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Review of the impact of technology-enhanced learning on roles and practices in Higher Education

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Summary

This initial review draws together the state of the art in research into the impact of technology on roles and practices in higher education and sets an agenda for the remaining work of the project.

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Review of the impact of technology-enhanced learning on roles and practices in Higher Education

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Introduction

This report is the first deliverable of the Kaleidoscope Jointly-Executed Integrative Research Project, *The impact of technology-enhanced learning on roles and practices in higher education*. The project has two objectives:

1. To explore the impact of new forms of technology on roles and practices, and
2. To identify the kinds of intervention best suited to supporting staff within the processes of change that surround the introduction of technology-enhanced learning.

These are reflected as themes within this document, which provides a review of current research.

In the first section of this report, general trends and issues are raised. This sets the scene for a series of sections in which national developments from across Europe are presented as case studies. A discussion section follows, which draws out the main themes identified in these cases and synthesises the research thus far. This synthesis then forms the basis for the report’s conclusions, which both highlight areas of impact that are well understood and identifies the areas where further work is required.

The aim of this project is ambitious given the many different roles and practices that will be influenced by technology, as well as the diversity of technologies that are both currently available and that are continually emerging. The rapid growth of computing, networks and infrastructure offers increasing and ever changing potentials for technology use in education, and the subsequent impact on practice and roles in education generally is set to be enormous. This in itself presents challenges for research investigating the impact of technology in education – both for learning itself and for the impact on practitioners involved in educational policy and educational establishments.

Early implementation of technology in education has focussed on stand-alone software applications, and specifically developed software programmes for learning continue to increase. The recent development and growth of the internet and the world wide web are part of fundamental changes in the ways in which we live, work and learn, and are already associated with significant impacts upon Higher Educational Institutions across the world. Furthermore, current developments in mobile and ubiquitous computing are likely to increase and change the potential for technology-enhanced learning and subsequent teaching practices. At a general level such technology characteristics can be seen to underlie various changes in education practice and social evolution.

The development and growth of the internet and world wide web have led to global information dissemination and provided radical changes to global communication and interaction. In addition, such web based communication technologies have enabled changes in the social practice surrounding computer use and influenced choices made at all levels, by academics, librarians, institutional policy makers and politicians. Collectively these shape and contribute to the increasing development of distributed and distance learning. Different models of how learning can take place are evolving, removing the constraints of who can participate and the location of learner or tutor. Demand for teaching via the internet has therefore increased, promoting further development of online and distance learning. Thus primary changes in higher education of late can be seen through: (i) an increase in computing resources in campuses worldwide, and (ii) the increased use of web-based technologies to supplement instructional activities. Such development has enabled a growth of academic resources online, making libraries accessible through remote connections and reducing the need to be physically present in conventional face-to-face academic settings; an increase in administrative services being carried out through networked resources, typically using web-based technologies; a growth in demand for life long learning opportunities, which consequently affect the need to adapt technology into instructional delivery; and an increase in the average age of university students, who often combine additional responsibilities of family and work with their studies. The impact of such technology developments can be seen to cut across different levels of institutional structure, for example, organisational changes in policies and institutional approaches toward the use of technology for teaching and learning; an increase of emphasis and volume in staff development modules in campuses worldwide to support academics' use of technology in their teaching; and an increase in emphasis on quality of teaching, as instructional activities become more transparent online.

Although some research is beginning to explore the impact of technology on educational institutions and the roles and practices therein, the research to date is diverse, with no well-established methodologies. Most issues researched are dominantly centred around the school systems, making it almost impossible to draw insights and pointers to issues faced at tertiary level education (Stierer and Antoniou 2004). Furthermore, a strong emphasis of the research being on internet technologies and distance learning, often based on disparate case studies, highlights the need to amalgamate evidence to date and set out research needs in order to inform the ways in which technology is integrated into Higher Education. This review aims to establish findings of international research to date that has investigated various issues surrounding technology enhanced learning in Higher Education, including the recursive relationship between technology development, technology use, technology and organisational policy and the subsequent effect on the various roles and practices within educational institutions. From this we can draw together similarities and differences in technology implementation, ways in which existing roles are developing and the emergence of new roles, as well as the origins and influencing factors of such changes. In addition the review will reveal the current gaps in methodologies and in our current understanding of the impact. From this we can begin to map out where research effort would best be placed in order to assess and inform the impact of staff development, training, and educational policy (institutional, national and international).

Background

Many commentators have argued that technology has the potential to transform educational practice, typically as an element of wider organisational transformation such as the development of mega-universities (Daniel, 1998) or as a consequence of competition in international educational markets (Hannah, 1998). Others have taken a less deterministic position, but see a link between technology and changing educational practices such as the creation of more flexible opportunities for learning (e.g. de Boer and Collis, 2005). Clearly, technology is associated with changes in practice but the nature of this association is complex and contested.

There are many reasons why this relationship has remained obscure. Perhaps the first point to emphasise is that practice in Higher Education has always be fluid and complex; in such a situation, disambiguating the role that technology plays in this process becomes difficult. Henkel (2000), for example, discusses the way that academics' identities are shaped by the communities they participate in (such as the institution and the discipline), the values they hold and the practices they engage in as professionals. These identities, she argues, have had to change in the wake of successive policies that have re-shaped Higher Education, such as massification, the changing relationship between institution and state (especially in terms of the way funding is allocated), the rise of managerialism and instrumentalism and the subsequent re-positioning of Higher Education as a competitive market. This has affected the norms and conditions of employment, including far fewer permanent appointments, with a longer 'apprenticeship' (doctoral, post-doctoral and then fixed-term positions) preceding any kind of secure position. Social technologies such as quality assurance and accountability systems have further influenced notions of academic work and identity. Within all of this, there have been particular changes to academics' identities as teachers. The growth of student numbers has led to a change in the kind of teaching relationships that are sustainable, with less individual attention being possible. Additionally, many students entering Higher Education now have markedly different views of what universities are for from those who teach them.

Although Henkel's work illustrates that what it means to be an academic is complex and also constantly changing, her study has nothing to say on the relationship between such an identity and technology. Taylor's research (1999), however, does address this. First, he shows how the changes Henkel describes are typical, rather than exceptional, in the context of universities – many supposedly 'contemporary' issues (such as the autonomy of institutions, expansion of student numbers, the status of the disciplines) can be found in literature over a century old (p16-17). He argues that change and flux in what it means to be an academic has always been present. This state of uncertainty and perceived turbulence *is* the normal state of affairs. However, he does discuss how technology has come to play a part in this ongoing process of re-invention, proposing that this will not *cause* change but does have a role to play in shaping an already changing situation. This directly challenges notions of technical determinism that might position particular systems or resources as being the cause of new practices, changes in performance and so on. Instead, they act as a kind of catalyst. He notes, however, that many academics resist the introduction of new technologies because they believe that these *will* cause change – specifically, changes that they do not agree with, such as the continued erosion of personal contact with students, the commodification and industrialisation of education, and so on. What this kind of resistance illustrates, he argues, is firstly that change is political and power-laden (and that technology is implicated in these politics) and secondly that the process of change includes loss as well as gain, so that in many cases people who believe in the current system will have to grieve for what they lose as new practices supersede old.

