some form of internet access, while only 54% of these have access to broadband (COMREG, 2007).

2005/2006, 792 Moodle courses were active involving 581 assigned teachers. It should be noted that one teacher may be assigned to several courses and that more than one teacher can be assigned to any given course.

Data on usage of Moodle resources and activities was extracted for each active module. Although data on all Units and Faculties was available – including DCU's distance education department – only data relating to DCU's four core faculties (science and health, business, humanities and social sciences, and computing and engineering) were included in this exploratory study. The four core faculties share a number of infrastructural and administrative commonalities. Teaching is mainly campus-based, and in the majority of cases, one lecturer is responsible for the design, teaching and administration of a particular module.

The second data set was a survey of staff users carried out by the learning innovation unit at the end of the academic year 2005/2006 with a view to determining staff perceptions of the Moodle platform and to assess training needs. Preliminary findings from the qualitative analysis of the survey (Galvin, 2006) as well as raw data from selected open and closed questions were used to interpret some of the numerical information extracted from the VLE and, more specifically, to identify possible contradictions. There were 143 survey respondents in total, of which 135 were academic staff, representing 27% of the total number of academic staff in DCU. The survey was directed at both users and non-users of the Moodle system; 28 of the respondents were non-users. Finally, informal conversations with colleagues, postings on discussion lists, and operational documents and procedures provided additional insights on staff usage patterns, perceptions and attitudes towards the system, as well as the overall structure of the teaching activity as supported by Moodle.

3.3. Preliminary results

Overall usage statistics taken at the end of 2005/6 indicate that almost 70% of academic staff, many administrative staff and most students use the VLE in some way; that is, the application of learning technology in DCU has shifted from the periphery to the mainstream. In addition to teaching and learning purposes (71%), the survey responses suggest that Moodle is used for disseminating course-related information (51%), administrating assessment (40%), surveying (17%) and communicating (48%) with students, as well as enabling student collaboration (21%). The weekly format is the preferred course framework with 67.8% of all active courses using this structure against 32.2% for the topic format, thus suggesting that Moodle courses tend to replicate the prevailing face-to-face weekly lecture/tutorial delivery structure.

A closer look at the number of objects created by the four Faculties allows us to gain some preliminary insights into the practices of colleagues involved in the campus-based delivery of programmes of studies during that same period. In total, 4740 activities (30%) and 11044 resources (70%) were created on the platform during the course of the academic year (see Fig. 3). Faculty A contributed the greatest number of resources (44% of all resources and 32% of all activities), followed by Faculty B (28% of all resources and 11% of all activities). Faculty C created the greatest number of activities (43% of all activities and 23% of all resources). Having developed a number of collective or individual web-based systems, Faculty D has created the smallest number of objects on the platform (8% of all objects). Resources represent by far the greatest proportion of objects added to the platform by Faculties A and B (76% and 86% respectively), while resources and activities are more equally distributed in the case of Faculties C (55%/45%) and D (48%/52%).

These differences between faculties also reveal themselves in the breakdown of the various types of resources (Fig. 4) and activities (see Fig. 5) added to the system. The bulk of the resources (82%) created by the four Faculties overall are text-based content such as word processing and pdf files (48%) and PowerPoint files (34%), followed by internal (i.e. created within Moodle) or external (i.e. linked to) HTML pages (11%). While some of these resources may well contain embedded animations, videos or sound, the latter only represent 7% of the artefacts uploaded to the system. Video and sound files are predominantly used by Faculty C, while Faculty D provides the highest proportion of in-house text documents (81% of uploaded resources), mostly converted into pdf format (98% of all text documents).

In relation to activity types created via Moodle (see Fig. 5 below), the primary activity types are discussion forums (78%), followed by assignments (10%) and quizzes/Hotpotatoes exercises (5%). Collaborative and/or reflective activities such as wikis (1%) and journals (2%) remain marginal. With 199 quizzes in total, Faculty A

