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An Ecology of Constraints on e-Learning in Higher Education: The Case of a Virtual Learning Environment[1]

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ABSTRACT *The implications of e-learning in higher education have been limited by an array of technical, institutional, social and economic constraints on innovation. This paper describes a case study of the introduction into a university of a widely diffused e-learning platform: an enterprise-wide virtual learning environment. The study suggests a variety of patterns and themes tied to the social dynamics of this innovation. These highlight variations across instructors in how the technology was employed, which illuminate the complex ecology surrounding its implementation and use. This offers insights into the faltering development of e-learning in higher education, and learning more generally.*

Keywords: course management system, ecology of games, e-learning, information and communication technologies, institutional change, virtual learning environment.

Introduction

Innovations in e-learning are expected to have major implications not only for distance education across all levels of education, but also for classroom and 'campus-based' environments. These implications stem from the potential of information and communication technology (ICT) innovations to reshape access to:

- information, such as by permitting interactive multimedia visualization and simulation of information and models to assist students in learning skills, such as in building models or working in a virtual chemistry lab;
- people, as in the networking of students, teachers and experts that reaches beyond classroom walls;
- services, for example in facilitating routine transactions like registering for a course; and
- technologies themselves, as when e-learning increasingly requires students, teachers and classrooms to be equipped with particular ICTs.[2]

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The social dynamics affected by such reconfiguring of access are so complex that outcomes are unpredictable: some could take the quality of the teaching and learning experience up to new levels, others could see the disruption of traditional learning processes in ways that destroy what once worked well without adding more effective new e-enabled methods—or even not have a discernible learning effect. That explains why e-learning has generated a heated debate between utopian proponents and dystopian critics of the new technologies and their use in education.[3]

There is nothing inherently good or bad about stability or change *per se*. Innovation researchers have often studied the diffusion of new technologies that were perceived as being in the general public interest, from the spread of hybrid seed corn to the adoption of e-government capabilities that aim to enhance the delivery of public services. However, a new idea could be silly, have harmful unintended consequences, or just fail to diffuse and fade from sight. An innovation often requires new skills and new ways of living and working if its capabilities are to be used to make any significant change. Traditional practices might not be sustainable in the face of technological and economic change, but also might be so entrenched in social and institutional structures that they limit the scope for innovative change.

In education, the interplay of these technical, institutional, social and economic forces could increase the cost of education, unless the technology enables educators to accomplish their work in more cost-effective ways. Resources could be wasted by either under-scaling or over-scaling, investing too little or too much in particular technical initiatives. This change is taking place during a period when education budgets are severely constrained and demands are increasing dramatically, for example through the cohorts of young people who are growing up with ICTs as part of their way of life, thereby adding real pressure on educators to keep pace with the state of the practice.

At the same time, there is much debate about educational strategies and paradigms. On one side are the 'progressives' championing collaborative learning-by-exploring-and-doing using adaptive qualitative assessments; on the other are 'traditionalists' who promote teacher-led, person-solo, classroom-based drill-and-practice and individualized quantitative testing and ranking. A characteristic of education cultures throughout the world is that instructors generally teach the way they were taught (just as parents often want their children to be taught in the style in which they were taught): using a traditional one–many teaching paradigm based on class lectures and discussion. With notable exceptions, such as the one-on-one tutorial approach, this paradigm is entrenched in most educational institutions, which generally tie teaching rewards to the quality of classroom education. As systems and software used for e-learning are constructs that generally embody a particular educational paradigm, the broader debates about educational paradigms will also be key influences shaping outcomes from the introduction of e-learning tools.

For example, traditional teaching paradigms are designed into many e-learning products in order to facilitate their marketing, based on analogies to what teachers already know and understand. This is true for institution-wide virtual learning environments (VLEs), one of the most widely disseminated forms of e-learning. VLEs provide online support for the management and operation of most aspects of a course, including: the distribution of multimedia material (such as readings, lecture notes, assignments and images); student–teacher and group discussions;

exam and grade administration; and other teaching and administrative tasks. One proprietary VLE, BlackBoard (www.blackboard.com), uses the analogy of 'chalk-and-talk' to convey its centrality to traditional conceptions of teaching. The open-source Bodington Common's VLE (http://bodington.org/index.html) employs an analogy to university buildings to help teachers and students understand how to move around in its virtual space.

Such developments raise a number of intriguing questions about the role of e-learning systems in relation to different educational models, as well as other aspects of technological innovation. What kind of model should guide designers of e-learning systems? How do debates about educational paradigms constrain or facilitate e-learning innovation? Should e-learning seek to be a catalyst for new educational paradigms, or essentially provide more efficient support for traditional approaches? Who should determine which paradigms are built into courseware? What are the social dynamics that determine the paradigms used, and how can they be influenced by e-learning initiatives?

This paper explores these issues and seeks to provide some pointers to answers to such questions through an analysis of an in-depth case study of the diffusion and use of a proprietary, commercially marketed VLE at a private US university. The details of case studies can paint a more general picture by highlighting patterns and themes that can be hidden from the view of evaluations and assessments of learning effectiveness. To the degree that these patterns are supported by other case studies, conducted by other researchers, they gain validity as useful theoretical perspectives.