Specifically, Taylor describes the "CIT trap" (Computer and Information Technologies): the simultaneous commitment to value both the local and the global (internationalised courses that are relevant to all), and the deceit that because these technologies seem to offer exciting new potential, anyone who is sceptical, hesitant or reluctant to engage with them are technophobes. He argues, "the discussion of change tends to highlight issues of discontinuity, rather than issues of continuity. This can be deceptive, and result in 'anticipated entrapment', which may itself be far more intrusive than the outcomes of the change. […] The extent of anticipated change in their teaching roles made it very difficult for those who had not yet experienced that change to see it as other than threatening and negative" (p59-60). He also describes the way in which academics' identities may alter to emphasise their role as instructional author, to the detriment of other roles (such as 'teacher').

This complex, shifting context in which change is the norm, rather than the exception, makes it difficult to define terms such as 'impact' and 'effectiveness'. Without any fixed point of reference to compare with, and with multiple influences affecting practice simultaneously, attributing causality to a particular intervention (such as a new technology) becomes extremely difficult to do in any credible way (Oliver and Harvey, 2002). If such changes cannot be attributed easily to a 'thing' (an intervention, such as a new practice or technology) then claims about effectiveness also become tentative and problematic. It may be possible, through a combination of self-report, observation and analysis of documents and other artefacts, to provide convincing arguments about how the use of new technology has affected a particular person – but such methods are time intensive and unlikely to scale, and generalisation from such particular analysis would be inappropriate. A particular issue here is that of representativeness: given the constant changes facing higher education, and the recognised variation in roles and practices across institutions, disciplines, national and regional policy regimes and other identity-shaping constructs, great care must be taken about the generality of claims made on the basis of analysis.

This complex background necessarily shapes the review presented here. The review will open with general claims that are drawn from the literature; these will be considered and explored to reveal how they are more complex and nuanced than is often recognised. Following on from this, there will be a series of accounts of particular kinds of impact within specific settings. Rather than attempt to hide the differences and diversity in the way that technology, roles and practices are related, these will differ in structure in order to reflect the priorities and concerns of each national context. This is the inevitable consequence of the complexity identified here. However, each section will open with a review of the educational context in that nation, and integration will be attempted in the discussion section that follows, where common themes that emerge from the reviews will be explored in order to provide some degree of synthesis.

The international impact of technology-enhanced learning

This section provides an overview of the impact of technology on universities worldwide. As noted earlier, the pattern of growth in the use of technology in higher education of late can be seen through:

- Increasing computing resources, including web-based technologies, encouraging supplemental instructional activities; a growth of academic resources online; and administrative services provided through networked resources;

- Organisational changes in policies and approaches;

- An increasing emphasis on quality of teaching and the importance of staff development;

- Changes in social practice, e.g. a growth in demand for life long learning opportunities, which consequently affect the need to adapt technology into instructional delivery; and an increase in average age of students.

Such developments bring about changes in the way teaching and learning is dealt with in higher education. Innovations in technology, which initiated changing demands in education, have been used to argue that there is a need to reassess and revisit the roles and practices of educators, to accommodate "more flexible learning, for the growth in university services, and for more cost-effective delivery of higher education in an increasingly competitive environment" (McCann et al., 1998).

The introduction of Internet technologies has dramatically changed the landscape of higher education worldwide, and has enabled higher education to expand access to education and training; raise the quality of education; lower the cost of education; and increase the cost-effectiveness of education (Bates, 1996). In addition, internet technologies have facilitated the expansion of quantity of courses and programmes; the generation of higher levels of tuition-based revenues; the development of specialised programmes of study, which were not plausible otherwise; and the use of the process of technological innovation as a vehicle for revitalisation of other aspects of other (university) operations (Daniel, 1996).

These observations indicate the extent to which technology is implicated in the way higher education is governed and managed, to meet the needs and expectations of students of today. There have been many attempts to use technology in higher education, and the following sections will present aspects of how these efforts have taken place in universities across the globe.

Teaching and Learning in Higher Education

Since the introduction of computers to classrooms over 20 years ago, numerous papers have heralded the potential of computers to improve the quality of teaching and learning (Mayes, 1995), many believing that it would radically change the way knowledge is taught and learnt. The changes brought about with effective use of technology have led to new concepts of university teaching such as 'distributed learning' in North America, 'networked learning' in the UK, and 'flexible learning' in Australia (Bates, 2000). Some benefits of using technology over conventional classroom teaching, particularly in higher education, have been observed (Bates, 2000). For example,

- Learners are able to access high-quality teaching and learning at any time, at any place;

- Information previously available only through a professor or instructor is accessible on demand through computers and the internet;

- Well-designed multimedia learning materials can be more effective than traditional classroom methods because students can learn more easily and more quickly through illustrations, animations, different structuring of materials and increased control of and interaction with learning materials;

- New technologies can be designed to develop and facilitate higher order learning skills, such as problem-solving, decision-making and critical thinking;

- Interaction with teachers can be structured and managed through on-line communications to provide greater access and flexibility for both students and teachers; and

- Computer-mediated communication can facilitate team teaching, use of guest faculty from other institutions, and multicultural and international classes.

The realisation of such benefits requires that technology be effectively integrated into teaching practice. Integrating technology into classroom instruction has long been the centre of debate and concern in academic circles. For example, Green (2001) found that 31% of respondents from the Campus Computing study perceived that assisting educators to integrate technology into their instruction was the single most important IT issue faced by two- and four-year colleges in the USA. However, research also suggests that integration of technology can be problematic. A report from *The Observatory on Borderless Higher Education* (The Observatory, 2002) reviewed selected findings from an international study, which aimed to provide a Commonwealth-wide perspective of relevant university activities specifically those related to Online Learning. A survey targeting approximately five hundred universities who were members of the *Association of Commonwealth Universities* and *Universities UK*, elicited a varied response rate of 101 responses from 71 countries, which represented 20% of institutions contacted. The findings indicated that, although there was “widespread enthusiasm for online delivery for both strategic level and among faculty”, very few participating universities had integrated major online learning elements into their curriculum or institution-wide use of online distance learning (The Observatory, 2002). These findings illustrate an interesting perspective on the adoption of online learning - that although there is widespread interest in using online technology, there are gaps in the way it is assimilated into existing academic routines, services and strategies. This suggests that the impact of technology on the roles and practices of the university educators is still developing, since it is yet to be completely integrated into the existing curriculum.

Mishra and Koehler (in press) identified seven fundamental reasons why it is difficult for university educators to integrate technology into their courses:

- Lack of experience in teaching/learning with technology

- Rapid rate of technology change

- Inappropriate design of software

- ‘Situativity’ of learning (denoting how teacher knowledge is situated and local)

- Emphasis on “what” instead of “how”(focus on the technology rather than the meaningfulness of its applications)

- Time intensive nature of technology integration
- “Somebody else’s Problem” (SEP) syndrome (tendency to place blame or fault onto another party, which affect the way technology is managed or delivered to the end users)

Commonly, university educators have not required formal training in instruction, which raises the question of how, if educators are not adequately trained in pedagogy, and at the same time are not comfortable with technology, they manage the use of technology in teaching.