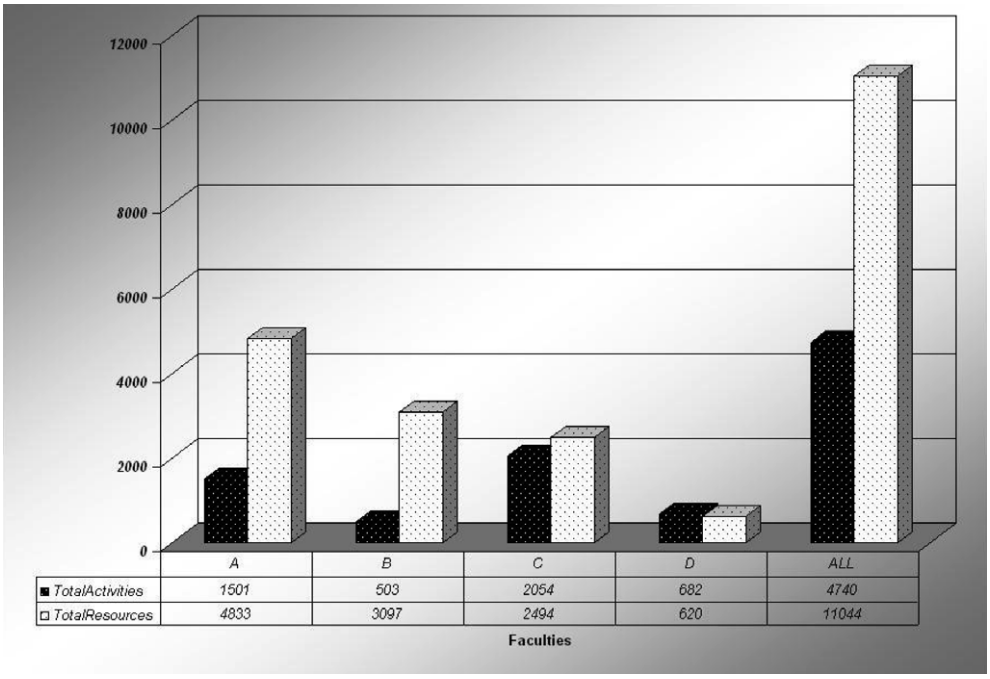

Fig. 3. Resources and activities per faculty.

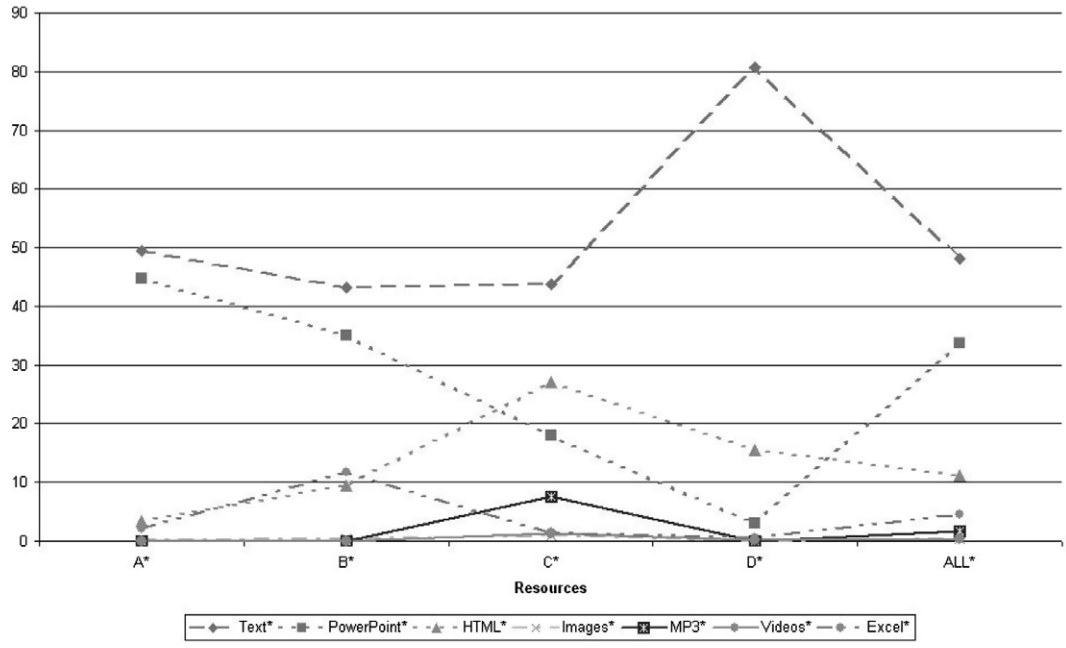

Fig. 4. Breakdown of resources types created per faculty.

is the main creator of Moodle quizzes (94% of the total number of quizzes created by the four faculties). Faculty C contributes 57% of all assignments administered via Moodle as well as 43% of all discussion fora and 87% of all chat rooms.