We chose to study a VLE because of the rapid diffusion of these systems in North America and Europe. The case surfaced patterns and themes of potential relevance to a wide range of e-learning and other educational initiatives, for instance by illuminating the array of actors whose interests are at stake in this kind of development. In particular, it moves from the constraints found in this study to more general observations about the political complexity of implementing any ICT-enabled educational and learning innovation. We capture this within the framework of what we call an 'ecology' of e-learning games.

The Ecology of Games Underpinning e-Learning Innovations

The role of politics in technical innovation is one approach within a broad array of research on the social shaping of technology (SST), which highlights organizational, cultural, economic and other factors influencing the process of technological change and innovation.[4] This approach reveals ICTs as inherently political innovations because they are anchored in choices that reconfigure access to information, people, services and technologies.[5] Outcomes from the use of ICTs unfold as the products of countless strategic and everyday decisions made by a myriad of players in many different games in different arenas; within these, underlying conflicts, divergences and power structures often make it difficult to reach agreement. This is why an ICT innovation cannot be viewed as being on a predetermined, technology-driven path that will produce predictable results. Instead, outcomes are shaped unpredictably by the negotiations and interplay between actors.

This perspective on ICT choices shaping access captures and anticipates the role of players in games not directly focused on VLE development *per se*, such as government policy makers, certification bodies, ICT suppliers, and other actors far

from the classroom. It also helps to explain how many stakeholders, from individuals to global corporations, can influence outcomes because different paths are opened or closed when different decisions are made about the use or non-use of the technology. ICTs could also change the rules of some games in unpredictable ways by empowering some players and constraining the power of others, for instance with the role of the teacher diminishing if students spend more time learning directly through e-learning systems. The ecology of games view also acknowledges that choices about ICTs can be driven by a variety of motives other than reconfiguring access, such as a desire to improve the efficiency of current teaching methods, even though they shape or reconfigure access in practice.[6]

Profound and far-reaching consequences of this reconfiguring of access are possible for all those involved in an institution-wide innovation like a VLE, including faculty, administrators, students, librarians and others in a university. Many outside the institution in which decisions are taken are also affected, such as those in institutions with which the university competes or cooperates. These ripples (sometimes tidal waves) of change occur because reconfiguring access alters social, organizational and economic relationships across geographical and time boundaries. Significantly, this can change the 'communicative power' of people: the capacities that individuals and groups can build by commanding cultural, knowledge and material resources for communication, such as that gained by a learner with access to educational support on the Internet.[7] Communicative power and the nature of, and outcomes from, the development and diffusion of ICT in an arena like learning and education are shaped by choices about whether and how to use, or not to use, the technological innovations to pursue educational goals.

These choices are made by 'actors' within a broad ecology of games.[8] Here, the terms 'game' and 'ecology of games' are not employed in a formal game theoretic sense, but more generally. We see a game as an arena of competition and cooperation structured by a set of rules and assumptions about how to act to achieve a particular set of objectives. From this perspective, an 'ecology of games' is a larger system of action composed of two or more separate but interdependent games.[9] Within each game, players follow the traditions, rules and disciplines of that game.

All players have a role in shaping outcomes and assume different roles in different games; some act in many related games at the same time. The behaviour and decisions of all actors affect those of other actors. The outcomes of such games can influence the rules or outcomes of games both directly within the education sector or in contexts not directly focused on e-learning, such as the e-games in software, movie, ICT and defence industries, which make use of simulation and modelling techniques that use, or are used by, e-learning systems and vice versa. Physical access to ICTs, such as a VLE, is an important aspect of the access reconfiguration resulting from these games. But the central issue is something else: the design and use (non-use) of a particular technology and how that opens or closes off options and networks by strategically reconfiguring access.

The Case Study

Most research on e-learning has focused on its success or failure, particularly its impact on student learning.[10] The case study reported here began as an exploration of the use and impact of e-learning, seeking to contribute to an empirically anchored perspective on the factors that affect e-learning innovations

in higher education. But the study quickly moved to focus more attention on the constraints on the innovation process when the limits on the use and impact of e-learning became clear.

The study builds on other investigations into the social shaping of technology that have highlighted organizational, cultural, economic and other factors influencing the process of technological change and innovation.[11] It was only in the late-1990s when the diffusion of the Internet generated more multi-disciplinary research on the potential for online learning and education that SST researchers began to look at educational innovations.[12] Before then, educational institutions were studied primarily by students of education, administration and instructional technology, focusing on experimental or evaluation research on outcomes, rather than sociologists and political scientists, focusing on the social shaping of technological innovations and their outcomes in the educational context.

This study of a VLE contributes to this growing multidisciplinary perspective on e-learning and education. VLE systems began to diffuse widely in the late-1990s and quickly became a status symbol of innovation, with many higher-education institutions not wishing to be left without their own system. They were viewed as being of critical value as an organization-wide standard that could enable innovation in e-learning among non-technically proficient instructors and students, but also an innovation that would seed investments in complementary innovations, such as in digital libraries, electronic registration of students, and the provision of wireless networks and services.

The Mix of Research Approaches Employed

To protect the anonymity of the Centre and University, which permitted us to follow up on issues raised by the survey responses, we gave pseudonyms to the university ('NEU'), and VLE ('eClass'). We chose NEU because eClass had appeared to diffuse rapidly within this university. The principal organizational actor at NEU was 'the Centre', which was responsible for the use of ICTs in teaching and research.