Changes in the way teaching and learning is managed at higher education also take place as E-learning gains popularity as a new gateway to undertake higher education courses. The student population has not only increased in number, but also in age average, and tends to have additional obligations besides their studentships at the universities (Beller and Or, 1998). This raises concerns which challenge the set up of residential universities and colleges where high quality learning depends, to a large extent, on finding a sufficient number of suitable lecturers; studies are expensive; thus, limiting accessibility and being subject to budget cuts and restrictions; and where traditional learning is limited to a particular place (the classroom on campus, which is also expensive to set up), a specific time, and a uniform pace. Without adequate human resources, funds and physical space to operate, to cope with the growing student numbers and changes in demand for career-oriented study programmes, these residential entities may not be able to provide for the changing educational market.

Similar issues have emerged in Australia where The Yetton Report (1997), which analysed the uses of technology in the Australian higher education, identified six vital goals that universities should adopt when reviewing their IT strategies as bases for competition through differentiation in the marketplace: the need to improve the quality of teaching; the need to reduce costs; the need to service new but multiple campuses; the competition for students; the changing profile of the student base; and inter-university collaboration. The initiative taken by the Australian universities to equip themselves with strategic technology provisions was also supported by their government, which helped to fund some infrastructure directly, commission research projects that relate to use of ICT through the Evaluations and Investigations Programme, and fund innovative practice through teaching development programmes of the Committee for University Teaching and Staff Development (CUTSD) (Yetton, 1997).

The important role that the CUTSD plays in helping Australian university educators to address changes in their teaching practices highlights the current shortcomings of conventional practice, where the tendency to recognise and reward efforts by university academic staff is solely based on research initiatives, with too little credit being placed on teaching skills developed through ‘the new environment’ using ICT (Yetton, 1997). A milestone was achieved in 1997 when the government inaugurated the Australian Awards for University Teaching to recognise and encourage good teaching practice.

These are some of the developments taking place in higher education institutions worldwide. Although the prevalence of literature focusing on developed nations may give an impression that advancements in wealthier countries is more pervasive than in developing nations, there are also initiatives taken in various developing countries, for instance in Singapore, India, South Korea, India, Malaysia, Thailand, Japan and China.

Emerging Trends Internationally

Changing and Adapting Roles in Higher Education

To understand the changing roles of the educator, this section will look at how emerging trends of digital technology, digital delivery and strategic partnerships affect the scope of tasks and responsibilities of an educator using technology in higher education today.

There are essentially two dimensions of change in roles within higher education worldwide: in campus and virtual campus. The most prevalent changes in academic culture are felt by residential universities, as information resources grow exponentially with the developments of digital publishing and internet technologies. It is widely accepted that the conventional 'stand and deliver' lecture approach may not be the most effective or efficient way to teach. However, overcoming the inertia of seven centuries of tradition in lecturing can be an intricate and complex task (Altbach, 1998; Hooker, 1997). Lectures, typically portrayed as being non-interactive and passive, are now relatively easy to supplement with multimedia elements, and students can use technology to interact with their lecturer and peers without disrupting the flow of content delivered within an instructional session. Technology has also enabled students to 'attend' lectures without being physically in the lecture theatre, and lecture sessions can be taped and replayed for further reviews by students, thus allowing for individual learning paces.

A popular term to label the use of both technology and face-to-face instruction is 'blended' learning. On campus, residential students are provided the opportunity to use learning technologies to extend and expand their normal classroom instruction. Some of the common technology tools used are emails, bulletin boards, computer conferencing tools, graphical representation tools or simulators, databases, and search tools (Web), which can be used to promote the higher order thinking skills of students. Lecturers can create learning opportunities that challenge their students' thinking, and encourage (and sustain) a collaborative learning environment through the use of technology-mediated communication. Some real life classroom implementations have been realised, for example:

> The Math Emporium (cited Bates 2000): With a high failure rate among 1st and 2nd year undergraduates taking mathematics courses at Virginia Tech, USA, instructors attempted to create a technology centre for the 7000 students enrolled for mathematics. The centre, called the Math Emporium, had over 500 workstations, and open access 24 hours a day, seven days a week. The students go through the course materials using programmes provided on the workstations, and are able to ask questions whenever needed with senior students and instructors who patrol the centre constantly. They can also opt to attend the classes, study with a tutor, listen to a live lecture, work in small groups or study individually using computer-based materials. Since the Math Emporium concept was first introduced, the students' exam performances increased by 25 to 30 percent.
>
> College Boreal, Canada (cited Bates 2000): All lecturers and students are provided with a laptop at this college. Students pay $1200 a year for their laptop, which covers insurance, support and maintenance services. Lecturers are provided a physical and virtual space called 'Le Cuisine', where they can exchange academic 'recipes' and 'simmering' academic projects related to technology use in education. The space also provides for professional staff development programmes and has the facility to try out state-of-the-art software and tools to be used and evaluated by the lecturers. The college allocates 2 percent of total academic salary to professional development, and it assigns guaranteed time-out for professional development, workshops and meetings related to technology use.
>
> ActiveCampus Project (Ratto et al., 2003): An application, 'ActiveClass', using PDAs was introduced as part of the computer programming degree at UCSD to encourage increased student participation in large lecture classes. Students used PDAs in a classroom context to facilitate collaboration and interaction. For

example, they could post questions about issues arising in the lecture, in a way that meant they were anonymous to other students, and questions could be voted into a priority order by all the students. This application provided the facility for students to ask questions without interrupting the course of the lecture but also enabling the lecturer to filter questions and answer at an appropriate time; students didn't feel they were exposing their ignorance; questions rated by other students gave important information to lecturer on the significance of questions posted; and anonymity engendered a broader range of questions to be asked.

By committing to the use of technology, teaching could expand the conventional forms of classroom delivery. Cases such as those above prove that such initiatives can be designed and implemented, with appropriate organisational policies, funding, and academic culture/context put in place at each learning organisation.

The second broad area where roles are changing concerns the development of virtual campuses. A popular trend for technology use in education is as a delivery mechanism for distance learning programmes. If one conducts an armchair research using the popular search engine 'Google' to find "online degrees" offered by virtual campuses, the result from the search presents approximately 15 million random links to websites related to 'virtual education'. To date, there are more than 100 active websites that provide catalogue services for these online degree programmes, mostly based in the USA. This suggests how pervasive online learning has become, especially in delivering post-secondary education worldwide. Virtual degrees have become a booming educational market that caters for adults who wish to acquire academic certification, on their own terms. Over the past few years literature has depicted an increasing tendency to offer existing distance learning modules, or create new ones from existing on-campus programmes. In the US E-learning has been extensively used to deliver distance learning programmes, with traditional universities at the forefront of exploring how technologies can be used to expand their existing distance learning modules. Some universities are creating new paths by adopting dual teaching methods (Beller and Or, 1998), for instance Stanford University now offers Masters in Electrical Engineering completely online. There are currently numerous examples of traditional universities that have already begun to extend their standard residential study programmes to 'virtual campus' programmes, using the aid of technology. The University of Illinois, for instance, currently offers 63 online programmes, including twelve Masters level programmes, over and above the normal resident student enrolment. Penn State University began its World Campus project in 1998, and is now offering 30 fully accredited degree programmes online, in fields ranging from general education to information systems, counsellor training, and turf grass management.