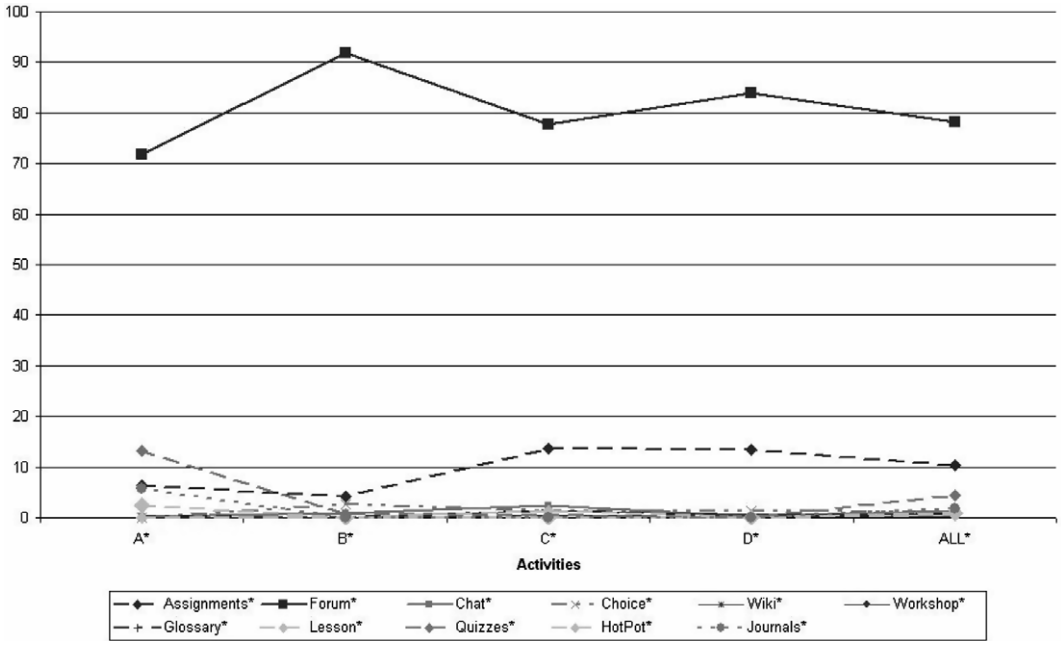

Fig. 5. Distribution of activity types (%).

Taken together, the preliminary results outlined above suggest discipline-specific approaches to teaching and learning across the four faculties and reveal some emerging patterns. For example, Faculty A, B and D seem to use Moodle mainly for the distribution of lecture notes and PowerPoint presentations, which are sometimes accompanied by quizzes and class discussions, thus suggesting, especially where course owner has chosen the weekly format, a teacher-led and content-driven approach locating the individual learner at the centre of the learning process: students are expected to work through notes and/or PowerPoint presentations prepared by their lecturer and used in class, to ask or answer questions via the class forum, and to test their understanding of the subject matter and their ability to solve questions by attempting quizzes. By contrast, the content provided by Faculty C is more varied in terms of the supporting media that are used to create it, thus suggesting the use of in-house digital recordings or a digitalisation of video or audio tapes that may have been previously used in a different format (e.g. VHS) during class. Collaborative learning would appear to play a more important role in this Faculty, not only through discussions but also through other activities such as the collaborative production of content via a wiki or glossary. Yet, the preponderance of resources compared to activities, as evident in the usage data extracted for the four faculties would suggest that Moodle courses generally mirror the corresponding face-to-face mode of delivery. Although students are given additional opportunities to engage with course-related topics via discussion forums or chats, lecturers generally appear to favour the distribution of course-related documents over the creation of interactive and collaborative activities that may enable the online construction and manipulation of content by learners.

The next section will explore some potentially explanatory factors for the limited exploitation of Moodle's more advanced functionalities and the resulting impact on teaching practices.