We employed a variety of empirical approaches to gain a textured and detailed understanding of how eClass diffused, and with what effect on learning and education. We undertook a detailed course-by-course analysis of the electronic records and reports on the everyday use of eClass, which we used to develop a reliable count of actual adopters and users, as discussed below.

We also surveyed users. The electronic facilities of eClass enabled us to email all registered current and former instructors, asking them to complete a short (about 15 minutes to administer) Web-based questionnaire, asking for information such as participants' use of eClass and their overall usage of personal computers and the Internet. Two reminders were sent. Survey responses from 225 individuals were gathered from January to March 2002, representing about a 50% response rate, based on our estimate of the number of actual users. Of these, 191 were completed fully; the rest were typically from individuals 'registered' for eClass but not actually using the VLE.

These surveys and interviews were complemented by more in-depth interviews with key staff of the Centre, which permitted us to follow up on issues raised by the survey responses and records on actual utilization. We also attended training sessions and eClass courses with university instructors, enabling participant-observation of these events. These sessions created many opportunities to speak

informally with eClass technical specialists, department coordinators and users, including students. The senior author also monitored several University committees that dealt with issues around eClass.

Students were not surveyed online, but we conducted participant-observation of classrooms using eClass. We took advantage of these occasions to interview students about their use of eClass and any problems they encountered. We also spoke to staff at the Centre regarding the benefits and problems experienced by students.

In addition, we conducted in-depth 'embedded' case studies within our larger case.[13] With the help of VLE utilization records and survey data, we identified 20 instructors who were among the most intensive or creative eClass users. Each instructor's use of the VLE became an embedded case study. These were conducted through semi-structured personal interviews with each instructor supplemented by their survey responses and course records, including the content of their VLE course site.

Patterns of Adoption and Use of a VLE

The Centre introduced a trial version of eClass at NEU in the Spring 1999 semester. Workshops and training sessions for faculty and instructors plus general word-of-mouth recommendations led to rapid growth over the next two years, from six at the start to over 1,000 by Spring 2001 (Figure 1).

Despite continuing growth in demand, by the spring of 2001 the introduction of new courses was stopped because eClass had reached the limit of the pilot version's capacity. The Centre therefore upgraded in Summer 2001 to a newer version that could support many more courses. However, when the Centre began migrating older courses to the new system, implementation problems arose. They were serious enough to cause many instructors to abandon their use of eClass because they were no longer able to use it effectively.

There was real interest in eClass at NEU, but system logs exaggerated the actual level of diffusion. Many eClass courses listed as being live on the system's logs were actually old courses. The logs also included 'shell' courses that had been set up by some departments but not used by teachers, along with some of the Centre's own internal training courses, some mislabelled courses and various test runs. Once these were eliminated, the diffusion curve of eClass remained substantial, but significantly less widespread than had been commonly understood.

In analysing eClass courses in more detail, we uncovered multi-layered levels of innovation. In the spring of 2002, 6,814 courses were offered at NEU, with 752 (about 11%) registered for eClass. Of these, 700 actually used eClass, accounting for about 110 teachers among a faculty approaching 2,000. However, in line with the general perception that eClass was diffusing rapidly, our survey respondents believed eClass was used by many others: 19% said all courses in their department were using eClass and 35% thought most courses were using it. Only 13% said eClass was rarely used in their department, which is probably closer to reality.

Moving beyond mere adoption to look at actual usage, we found that most instructors did not make extensive use of eClass, although some did. This led us to conduct the embedded case studies, enabling us to see how active eClass users applied the VLE in their courses.

Questionnaire responses indicated that eClass users spent an average of two to three hours a week on the system, with 60% using it for no more than two hours per week. Instructors had used the system for an average of two semesters in about

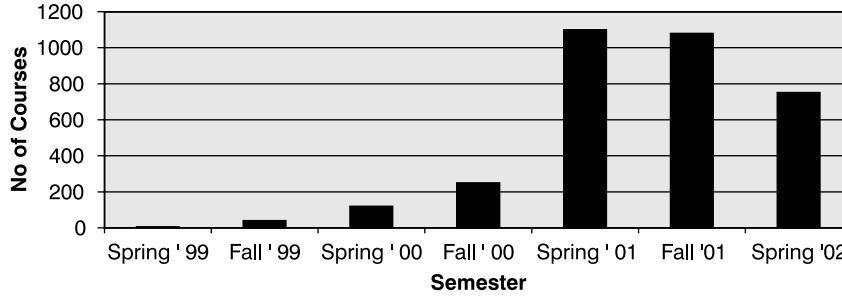

Figure 1. Number of new eClass course registrations, 1999–2002.

three courses; just 26% used it for three or more semesters and 31% for only one. Despite limited levels of use, most eClass users (71%) felt it was 'very helpful' or 'helpful'; less than 9% found it 'not helpful'. Some 70% of respondents said they would definitely use eClass, further supporting its perceived value. This is consistent with the attitudes of other courseware users at other universities.[14]

Access to a wide variety of computer and Internet resources was the most critical determinant of using eClass. We found a clear positive correlation between instructors' use of eClass and other computer-based instructional technologies, such as email, presentation software and the Internet/Web. For example, almost all eClass users had a computer at home, 46% had broadband Internet access at home and 76% had a portable computer. Except for white boards, more traditional non-computer-based media had lower rates of use among the users of this VLE. Only a weak positive correlation was shown between the times spent using eClass and a number of factors conventionally expected to be relevant to e-learning, such as the age of teachers, their computer knowledge and experience and the discipline of the course. The acknowledged ease of use of eClass might have contributed to the lack of differentiation between more computer-oriented and non-technical schools.