However, despite the launching of on-line degree programmes Brennan et al. (2002, cited in Shannon and Doube, 2004) identified that technology was being used in Higher Education mainly for "searching, for communicating, for providing information, and for processing text in various forms – not for full online delivery". In fact the existence, or non-existence (in the physical sense), of these virtual campuses has sparked much scepticism. Although there are a small number of distance universities with a digital model, e.g. Tele-University Quebec, Athabasca, Pheonix, these are limited. Indeed proper accreditation of many online degree programmes was found to be lacking, positioning these "anytime anywhere" learning opportunities in very questionable standing. For instance, in early 2004, Wired magazine revealed finding from an investigation by The General Accounting office (USA) that 28 high-ranking officials in the US, and at least 463 government employees, have fake degrees from online universities, also termed "digital diploma mills" (Singel, 2004).

Furthermore, in a report from the House of Commons on Education and Skills, the virtual university initiative, UK e-Universities, was noted to be a failure. This project was allocated £62 million to launch, develop and run study programmes collaboratively with different institutions of higher learning in Britain. It received backing from many leading universities in UK, and although it was provided with public funds, it was run as a private-public entity. With only 900 students enrolled, the project was shut down in Spring 2004, failure being attributed to many things, including lack of educational market analysis, lack of analysis on target learner groups, lack of pedagogical development focus, and many more (The Observatory, 2005).

These failures signal a transition into a more mature stage of development for E-learning practice, as educators and the education market reassess the strengths and weaknesses of learning opportunities presented through these digital technologies, by the merit of the providers of the study programmes. In addition the concept of the 'virtual university' has comes into question. Cornford and Pollock (2002) suggest that the 'virtual university is the university made concrete' and that the more virtual the institution the more standards are required to be prescribed and set out.

Finally, it is worth noting that there are also changes in the academic role that relate to duties other than teaching. For example, a case study exploring the technology change from a physical university to incorporate a virtual university (on-line distance education) in South Africa, identified four impacts of technological change on teacher roles: academic staff become facilitators of knowledge where they are no longer bearers of knowledge; they use technologies to manage administrative and research components; they must ensure they remained experts in their respective fields; and finally they were encouraged to be sophisticated users of technology for learning facilitation (Lazenby, 1998).

Alliances between autonomous institutions of higher learning

Developments in E-learning have also enabled autonomous institutions of higher learning from around the world to collaborate and create an academic alliance between them, to strengthen their positions in the educational marketplace. For instance, in 2001, eleven universities in the USA and UK collaborated to create a unique international distance-learning partnership (Carr, 2001). Their plan was to create and sell online graduate courses, forming one of the more extensive alliances between autonomous higher learning institutions their aim being to provide a much higher-quality offering to students than could ever be offered by a single institution" (as stated by David Pilsbury, chief executive officer of the collaboration Worldwide Universities Network). The network includes Pennsylvania State University, University of California at San Diego, University of Illinois at Urbana-Champaign, University of Washington, and the University of Wisconsin at Madison. The British partners are the Universities of Bristol, Leeds, Manchester, Sheffield, Southampton, and York. Other academic alliances include Universitas 21, which is a partnership between more than 17 Commonwealth universities. The alliance recently included a new partner from the publishing industry, Thomson Publishing, which reinforces the strength of digital content development and production initiated by partners of Universitas 21.

University-Corporate Collaborations

There has also been a steady increase of collaborative study programmes created between universities and corporate institutions. Examples include:

- OFEK (Open University Israel and Gilat and Arel)
- University of Colorado and Reel Education
- Georgetown University, George Mason University, Berkeley University and UOL Publishing Limited

With the direct involvement of corporate sectors in academic institutions through such collaborations, the roles of university educators are influenced by commercial decision processes, such as placing emphasis on return on investment for technology infrastructure and human resource training.

Changing academic practices

How do educators at higher education institutions cope with these developments, and what effect do they have on teaching roles and practices? One important product of using technology in university classrooms is that it has enabled university educators, instructional designers and managers to question how learning takes place (McCann, 1998). For example, in the era of life-long learning, educators are expected to promote explicitly the kinds of learning outcomes that may have been seen as implicit or even incidental in earlier decades, such as critical thinking, problem solving, written communication and the ability to work collaboratively (Uchida, 1996). Because of the fluidity of information design and access on the web, these skills are well matched with web-based activities (Owston, 1997). When used in instruction technologies are also shown to provide increased opportunities for interaction, and thus enable joint problem-solving, shared learning and enhance face-to-face contact Chickering and Ehrmann (1997). Specific identification of the use of tools such as these encourages educators to explicitly look at their teaching practice. However, this should by no means discredit conventional pedagogical approaches to address the teaching, as research in this area has shown that when using technology, it has to be guided with an understanding of effective learning conditions (Alexander, 1995; Taylor, 1996).

The growth of web based technology and subsequent development of on-line courses for distance learning has particular implications for educators' roles. Lairson (1999) viewed the conceptualisation of 'online courses' in relation to the changing role of the educator as follows:

> In this process of redefining the course in an online world, the role of the professor changes to one of learning coach, creator of online activities, definer of competencies appropriate for students, and redefiner of traditional disciplines in terms of both knowledge and competencies that can be developed through study. In some ways, the role of the professor as ``infominer" - someone who seeks out, sifts through, organizes, and provides information - goes beyond this role as it operates today.

This reconceptualisation suggests that, to remain relevant, educators at higher education today need to be able to utilise technology, and in the case of in-line learning, not least, to develop well structured web content. This in itself is a complex task and has implications for educators skills and training. Boettcher (2003) discussed the meaning of "well-structured content" on the web, and looked at three paradigms of content, which define the levels of support that educators would have to design and provide, to ensure that meaningful learning occurs when using online materials for their instruction. She proposes that the nature of digital content is a rich blend of elements, without the conventional boundaries of time, space and formats. Boettcher also noted that for online learning to be well-structured, the identification, selection, and development of course content must be:

- Semantically well-structured for instruction; this corresponds to the teaching component of the learning experience.

- A good fit or well-structured for a particular student; this corresponds to the learner component of the learning experience.

- Technologically well structured; this corresponds to the environmental component of the learning experience.

According to Boettcher (2003), there are three paradigms of content and corresponding levels of support: Level one: content that supports core concepts and principles, for example, that provides descriptions of core concepts dynamically using visual, audio, and graphic illustrations or demonstrates relationships among core concepts, such as concept maps; Level two: content that supports well-structured problems with known solutions, for example, presents consistent elements of the problem sets to the students, reveals patterns inherent to the problems, or engages the learner in the solutions; Level three: content that supports less-structured, complex problems without known solutions, for example, provides complex scenarios, engages the learners in solving problems where neither the elements or the solutions are known, or provides real-world problems such as those worked on in engineering and applied disciplines. These levels indicate the intricacy of dealing with digital content, and without proper training and support, a university educator may not be able to design or deliver meaningful learning through technology integration into their instruction.

This highlights the tension between policy strategies to increase technology enhanced learning and the crucial necessity to ensure effective underlying pedagogy. On the one hand Downes (1998) suggests that "except for the prestigious conventional institutions for which there is no shortage of demand from full-time resident students, universities that ignore the new knowledge media may go the way of the dinosaurs". However, on the other hand, Mazouè (1999) asserted,

> Whether this trend in education is a good one or not will depend on the creativity and commitment of educators to provide instructionally well designed online resources for their students. Online courses can offer students a quality education, but only if educators take the time and trouble to ensure that they are designed in such a way that they embody principles of effective instructional practice.