3.4. The (non)-transformation of teaching practices

As observed in the previous section, the breakdown of the various resource and activity types suggests that, in many cases, the VLE is being used to disseminate electronically materials previously distributed via the DCU Intranet or on paper. This is also reflected in the authors' day-to-day encounters with academic staff, who often initially contact them because they "need to upload their lecture notes to Moodle", and in the survey respondents' description of their use of Moodle (e.g. "I use Moodle to distribute class notes and other information", "I use Moodle mostly as a simple way of getting lectures notes, exercise sheets and other infor-

mation to students'', ''I mainly use Moodle to put notes online and to send news items to students'', etc.). In addition, most of the content added to Moodle is created outside of the VLE – typically using software that staff are more familiar with, such as Word and PowerPoint. Consequently, the main interaction with the VLE that most lecturers experience is to upload content: face-to-face delivery is being replicated on-line. While the introduction of the VLE may have triggered a shift in the *mode* of dissemination of these materials, and while it may represent a cost and time saving for the university in terms of printing and photocopying (which is now passed on to the students), little disruption or transformation of teaching practices has thus far occurred.

Access to adequate hardware and software, as well as the rules and division of labour imposed from the outside by both the Moodle Administrators and the platform itself, are likely to contribute to or prevent the successful integration of digital teaching materials and learning activities in the curriculum. They cannot however fully explain the low uptake of more advanced functionalities. Respondents to the survey carried out at the end of the academic year 2005/2006 were asked to indicate reasons why they do not use some activity types in their Moodle courses.

Approximately one third of the 87 respondents to this question state that they do not use, or do not need to use, activities that are not relevant to their course, subject or practice. For example: ''Doesn't lend itself to the method of course delivery chosen for the course'', ''I have no need at present for them'', ''My current teaching practice does not need them'', ''No need for them with our current courses'', etc. Most of these respondents also report that their use of Moodle is restricted to the dissemination of lecture notes and other course related information (see earlier discussion). In addition, many do not perceive the need to integrate more advanced functionalities in their teaching nor to change their current teaching practice:

> *''I am satisfied with the functions I currently use which enhance module delivery and dissemination of information. I don't feel the need to expand my current repertoire. There are [also] some functions that I haven't explored in great depth''.*

The lack of familiarity with advanced functionalities, alluded to in the above response, is probably one of the primary reasons for the low uptake of a broad range of activity types. Indeed, 60% of given responses suggest that a lack of awareness, knowledge and familiarity with some more advanced functionalities is the main reason for not attempting to exploit them. For example: ''I am not familiar enough with their functions'', ''Not too sure how to use them'', ''Not yet knowledgeable in them''. Most responses in this category also refer to the lack of time or opportunities to learn how and for what purpose to use these activities, which often entail a more complex design process: ''Have not had chance to explore'', ''haven't got around to assessing them yet'', ''I haven't got around to investigating them yet'', etc. Usability issues and the complexity of the interface are also mentioned in relation to the steps required to implement tools such as glossaries, wikis and workshops (peer-review tool). The discussion thus far suggests that the low uptake of more advanced functionalities is the result of a lack of a perceived need and/or motive for changing one's current teaching practice, combined with a lack of knowledge and competencies on the part of lecturing staff despite training opportunities and on-going support offered by the learning innovation unit. The survey responses, as well as Galvin's (2006) preliminary qualitative, provide some further insights on training and support issues.

Only 43.2% of the survey respondents indicate having attended the formal training sessions provided by the learning innovation unit as briefly described in the previous section. The reasons given by those who did not attend any training sessions include: self-training; introduction to Moodle by a departmental colleague; unsuitable timing of training sessions; and a preference for one-to-one sessions provided by LIU staff. While the comments received from those who did attend the training sessions are overall positive, Galvin (2006, p. 15) draws attention on a number of areas requiring improvement. In particular, the pace at which the training is given needs to be addressed as well as the transmission model adopted by the trainer.

However, the analysis of the survey falls short of uncovering some emerging contradictions between the *object* of the training sessions and the *actual needs* of academic staff. More specifically, comments from survey respondents would suggest that most of them have developed a limited range of basic *tool-related competencies* (e.g. ''I could get more of Moodle if I was more familiar with advanced features'', ''I don't know how to use them'', ''too complicated'', etc.), either through their attendance to training sessions or through interaction with more skilled colleagues, including Moodle support staff. Fewer have developed *task-related competencies*

("I would like to get feedback from other staff members on ways in which they use various applications of Moodle in the courses", "we are shown the features and how it works but not how best to apply it to teaching") and *metafunctional competencies* (e.g. as evidenced by the large volume of requests for support with problem-solving and troubleshooting).