Not only were more experienced computer users likely to employ eClass, but eClass promoted more computer use. The most widely perceived changes tied to eClass were the respondents' use of time and the geography of teaching and learning. The activities that had increased most by the use of eClass were being online, communicating with students and using email, followed by increases in the time spent preparing for class and working from home and at the office.

Respondents saw improvements in pedagogical practices (such as increasing communication among students or helping students learn about online media) and in work efficiency (such as in saving time), as among the main motivations for using eClass, as shown in Figure 2. Some 74% felt ease of use is a major motivator, which also helps to save time and investment in learning to use the software. Other analyses showed that those who rated 'ease of use' as an important motivation were more likely to have used eClass in more courses, and those citing pedagogical reasons were more likely to spend more time per week with eClass.

The primary value attributed to eClass was its ease of use in posting and distributing documents, assignments and announcements to students (Figure 3). An important secondary use was for communication, such as emailing students. eClass enabled email lists to be generated automatically as students registered for their courses. But most respondents placed most value on distributing information

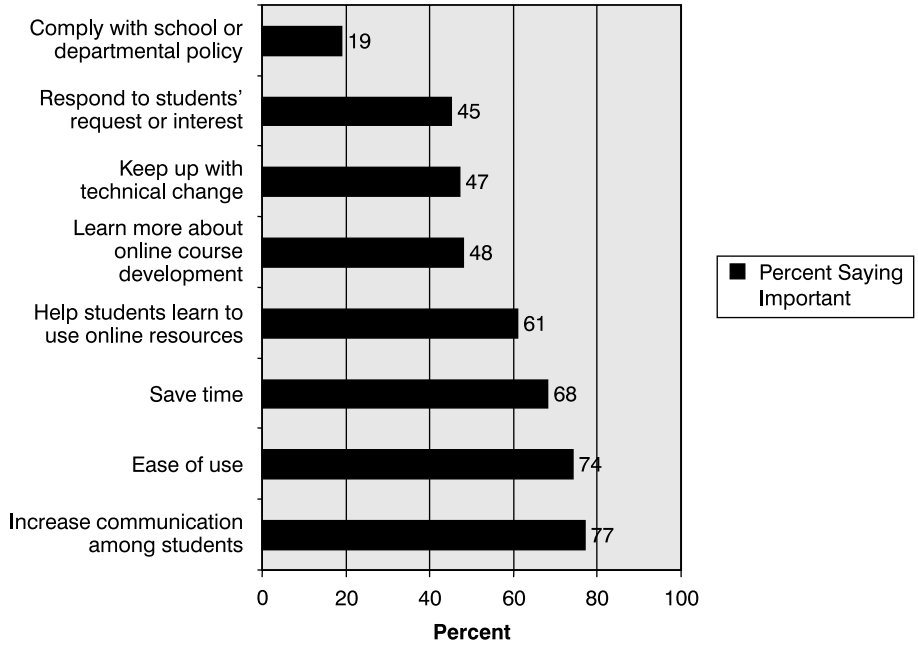

Figure 2. Motivations for VLE use.

rather than on online discussions, group facilitation, virtual chat and other more interactive forms of communication.

The significance of both pedagogical and efficiency impact was supported by a factor analysis of a series of questions concerning instructors opinions

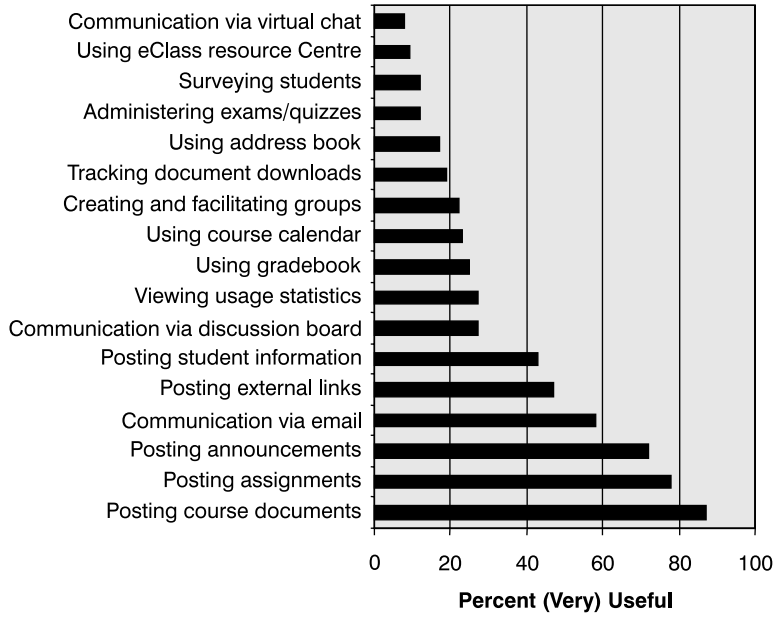

Figure 3. Useful features of the VLE.