Changing Teaching Culture: The case of transnational programmes

The advent of E-learning technologies has also allowed for new types of study programmes to be offered to students worldwide. An excellent example that illustrates the use of information and communications technologies in the South East Asian region is the transnational education programmes, where learners are located in a country different from the one where the awarding institution is based (UNESCO and Council of Europe, 2000). The growth of demand for transnational education is predicted to rise to more than 480,000 students in Asian countries by 2020 (Global Alliance for Transnational Education, 2000). The programmes are typically delivered through 'offshore branch campuses, twinning arrangements or international distance education' (Ziguras, 2001).

One emerging issue for educators involved in transnational programmes is the inevitable tension between global modernising trends and local conventional teaching and learning practices. Ziguras (2001) investigated how educators involved in transnational programmes improve their delivery with the use of distance learning technologies, and how countries in

South East Asia (Singapore, Malaysia and Thailand) implement their government policies toward the use of educational technologies for higher education. In addition, he identified cultural differences between students in Australian universities and those who are taking similar courses online from Singapore, Malaysia and Vietnam. This study highlights how conventional pedagogical beliefs and practices are being challenged by the requirements of the awarding institution, whilst at the same time, educators are having to cope with the needs of their local students in the classrooms. For example,

> Because the Internet promotes pro-active teaching and learning, it may affect the balance of power in countries where the educational system is centralised and authoritarian…. In societies where discipline and submission to authority is praised rather than individualism and freedom, teachers might feel too uncomfortable to take initiatives, to accept the scrutiny of peers, or to hand greater control to their students. Likewise, students accustomed to traditional methods may find it hard to adapt to active and innovating learning techniques (Jae-Eun Joo 1999, cited Ziguras, 2001).

This statement indicates the types of challenges that educators who are embracing technology would have to deal with in their instructional approach. The diversity in learning cultures and the varying levels of learner adaptation to technology-enhanced learning may affect the scope of responsibilities expected from the educators.

Awards and Rewards

As more and more university educators use technology in their courses, the need to keep them motivated to continue exploring innovative uses of technology is realised. This prompted university administrative teams to identify ways to reward and recognise the ideas and efforts undertaken by their educators. One such exercise was done at University of Illinois Online in 2004, where recognition was given to outstanding online teaching. The evaluation of effectiveness was determined by the teaching strategies used by the educators, and the feedback received from the students who attended their classes.

In Australia the government has created a committee (CUTSD) that predominantly looks into identifying and promoting good teaching, learning and assessment practice in universities and fostering innovation. In 1996 CUTSD grants were mostly awarded (795) to initiatives that explored the uses of multimedia packages, hypertext databases and design tools and support tools for electronic tutoring, all considered to be innovations in teaching, learning and assessment (McCann, 1998).

Further national initiatives for the development of innovative teaching also exist, for instance, National Teaching Fellowships in the UK, National Teaching Development Grants in Australia and the Council for the Renewal of Undergraduate Education in Sweden (Brew and Boud, 1996).

Impact on Staff Development Initiatives

Staff development programmes are argued to be essential in making the transition to and integration of technology in congruence with pedagogical concerns, and also to ensure return on investment on technology infrastructure. However, in a survey of 2600 academics in 15 Australian universities, McInnis (2000) found that 66 percent were developing ICT courseware, another 72 percent were involved in computer-based learning, and 46 percent were working on distance learning programmes, but only a handful received any training for the work they were undertaking.

According to Ellis, O'Reilly et al. (1998), academics at many Australian universities are challenged by the growing demand for more online learning opportunities. Hand in hand with this is an increased expectation of academics to be competent, in terms of designing and managing their contents, pedagogy and technology, and this has pushed for added opportunities in staff development to provide support and training for the academics to learn these skills.

A survey (Ellis et al, 1998*),* conducted on all Heads of Departments of Staff Development Units in Australian universities between 1997 and 1998, indicated that training programmes held for academics are mainly done through conventional classroom-based sessions, and these sessions were conducted by internal and external groups of trainers. The most popular tended to be those related directly to the pedagogy of online course delivery, web design and course authoring. In addition, the survey revealed that there were many 'unmet needs' in their respective universities. Only one third of the participants believed that their needs were met by their organisations. Reasons provided ranged from 'insufficient staff' to 'almost no funds'.

A further study (Shannon and Doube, 2004) exploring the barriers to using web supported learning and teaching in higher education in Australia focused on academics rather than staff developers. This showed a lack of inclination to adopt web supported teaching for various reasons: inadequate staff development; high workload; lack of time; lack of knowledge and skills; inadequate tools and infrastructure; concern over value of technology for quality learning; and inadequate support from institutions. This study identified a gap between the high value placed on the internet and technology for teaching and the low use of such tools. Although teachers valued web based technology for teaching in theory, there was reluctance to adopt it in practice, and those that had adopted technology for teaching early on were reluctant to include further advancements in the technology on offer. This study also identified ways in which the adoption of technology could be encouraged through promoting the professionalisation of teaching itself, giving the teaching component more status, and on the way in which staff development was structured and organised. One particular way proposed was to exploit academics' emphasis on research, by promoting a more research-informed basis for using technology for teaching as well embedding research and technology into the teaching process itself.

Impact on the role of Instructional Designers at Higher Education

Conventionally, instructional designers or media specialists are the first points of contact for academics using technology-based tools for their instructional delivery. However, with the extensive developments in E-learning technology, where the tools and learning environments are becoming increasingly user-friendly, academics are quickly learning to adapt to using the technology tools without expecting substantial support from the instructional designers or media specialists at their institutions.

A study by Schwier, Campbell et al. (2004) presented perspectives from instructional designers who are working with the teaching faculty at three universities in Canada. They looked at the changes in roles and expectations of being instructional designers, as they act as support to higher education instructors/teachers who gradually used more technology elements in their courses. This preliminary study reported that "the focus of designers is institutional more than societal, but that they exhibit high standards of performance and care for the appropriate integration of technology into learning environments".

A study by Torrise-Steele and Davis (2000) that specifically looked at instructional designers, found that:

- The interaction with the academic proceeds on the conceptualisation of the process of development as a complex transformation rather than simple translation of teaching materials. This idea of development as a process needs to be made explicit.

- The development of online materials might be conceptualised as an overlay of two processes: that of material design and development and that of changes occurring in how the academic thinks about teaching and learning.

- The designer can assist with an integrated approach to curriculum development conducive to transformation by bringing frameworks such as the seven principles of good practice (Chickering and Gamson, 1987) to bear on the process.

- The designer can empathise and address staff concerns arising from the pressure of innovation (time, workload, confidence).

- The designer can foster collaboration and strong team support in the development experience.

- The role of the educational designer as described by the multimedia unit at Griffith University shares some of the basic characteristics of a change agent as characterised by Havelock (1982). It seems appropriate that educational designers are perceived as change agents with an active role in professional development of teaching staff, thus in facilitating innovation, rather than simply acting as an 'adviser'.

- The designer can promote reflection.

A further study by Torrisi-Steele and Davis (2000) on ten faculty members who acquired assistance from instructional designers to build their course websites, found a number of things that the academics learned from their experience of putting their course information and materials online. Perceived advantages included easier access to content and reduced requirement to attend scheduled sessions, students being expected to prepare before sessions, the possibility of 'freeing up' face-to-face time for analysis rather than presentation and forcing the good discipline of being organised in advance. Perceived disadvantages included technical problems, less interaction with students leading to the possibility of losing track of students' progress, unequal access to equipment, students becoming less willing to ask for help and the belief that computers are taking over teaching.