The above discussion suggests that the Moodle VLE has not yet become a *functional organ* for the DCU academic community. Rather than augmenting the capabilities of lecturers who are new to the concepts and principles of e-learning, it may at times limit their attempts to successfully integrate new technologies into their existing practice. This is further evidenced by the perceived negative impact of the use of Moodle on student learning as reported by some respondents: a number of comments relate to the decline of student attendance patterns, to the resulting lack of face-to-face contact, and to difficulties in integrating on-line and face-to-face learning activities. All are seen as a direct consequence of the integration of Moodle in the curriculum, or rather to the availability of lecture notes on the system: "Attendance at lectures has dropped since lecture material has gone on the moodle system", "[...] the fact that I provide lecture handouts on Moodle often results in students expecting to be 'entertained'", "there is a worry that students will view it as a substitute for lectures, rather than a complementary element". While attendance issues in higher education cannot be reduced to the online availability of lecture notes, we suggest that the prevailing use of the VLE to upload lecture notes discussed earlier introduces a contradiction in the *semiotic space* of the teaching and learning activity in which DCU lecturers operate. More specifically, the conventional rules and social organisation of the'old' activity are disrupted: attendance at lectures is not longer perceived by students as essential.

According to Galvin (2006), however, most comments indicate that academic staff perceive Moodle as having a positive impact on staff teaching and student learning. Emerging themes include better support for and integration of remote/part-time students, the possibility of monitoring student progress throughout the course, and the freeing-up of class contact time for "higher-level activities" as well as a reduction in administrative tasks such as photocopying. Moodle is also said to facilitate communication among students and between staff and students, and to enhance the accessibility of information, and to enable the efficient organisation of class materials. In particular, the use of Moodle helps lecturers to make the structure and organisation of their course *visible*, to their students but also to themselves: "It makes the organisation of the module very clear", "[Moodle] helps me to have a visible structure to see how my course is progressing", "I like to see all the activities, articles, etc. all in one space. It gives me a good sense of the shape of my course". For these lecturers, Moodle is not only a tool mediating the *delivery* of learning content or activities. It also potentially mediates and shapes the *design* of learning activities, as illustrated by the following comment:

> *"Moodle has helped me organise my teaching material in a more systematic way and freed me up to concentrate more on pedagogic aspects of teaching".*

4. Conclusion

The analysis of patterns of usage of our institution VLE discussed in this paper provides a snapshot of an activity system undergoing constant transformations. The data analysed thus far, indicate that although use of the VLE is widespread within the university, little disruption of teaching practices – defined as serious transformation or alteration of the structure of teaching and learning activities – has occurred. The absence of significant disruption is evidenced by our preliminary findings and is supplemented by our experiences as practitioners working in the university: the VLE is mainly used for administrative purposes, to disseminate resources or information and to complement or replicate existing practices. The main types of learning materials added to the VLE are "static", content-based resources such as web pages and lecture notes. Although in many cases the VLE is used to collect assessments from students, the assessment methods employed have not changed (the workshop activity, a peer assessment tool, is used infrequently for example). Activities that demand collaboration or reflection, such as glossaries, journals, and wikis are used less frequently than those activities that replicate face-to-face teaching modes.

The lack of transformation of teaching practices can be partly attributed to the lecturers' lack of appropriate competencies, which is not properly addressed by the training and development programme offered by the

University: a mismatch between the object of the training sessions and the actual needs of lecturers has been identified as well as a requirement for the development of tool-related competencies to be supplemented with that of task-related and metafunctional competencies so that Moodle can become a functional organ for both staff and students. Until then, lecturers may not be equipped to address the disruptions caused to their existing teaching practice by their own pattern of Moodle use. In particular, tensions between the 'semiotic' and 'technological' needs, object and motive of the 'design for learning' activity may not be resolved.

It is however unlikely that training alone will suffice. More radical transformations of the overall social and cultural context of the university teaching practices are also likely to be required.

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