Table 1. Factor analysis of attitudes toward eClass[a]

Variables	Factor loadings 1	2
Factor 1. Convenience and Efficiency		
Students like to use eClass	0.803	
eClass is easy for students to use	0.882	
eClass is easy for me to use	0.680	
eClass is convenient for students to access	0.885	
Factor 2. Instructional Effectiveness		
I am teaching in new ways since using eClass		0.721
Students' performance is enhanced when using eClass		0.710
I interact more with students when using eClass		0.737
Some students participate on eClass who do not participate in class discussions		0.771

[a]Responses to agree–disagree items on questionnaire.

about eClass (Table 1). The analysis identified two independent factors: convenience and effectiveness. Efficiency (convenience) referred to beliefs that eClass was easy and convenient for instructors and students to use, while effectiveness referenced beliefs about the impact of eClass on such outcomes as student performance, participation and interaction (Table 1). Some teachers saw the system as efficient or convenient, but not necessarily more or less effective, and vice versa. This underscores a key theme that emerged from the research: the different ways instructors adapted eClass to their own teaching.

Different Ways of Adopting a VLE: Six User Types

Based on our embedded case studies, we identified six general types of eClass users. The most common feature was that eClass was used mainly to enhance and complement traditional forms of classroom teaching.[15] However, within this general pattern, we identified six main types of users, three focused on one-to-many and three focused on many-to-many forms of communication (Table 2). To help illustrate each type, the following descriptions include some hypothetical instructors based on a composite of actual users.

Table 2. A typology of approaches to eLearning

One–Many
eCopier: use of courseware to replace the copy machine.
ePublisher: creating electronic content for students.
eProjector: replacing the 35 mm projector.
Many–Many
eProject: facilitate team projects outside of the class.
eTeam: student-initiated virtual study group.
eClassroom: use for distance and distributed learning.

The eCopier: Substitute for the Copy Machine

eClass was used most often as an alternative to the copy machine, by providing students with online access to assignments, readings, lecture notes and other class documents. The eCopiers felt the system simplified their work and enabled them to concentrate more on their research by freeing the time they previously spent using the photocopier. Some eCopiers employed the VLE's interactive functions, such as group discussion and asking students to post additional links to relevant materials. For the most part, however, eCopiers did not alter their approaches to teaching, simply substituting the VLE for the copy machine. One said that eClass was more helpful to him than his students.

The ePublisher: Electronic Distribution of Enhanced Course Content

The ePublishing mode is distinguished by a commitment to using e-learning capabilities to create and enhance content, as well as to distribute or copy it. For instance, one ePublisher sought to 'eliminate all paper' by placing online all materials for his large introductory class, which were enlivened by cartoons, movie extracts and other multimedia creations. eClass was mandatory for his course and students had to check its website regularly for frequent updates of announcements and changes in assignments, which were not repeated during class lectures. This ePublisher opened an online 'virtual office' using eClass to interact with students at home. He also encouraged students to interact outside the class by regularly kick-starting online discussion sessions.

Like eCopiers, some ePublishers saw the VLE as enabling them to save more time teaching and preparing for class. Despite some technical problems, one ePublisher was convinced that evaluations and polls of students reflected favourably on his use of eClass. At the same time, he sensed that good students used eClass to their advantage, while poorer students do not make the effort to engage with eClass or their fellow students.

The eProjector: Substituting for the 35 mm Slide Projector

One eProjector taught in the art history department, and was most interested in the technology's obvious value in storing, retrieving and displaying visual images electronically. eClass has been very helpful to her and her students by giving online access to high-quality images they could previously see only at a library or museum, or in relatively poor-quality reproductions. She found that online discussions were not important to the class and were monopolized by a few students. She rarely used eClass features other than to view images. Nevertheless, she believed that eClass has changed the time and place of her work, as she could prepare visual images for her classes online from home rather than at the University or a library. However, she was concerned that using eClass had reduced interpersonal interaction with her students.

The eProject Coordinator: Promoting Group Work

One accounting professor used eClass primarily with undergraduates to facilitate group projects. He used the VLE to distribute course material, like the eCopier, but saw the main value of the VLE coming through the use of its discussion board, as

it helped students to learn how to work with technology in virtual teams. For instance, students were required to post their solutions to assigned problems on the discussion board so that other students could comment. He believed this exercise of peer critique assisted in the development of a 'spirit of excellence', as students sought to respond to criticisms. One central aspect of his course involved students working in small groups to analyse case studies. In this work, eClass functioned as an electronic gathering place for students who did not wish to meet on campus. The professor could occasionally check students' progress by accessing all the archives of the discussion board and virtual classroom meetings.

The eTeam: Grassroots Innovation in Student Groups

In one embedded case, computer-science graduate students obtained permission to reconfigure eClass software to form a virtual student study group to assist their group project on evaluating the use of various courseware systems. Although their instructor did not utilize eClass, the group decided they wanted hands-on experience with using such a system. However, eClass was programmed to permit only the instructor to set up discussions and other functions of the VLE. Therefore, the students worked with the Centre to obtain an eClass account that they had the authority to use on a frequent basis for personal group discussions and research.