The responses provide a good insight into the way that university educators adapt to the challenge to integrate E-learning into their courses. Their anxiety about the effect of using technology on their roles as educators can be derived from their responses, indicating a sense of insecurity about their power and scope of authority in their classroom. These responses, when viewed from the instructional designers' perspective, point out the sensitivity and concern of these educators when handling technology for their instructional delivery. This analysis could help frame staff development plans.

Changes in Pedagogical Approach and Practice

In the context of pedagogy, technology enhanced learning is a relatively new field of study. Research on the impact that technology has on the cognitive, psychological, social and emotional developments of a learner and an educator, within an instructional context are just beginning to emerge.

Mishra and Koehler (in press) have proposed a model for technology usage, called the Technological Pedagogical Content Knowledge (TPCK), which presents an extended dimension of knowledge that educators require in order to function effectively in a technologically-enhanced learning environment.

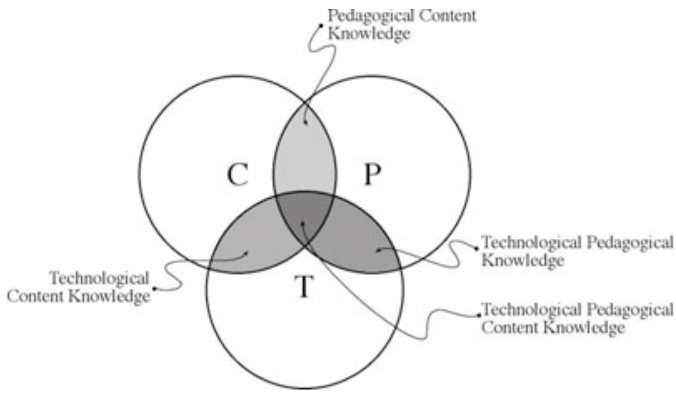

Figure 1: The model of Technological Pedagogical Content Knowledge

In Mishra and Koehler's model, educators need to have Technological Pedagogical Content Knowledge, an extension to three components introduced by Shulman (1996). In this revised model, the three circles indicate domains of knowledge, and the overlaps indicate four areas of inter-related knowledge. Their TPCK model recognises the fact that technology does not work in isolation, and that it has to be utilised with an understanding of how it can relate to pedagogy and content being taught and used in instruction. They argue that:

> Effective online teaching requires instructors to think deeply about the relationship between all three knowledge bases, not individually but in a co-evolutionary and co-constructed manner. The addition of a new technology reconstructs the dynamic equilibrium between all three elements, forcing instructors to develop new representations of content and new pedagogical strategies that exploit the affordances (and overcome the constraints) of this new medium.

They further suggested a potential restructuring of professional development in teaching, which takes into account the elements proposed in their TPCK model. The approach is termed 'communities of designers', and is designed to actively engage the educators in authentic pedagogical contexts/issues.

The impact of technology-enhanced learning in the UK

Learning technology is predicted "to change both the prevailing teaching paradigm and the academic role" (JISC, 2003). E-learning has moved into the mainstream in terms of educational policy and there are now e-learning strategies agreed by the Department for Education and Skills, (DfES, 2005) and the Higher Education Funding Council for England (HEFCE, 2005). This section begins by outlining the role of policy and politics in patterns of change with respect to technology in education, followed by research from different perspectives which points to emerging changes in academic practice and the development of new roles, and finally outlines research looking at effective ways of designing interventions in teachers' practice.

Patterns of change, policy and politics

The UK's Association for Learning Technology recently produced a book to mark its 10th anniversary. This summarised developments in policy and practice relating to the use of technology in education within the UK. In a summarising chapter (Oliver, 2003a), several points were drawn out:

- The tendency for practitioners and researchers in this area to forget the quarter of a century of existing research that underpins current practice;
- The rational, technical and financial discourses that, under the banner of managerialism, are being used to justify changes to existing academic practice;
- The dissonance between this rational approach to change and the complex, holistic and iterative perspective held by many academic developers;
- The use of designated government funds to drive practice in particular directions by 'bribing' academics to take an interest in them;
- The way in which technology that has been successfully embedded is taken for granted and thus forgotten about, whilst attention shifts constantly to new, as yet problematic, technologies;
- The relative neglect of attempts to theorise practice;
- The tendency to conflate teaching with resource provision and learning with accessing resources; and
- The need to treat teachers as learners (including provision of opportunities to 'play' with technology and a greater tolerance of mistakes) if they are to develop new practices involving technology.

This analysis served to highlight controversial points such as the way in which technical changes were used to justify changes in the division of labour within institutions. Such analysis of the relationship between policy and practice in relation to technology and education in the UK is relatively rare. However, there is a long history of policies concerning what is now called 'e-Learning' within the UK. Perhaps the first of these was the Flowers Report in 1965, which reviewed the technology infrastructure available to universities and began to make recommendations about national computing resources. This eventually led to the development of the Joint Academic Network (JANET), the technical backbone on which current Internet provision in universities is built. Shortly after this report (1967), the Barnard report broke new ground by advocating a focus on the computing skills and competencies of undergraduates, leading to the development of a national concern with what is now called 'information literacy'.

Over the intervening four decades, there have been several policy initiatives that have built on this foundation. Rather than review these exhaustively, a selection of important recent policies will be outlined.

The 1998 Dearing report set a vision for Higher Education across the next decade. Unsurprisingly, discussions of technology formed a central component of this document. E-Learning (referred to in the policy as communication and information technology – C&IT) was seen as vital both within courses and in the process of course selection, providing information to potential students about the offerings available to them. Pedagogically, the report took a clear stand in advocating resource-based learning. Arguing that it was wasteful to develop similar materials at different institutions, it proposed inter-university collaboration to develop high-quality materials that could be shared across a number of courses. An entire appendix was dedicated to demonstrating that current forms of face-to-face contact could not scale up to meet the increasing number of students with a diminishing amount of funding *per capita*. However, in spite of this, the proposed collaboration proved impractical at a national level and this idea has been dropped from subsequent policy.

More recently (2004), the government launched a policy document entitled *Towards an e-learning strategy*. (The policy arising from this consultation document was released in 2005, but was more conservative than this consultation document.) This advocated a different model for development. Part of its argument was structural, proposing that there should be stronger links between the educational market and commercial development firms (although it sought advice, rather than giving it, about how this might be achieved). It also identified a number of areas where technology was believed to have great potential in supporting learning – for example, in areas such as assessment practice, and particularly in moving beyond multiple-choice questions to new, richer assessment formats. Rather than advocating shared development and adoption of standardised materials, it proposed almost the opposite: that teachers be given specially-developed tools to create e-Learning materials themselves, ensuring that whatever they produce would be locally relevant (even if it were not of commercial production standards). Another major strand of this report concerned staff development; it was seen as naïve to provide such tools and expect teachers to develop new, innovative forms of practice without any kind of support. The *form* this development should take was not fixed; there was not believed to be any single 'right' approach, but instead different forms would be required depending on the context.

Both of these policy initiatives have been criticised by researchers, although the recent strategy consultation document was widely felt to be a step forwards. The Dearing report, for example, has been criticised (Smith and Oliver, 2002) for:

- Treating academics as materials developers, not teachers;
- Emphasising the economic arguments for education and neglecting the social or personal value that can arise for learners; and
- Presenting students in a negative light, primarily as needy consumers.

The other major initiative in this area in recent years was the UK's e-Universities Worldwide Limited (UKeU), a public-private venture that was intended to help market UK institutions' programmes in an international market; it was also hoped that it would develop a robust technical infrastructure that would advance current practice in this area. The UKeU's primary concern was distance e-Learning courses for international students; it worked with institutions nationally to develop courses offered and validated by that institution but marketed and processed through the centralised UKeU initiative. The UKeU was recently cancelled, citing low recruitment and high costs of development, amongst other concerns. Conole, Carusi and de Laat (2005) have analysed this failure and identified a number of contributing factors, including:

- A lack of consideration of the role of Learning Systems within the business model;
- An over-simplistic attitude to the development of relationships between the academic and business sectors;
- A failure to implement proper processes for negotiating the development work that academic institutions would undertake, possibly indicating a lack of trust between universities and the UKeU, whose learning team were often not consulted;
- An internal intolerance of sub-optimal processes, ignoring the need for such processes to mature and develop over time;
- The lack of a staff development remit to complement the technical development process; and
- An inequality of emphasis between its social mission to increase inclusion and disseminate good practice and the dominant commercial mission to maximise profit.

Taken together, what this emphasises is the social context in which e-Learning development work operates. Without care and attention given to establishing and maintaining constructive dialogue between the various parties involved, development cannot proceed and progress will falter. Similar conclusions have been drawn about smaller, project-level development work (e.g. Bradley and Oliver, 2002); without a flexible team who sees it as their role to learn about and work with all parties involved (i.e. whose focus is on the social processes of development, and specifically the negotiation of what particular processes or proposals mean for all involved), the development of modules within this particular project would have been impossible.

Changing roles and practices

As yet, research investigating technology-enhanced learning in the UK is mixed. Some focuses specifically on the effect of technology-enhanced learning on particular roles; other studies focus more on the different technologies, and the process of their implementation into teaching and learning practice.

The learning technology career development scoping study (JISC, 2003) investigated the impact of learning technologies on institutions and the roles, skills and activities of learning technology staff in the UK. With respect to the impact of technology on academics this survey reported that on average ten percent of academics in each institution were working with new technologies. These individuals were classed as ‘innovators’, having the motivation to be involved in technology implementation and to engage in relevant staff development. They were also seen to act as ‘peer experimenters’, an activity perceived as crucial for providing the basis for critical reflection on technology enhanced learning. Although these particular academics were seen to undertake more professional development, particularly integrating pedagogical and technical skills, academics in general were not found to regularly take up staff development opportunities. As such these individuals are seen to play a key role in the development of technology enhanced learning and be central to the roles of educational technologists and technology support staff. The implications of these findings could mean that the burden of technology and pedagogical practice could fall heavily on innovators' shoulders, placing high demands on time for keeping abreast of technological development, implementing technology as experimentation, reflecting on outcomes, providing recommendations for other staff or courses, and supporting other staff (academic and educational technologists) in implementation.

Such individuals may well be at the forefront of case studies on the implementation of technology for learning. For example, a series of case studies looked at the integration of technology for supporting learning in particular subject areas in higher education (LTDI, 1997). These primarily involved ready developed software packages, requiring implementation and delivery, rather than design or development. Although evaluation of the effectiveness of learning is lacking we can begin to identify features that appear to be important for their success: integration with current course content; team work and different members of the department working together (e.g. CALL). Although these are important features for the successful implementation of technology-enhanced learning, the design and the specific learning objectives of the software are also important, and may be one area where the role of academic or educational technologist may benefit from being developed in order to lay pedagogical foundations for the design of educational packages or software development.

Ubiquitous computing is a fast developing area, which brings new conceptions of mobile, anywhere, anytime computing with for example, new networking capabilities, sensor based interaction and context aware computing. "The shift of emphasis away from the development of stand-alone computer-assisted learning (CAL) programmes and towards the use of more generic tools within managed learning environments undoubtedly requires [not only] a shift in institutional support and investment", but also a shift in thinking about teaching practice (JISC briefing 6 p. 4). Research in wireless and mobile learning is nascent with few studies focussing on mobile technologies for higher education. However, there are some points to note from case studies currently in progress (JISC, 2003). Mobile technologies seem to collectively be useful for the following activities:

- Chat communication e.g. through SMS or IM (example case studies were student nurses, university students' interactive log book, combined with a virtual tool for field trip type of experiences);
- Sharing of material (e.g. student nurses, university students using laptops or PDAs);
- Creation of collaborative documents in real time (e.g. university students interactive log book); and
- As an organiser (e.g. interactive log book, student organiser).

Tentative inferences of the implications for the impact of these technologies on roles and practices can be made; for example, managing and exploiting 'chat', or the potential to involve outside experts in interactive session. In addition, one study showed such technologies demanded a high degree of technical support, pedagogical planning, and a flexible approach to content and delivery. Although such case studies demonstrate the emerging uses of technologies, they have not focused upon the impact that technology has on roles and practices. In such instances we can only begin to infer features that are specific to individual cases, but this may serve as a start to identifying features of changes taking place more widely.

Research from a different perspective provides more insight into the processes of change. The Economic and Social Research Council (ESRC) funded a broad project that examined the impact of the Virtual Society (Virtual Society, 2003). The outcomes of this programme of research included a number of results that touched upon the changes in Higher Education. Cornford and Pollock discussed the Theory and Practice of the Virual University (Cornford and Pollock, 2000). Their work was later published in book form as *Putting the University Online* (Cornford and Pollock, 2003). Further articles, including an investigation into the student use of 'learning nests' (Crook, 2002), can be found in Steve Woolgar's edited book containing chapters based on final reports from the programme (Woolgar, 2002). The research pointed to two processes in Higher education that could have an influence on roles and practices. Cornford and Pollock point to the ways in which virtual settings in universities ironically lead to university standards and procedures being made more concrete. This suggests that practice in universities deploying technology to enhance learning is likely to be more reified and canonical and less informal and fluid than it has been previously. Charles Crook's work points to the changes in the way students learn, from the shift away from traditional settings to such places as student study bedrooms and learning nests, in which multiple network technologies interact and students constitute their learning environment beyond the surveillance of academic staff. This potentially disruptive move may have serious implications for student learning and for the practices of teaching academics.

The Student's Experiences of Networked Learning in Higher Education project (NLin HE) ran for two years, reporting in 2001 (Goodyear et al., 2001; Jones et al., 2001). The evaluation team wrote a Pedagogical Framework for the DNER that tried to distil what was known about the relationship of pedagogy to the design of technological services and artefacts (Goodyear and Jones, 2002). The report noted that:

> Using pedagogical theory to design technological aids to learning has been the goal of a great deal of well-funded RandD in the learning technologies field over the last 25 years or so (see e.g. Sleeman and Brown, 1982; O'Shea and Self, 1983; Ohlsson, 1986; de Corte et al, 1992; Jones and Winne, 1992; Lajoie and Derry, 1993; Laurillard, 1993; Koschmann, 1996; Lajoie, 2000). In few cases has it been possible to show exactly how the functionality or look-and-feel of the finished product embodies pedagogical design principles. So caution needs to be exercised in handling pedagogical theory as a resource for design decisions.