The students' team leader said eClass facilitated online group discussions by giving flexibility and convenience in scheduling discussions because group members did not need to be on campus for meetings. For instance, some used the virtual chat feature for online discussions with colleagues accustomed to working late into the night. The group also used eClass for the online posting of relevant papers and external links to assist the team maintain an evolving group-reading list, which eventually helped them to write the literature review for their final paper. Their use of eClass also aided them in critically evaluating the system and offering suggestions to the Centre for improving the software for student use.

The eClassroom: Breaking Down the Walls to New e-Learning Futures

Only a couple of instances were identified of eClass being used in ways that approach e-learning visions of truly 'remote' or 'distributed' learning. For instance, one eClassroom Professor used it to create a 'semi-distance' approach for a Technology in Contemporary Education and Training course for 40 graduate students. This effort led him to restructure the courses he had taught for 20 years in a traditional classroom setting. An 'evolving' workbook accessible on eClass was used to contain materials needed for the course, including online instructions, assignments and course readings. Students on the course had to meet on campus only a few times a semester, including an initial orientation session, a mid-semester 'get-together' and for a final 'wrap-up' session. They used eClass for individual work and small live and/or electronic work groups. Their final product was a student-created portfolio of work presented in class as a PowerPoint presentation and posted on eClass for others to review.

Another eClassroom Professor saw his role as a 'facilitator of learning'. He was available on campus during weekly office hours, scheduled virtual office and classroom meetings via eClass and encouraged interaction via email, telephone, fax and post. Two teaching assistants offered administrative support to help him respond to students efficiently and with personalized care. One summer he taught

the same course with students from other universities in a completely distance-education format, in which he substituted the campus meetings with interactive television sessions.

The embedded case studies revealed some individuals who worked hard to experiment with new approaches to their teaching, despite most professors not adopting eClass. Taken together, these cases reinforced our other findings that most uses of eClass were anchored in traditional teaching approaches, although the same technology could clearly support a variety of approaches to teaching.

Hidden Patterns and Themes: An Ecology of Games Shaping e-Learning

Educational innovations are assessed most often through an evaluation framework. A given intervention is examined with respect to its use and impact on teaching or learning. This is analogous to other technologically deterministic perspectives on ICTs. However, we moved from our initial evaluative framework when our findings soon indicated the merit of seeking to investigate how political, economic and other social factors were constraining the design and use of the VLE.[16] An evaluation framework hides these dynamics, as the researcher focuses on a more simplified model of use and impact. In this case, the SST approach we employed turned us toward the identification of the constraints on the adoption, use and impacts of this innovation that led to the conservative patterns we found in this context.

The most salient themes we found underpinning this case related to the social shaping of technology through the complex ecology of games confronted by innovations in e-learning. For example, we identified a multitude of actors with diverse objectives who become variously involved in competing or cooperating to achieve their specific objectives through selling, buying, adopting, designing, implementing, or using eClass. The full range of actors and their objectives and strategies in this ecology of games is too complex to comprehensively document, but the nature of a number of games and their actors and objectives are illustrated in Table 3 and discussed in the remainder of this section.

By following the diffusion and use of eClass at NEU, we discovered how multifaceted the implementation process can be. It is not simply a matter of teachers using a VLE with more or less positive implications. It includes efforts by universities to keep up with the state of the practice, in competition with other universities. There is also competition among multiple vendors in selling e-learning and other ICTs. There has been much discussion about 'books versus bytes', but more multi-faceted competition is emerging through the availability of laptops and palmtop devices, mobile cellphones, e-mail, instant messaging, and other media competing for the time and attention of students, teachers, administrators, and other users of their multiple techno-wares. This competition could be discerned at NEU, which makes any assessment of one piece of a multimedia e-learning environment increasingly difficult.

Other conflicts within the university involved differences between central and departmental administrators, and users, with administrators interested in gaining efficiencies and economies of scale in licensing and purchasing, and therefore supporting an enterprise-wide or school-wide system, versus many users wanting to pursue their own styles and approaches and have more control over their own software. For example, the dean of an NEU school instructed his staff to put every class in the school on eClass. But this senior manager could only officially mandate

Table 3. Illustrative games shaping the pathways of e-Learning

Game	Main players	Goals and objectives
University competition	Certification bodies, students, real and virtual universities, parents, schools, journalists	Universities compete for students and faculty locally and globally by seeking top rankings in academic standards and ICT infrastructure.
Courseware competition	ICT and courseware providers, customers	Competition for institutional customers.
Competition for time and attention	Teachers, students, administrators, ICT vendors	Multiple information and communication media (books, instant messaging, e-mail, digital music, etc.) competing for users' limited time and attention spans.
Standardization	Central managers, vendors, users	Efficiencies from centralization of standard software and licensing v. user control of software selection.
Budget allocation	Departments and units vie for share of overall budget	Organizations put their vitality at stake through over/under investment in online infrastructures and applications.
Design and production of e-learning software	In-house development v. external ICT and courseware vendors; management and administrators; teaching staff	Struggle over acquisition of proprietary v. in-house and open-source software, including contention over educational and institutional paradigms embedded in software.
Distance education v. campus-based instruction	Policy makers, departments, ICT units, administrators, near and far student audiences, ICT and courseware specialists	Universities search for selling points to define and extend their reach; all players seek new markets for existing content and infrastructures.
Control of classroom	Teachers, students, e-learning vendors, administrators	Traditionalists use e-learning to enhance control of classroom v. progressives who see technology as lever to end teacher-led classroom paradigm.
Copyright v. copytheft	Content authors and publishers, consumers, virtual and real bookstores; copyright regulators	Competition and cooperation over rights and costs for access to learning resources for distance, classroom and personal education.
Pedagogical effectiveness of e-learning	Teachers, students, educational researchers, policy makers, e-learning software and system designers; administrators	Assessment of e-learning impacts as teachers use (or don't use) ICTs in pursuit of objectives shaped by different educational paradigms.
Implementation	ICT support staff, users, ICT product, service and training suppliers, non-users	Players struggle to implement and maintain e-learning innovations in the face of technical problems and social resistance.

Table 3. (Continued)

Game	Main players	Goals and objectives
Inter-departmental divides	Rich and poor, high-tech and low-tech groups	Groups with fewer students, lower budgets and/or less ICT know-how struggle against wealthier, more wired groups for resources.
Efficiency	Teachers, administrators and students	Players try to lower the costs of teaching, administration and learning.
Teaching assessment	Managers, internal external assessors, teachers, administrators, students	Quantified results-based evaluations v. qualitative assessments rewarding creativity and innovation.
Assessment of students	Certification bodies, teachers, students, administrators, employers, government	Teachers and students seek high grades; certification bodies, employers, government seek maintenance of overall high quality.

the use of technology. He was unable to influence behaviour, as eClass was used by only a few instructors, as it was they who held decisive control in this respect. Such difficulties for top university management in enforcing particular e-learning policies means successful innovation cannot usually be imposed from above, but depends on diffusing new ideas among the rank and file.

These debates interact with struggles over departmental and university-wide budgets, as departments seek to guard their own revenues and planners try not to over- or under-budget for a VLE or other ICT service.

Across the institution, the implementation of an innovation confronts strategies and actors organized to support and maintain existing standards and practices, a theme developed in studies of other innovations in e-learning, such as in administrative support systems.[17] Teachers, administrators, students and ICT personnel resist, assimilate, subvert or otherwise appropriate what is being proposed or imposed when a technical innovation threatens to disrupt the established ways of doing things. There are technology-oriented struggles, such as that between ICT staff wedded to open-source software and top managers focused on using a packaged proprietary system that reduces the need for in-house programming, with each regarding their view as the best for meeting the needs of users.

Key Actors in e-Learning Games

The eClass system was a strategic instrument in many games, such as that relating to distance versus campus-based education. This has engaged increasing numbers of higher educational institutions over the last decade, since the Internet boom began. The main premise of the distance-education view is that ICTs are becoming increasingly central not only in terms of how higher educational institutions

accomplish their tasks, such as promoting their institutions on the Web, but also in the educational products and services provided through online e-learning and other innovations.

The significant role played by individual teachers is spotlighted by the distinctive types of eClass users that characterized the embedded cases. Teachers are the primary end-users or adopters of a VLE within a university, since instructors are among the most critical decision makers on the adoption and use of technology in classes and for the way students organize their work with computers.[18] Decisions regarding computer use in classes are also affected by instructors' teaching styles, flexibility in adapting to new teaching situations, attitudes towards computers, length of experience using computers in their own lessons and their self-perception as computer users.[19]

Teachers are always searching for ways to get more readings to students at less cost. By extending the virtual boundaries of the classroom, eClass enabled some instructors to distribute material to students with less concern over copyright than they would otherwise have. Copyright was mentioned explicitly as a constraint on innovation by only one professor in our study. However, this is one factor that has made the copy machine less useful to instructors and is one significant uncertainty surrounding the provision of electronic access to course readings, images and lectures. At this time, eClass therefore gave relatively more communicative power to the instructors relative to publishers and authors. VLE courseware could also undermine or support the role of other traditional gatekeepers in education, such as faculty instructors, at the same time as fostering new gatekeepers, such as the technology administrators and technical support staff that control access to digital library resources and make decisions about technology upgrades.

We found eClass critical to instructors efforts to support their own pedagogical models. Each of the six types of users were able to employ eClass to support their model of instruction. In this sense, ICTs were malleable and able to reinforce alternative pedagogical models, rather than impose a particular e-learning model on instructors. However, the traditional analogies built into eClass constrained its use. For instance, it was not designed to enable students to form their own groups. That's why it took a relatively skilled engineering class to have the know-how to create a system to support their study group.

Other groups of relevant actors include the specialist developers who implement systems within organizations, challenged by the limitations of the technology and the resistance of some prospective users.

Policy choices by those who run school or departmental systems can result in different units having different levels of access to the Internet, dissimilar requirements for student technology literacy skills and different limitations on student Internet access.[20] At NEU, the humanities were often without wired classrooms, in contrast to some engineering departments that were well-equipped for Internet access. The potential role and impact of eClass was quite different across these departments, such as in the case of the eProjector art historian who had no facilities to display her images in the class.

eClass also became a strategy in a more general efficiency game, by enabling instructors to save time by not copying materials, and save students time by not taking as many notes, or being able to review notes from outside the classroom. One professor stopped distributing his lecture notes electronically when he realized that students were deciding not to come to class as they could read his notes online.

The paths taken by eClass were also shaped by assessment and ratings games, whether it be students seeking good grades or instructors seeking high student evaluations. For example, the way one professor's evaluations plummeted following technical problems that caused frustrations to students in downloading materials illustrated how technical failures can reflect poorly on the instructor, making it safer not to experiment. In such ways, the expectations and values of students can be either an impetus or a constraint on innovation.

Additional Constraints: Technology Versus Technology

This ecology of e-learning games helps clarify the complexity of introducing a major innovation like eClass. It also suggests why eClass has been more successful than many other innovations, as it plays a malleable and strategic role in such an array of games in higher education. But the ecology of games does not capture all of the constraints facing innovations in e-learning. For example, technical limitations rose to be a major barrier.

The Internet, Web and e-learning have been built on the shoulders of major technical breakthroughs, so it is somewhat ironic that some of the most critical constraints we found were limitations of the technology. The implementation of eClass was plagued by slow response times, trouble in updating courses from registration data and many other technical problems. For example, when a subset of students in one class was unable to log-on for several weeks because of errors in assigning unique passwords to students with the same last name, the entire class was delayed. And difficulties in upgrading eClass courses caused extreme frustration among an accounting professor's students when the course's website was frequently unavailable at times when they needed to upload their assignments.

The degree of technical interdependencies involved was another significant break on innovation. Instructors can often optimize use of an e-learning system only if they also have appropriate access to the right equipment, in the right place—whether it is access to the courseware from home or a projector in a classroom, as shown by the eProjector art professor's difficulties caused by the lack of an adequate projector to display images from the Web. Technical advances should therefore move in parallel in the classroom, offices, households and dormitories.

Summary and Discussion

It might be tempting to dismiss the apparently relatively trivial value of the traditional tasks for which instructors generally used eClass, such as in distributing their required readings. But efficiency and convenience matters, especially as teachers and students expect more material to be online. In the long run, this might not simply be an enhancement of the efficiency of copying functions. It could signal an adaptation to a more fundamental change in how students prefer to get access to course materials, which could have dramatic implications on the geography of access, such as where students study and the global audience that could be reached by a single instructor.

Secondly, the degree to which the lack of access to other ICTs undermined the use of VLEs and vice versa suggests that VLEs are likely to become more central as laptops, wireless and multimedia classrooms continue to diffuse. This is already

apparent in high-end multimedia classroom environments, where access to the Internet, VLEs and other multimedia systems can create a synergistic effect on the use of each technology. It is in these classrooms that the students appear to gain the greatest role in managing information and communication resources in a multimedia, multitasking environment, for better or worse.

Despite the many technical glitches and limitations of eClass, its restricted capabilities were still valued by most users, as has been found in other studies of VLEs.[21] This indicates that the value of such courseware to academic staff and their students is more complex than suggested by technologically deterministic models of e-learning. VLEs and other ICTs are sufficiently malleable to fit the strategic needs of many actors with different goals and objectives. They can be accommodated in the complex ecology of e-learning games that were taking place at NEU and other universities. This value is likely to increase as the technical constraints are addressed.

The growing availability of more online content and better communication facilities is also likely to move e-learning more centre-stage in higher education. This could lead eventually to the emergence of sustainable new e-learning paradigms. These are illustrated by the emerging subtle shift we found from one-to-many to many-to-many forms of teaching and learning, as well as by signs of an emerging multimedia-multitasking classroom in which students are online—in class as well as out of class.

Few are interested in innovation *per se*, so for innovations to gain widespread support and acceptance it is likely to be necessary for them to support or be adaptable to the diverse goals of multiple actors in different games, from administrators seeking economies of scale to students pursuing good marks or friendships. Our research discovered that the VLE at NEU was highly valued by many users but used innovatively by only a few. This VLE could be accommodated in the complex ecology of e-learning games that were taking place at NEU, and perhaps at other universities. The 'human face' revealed by the embedded case studies outlined some important social and institutional factors affecting e-learning innovation. This showed that much optimism about e-learning had been dampened at NEU by a variety of specific technical, institutional, economic and other social constraints. That is why the VLE was limited to a conservative role for e-learning in support of traditional classroom activities, as also found in other studies.[22]

The relatively limited use of the VLE at NEU in the period of the study does not support the anti-technology stance of some critics as tangible green shoots of innovation were found that one day could flower into more visionary e-learning futures. But it does back the view that educational institutions are not just providers of information or codified knowledge, but are vibrant learning communities offering contextual and social cues that are vital to shaping learning and education outcomes.[23] VLEs can be used, and were used at NEU, for supporting communication, study groups and learning communities in valuable new ways that can complement traditional media and methods, rather than replace them.

Our case study was sufficiently rich to provide substantive evidence to identify some important general themes and patterns. However, we are aware that our findings need to be refined and developed by further research on the many relevant institutional, social and technical dimensions we could only sketch in outline at this stage.

For instance, much of our study was seen primarily from the instructor's viewpoint. Further research should explore the use of courseware from the perspectives of students. Comparative research on the diffusion of educational technologies in institutions at all levels, starting from elementary schools, and studies lasting for longer time frames than available to us could also help to better illuminate the unanticipated consequences of e-learning innovations. Investigations into interactions between a VLE and other innovations in the use of wireless networks, laptop computers, and other new ICTs in higher education could also improve understanding of how more innovative e-learning approaches can be fostered, even in environments strongly influenced by traditional educational paradigms and teaching methods.

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