Perhaps more importantly the Pedagogical Framework noted a shift to a more student centred notion of teaching and learning in which what the student does, not subject coverage, takes centre stage. The report claimed that empirical research into higher education lecturers' conceptions of, and approaches to, teaching was becoming an active research area. Though there was still too little broad-based quantitative data to generalise about the scale and speed of a shift towards more student-centred views and methods (Hativa and Goodyear, 2001), some of the smaller-scale qualitative research had developed a sense of some of the key differences which could be found within teachers' shifting conceptions of teaching. Kember and Kwan (2000), for example, identified two main conceptions of teaching, each of which consisted of two subsidiary conceptions.

Teaching as transmission of	*Teachers holding this conception tend to see*	Teaching as passing information	*Teaching is merely passing information to students; emphasis*

knowledge	*teaching as a teacher-centred activity; the main aim being to transmit knowledge to students, who are considered as passive recipients of information*		*on* ***syllabus coverage*** *or meeting exam requirements, without much concern for students' understanding*
		Teaching as making it easier for students to understand	*Teaching is still conceived of as the transmission of knowledge but now with a concern for students' understanding; emphasis on* ***structuring*** *knowledge and organising teaching to help students understand, remember and apply*
Teaching as the facilitation of learning	*Teachers holding this conception tend to see teaching as student-centred; the main aim being to facilitate their learning*	Teaching as meeting students' learning needs	*The emphasis here shifts to the variety of students and the* ***diversity*** *of their learning needs; teaching is informed by a sense of responsibility about meeting these various needs*
		Teaching as helping students become independent learners	*The focus here is on the growth of the individual, rather than on specific knowledge and skills. Teaching is seen as a process of helping learners develop intellectually and become* ***autonomous*** *lifelong learners*

Table 1: Conceptions of teaching (adapted from Kember and Kwan, 2000)

The shift from teaching as the transmission of knowledge to teaching as the facilitation of learning has implications for the role of the teacher. While lecturing may remain important, it loses ground relative to the design of learning tasks and learning environments as a focus of the teacher's concern. Teachers spend proportionately more time designing useful learning tasks and identifying and improving access to good learning resources. This shift is related to changes in technology in complex ways and the new role signifies a shift in the locus of control over student learning. While teachers continue to occupy a powerful position, through making judgements about what counts as worthwhile knowledge and through grading students' work, students are potentially gaining power in a number of ways not least of all in the control of the presentation of the learning environment through the combination of technologies and media (Crook, 2002).

Though the project focused primarily on the student's experience it included an element that explicitly investigated the experience of practitioners of networked learning. This element was reported in Jones et al (2000) and Jones and Asensio (2002). The report on practitioners (Jones, Asensio and Goodyear, 2000) found that they describe a common overall philosophy of teaching and learning in networked environments that could be summed up in a few bullet points:

- People learn collaboratively by articulating and sharing their ideas, experience and expertise through discussion and dialogue.

- People learn by linking ideas from literature, online contributions and their own practice and experience.

- People learn by doing, by engaging with the activity or task.

- People learn from experience, either positive or negative and from exposure to different tutoring and learning styles.

On the other hand practitioners did not have simple rules that could be applied reliably to inform day to day practice, which the report referred to as ‘rules of thumb’. The authors also speculated that the overall philosophy found amongst these early adopters of networked technologies may not be found amongst the wider audience of practitioners that would come with more mainstream adoption.

The Final Reports from the NL in HE project included a guidance document explicitly targeted for teachers in higher education who were thinking seriously about making use of networked learning. The document noted that few teachers in higher education were used to talking with each other about pedagogy and design (Dunkin, 2001). Since that time the UK government has supported a number of initiatives aimed at changing the academic practices of teachers in Higher Education. In particular it developed the Learning and Teaching Support Network (LTSN) of Subject Centres. These centres were organised into 24 individual Subject Centres covering a narrow range of subjects or disciplines and a single generic centre dealing with common issues related to teaching and learning. These Subject centres and the LTSN now form part of the Higher Education Academy. A series of evaluation reports can be found on the influence this network had upon teaching and learning (Goodyear et al., 2002; 2001, 2001a, 2001b). At the same time individual universities began to develop certificate courses in teaching in Higher Education. Provided under a variety of titles, they were often accredited by a central body (the Institute for Teaching and Learning in Higher Education) that has also been integrated into the new HE Academy.

These initiatives taken together marked a sharp turn towards the standardisation and specification of an academics job role in Higher Education. The initial teacher training for university academics had a common format across institutions and though not centrally concerned with technology enhanced learning these courses included a technology in teaching and learning component. The format of the initial teacher training was commonly focused on the student centred approach noted earlier. The LTSN subject centres were modelled on the Computers in Teaching Initiative that developed the idea of subject centres. The LTSN explicitly inherited some of their technology remit. This was enhanced by a direct link formed with JISC to enable interoperability across the subject centres allowing cross searching and information feeds between the different centres. The professionalisation of teaching practices in UK HE has been closely associated with the introduction of technology enhanced learning.

The JISC Distributed National Electronic Resource was a large programme that led to the development of the JISC Information Environment. The evaluation of the programme included research into the current practices of students, academics and librarians in relation to digital resources. The reports on student searching strategies found that students relied on standard search engines, most notably Google, rather than the kinds of structured searching favoured by information specialists. This kind of searching for resources was also reported by academics. The evaluation found that Higher Education librarians had a strong focus on the organisation of electronic subscription services, but a contrasting and patchy approach to free Web-based resources. They also found that there were generally weak formal relationships between librarians and tutors through their departments.

Academics engaged in the delivery of courses were found to be promoting digital resources to their students in a variety of ways. Many academic web sites lacked any coherent structure to provide a context for the use of the resources. Some academics were keen to provide lists of links but they had little or no grouping into meaningful subject areas, and little annotation or explanation of the intended learning benefit. In addition, some of the descriptions of resources provided by academics were clearly wrong. There was evidence that lecturers did not understand the process of creating links to different resource types, especially those that carried authentication mechanisms. This was illustrated in attempts to embed hyperlinks to full text journal articles in PDF format that have been retrieved through an authenticated search. For the student, this simply resulted in an error message reporting a timed out session. It is clear that Higher Education institutions need to provide guidance to staff who wish to support their students in this way.

The use of digital resources was significantly related to subject and discipline area. Mapping across institutions showed a wide variation in the overall number of links from Departmental pages and more detailed analysis showed that this unevenness was retained when links to internal university pages were removed. Academic staff who were interviewed showed a variation in their use of digital resources that was linked to broad subject and disciplinary issues. This differentiation by discipline and subject area was also reflected in interviews with library staff. The use of digital resources could be broadly divided into two main types. In physics, engineering and mathematics the use of digital resources was closely related to the use of specialist software, in particular MatLab. In all cases the staff in these subjects expressed an interest in the use of images, including moving and 3D images and simulations, and this was particularly so in the case of biological sciences. In more social subject areas such as politics, languages and applied social sciences, the interest was mainly in the use of particular types of Web-based materials. These subjects needed access to the most current information and to news media such as local language newspapers. A third kind of use was found in areas that had access to large amounts of non-copyright materials such as history and law. In these cases large databases were used for searching for materials in both digital and non-digital forms.

The level of use of digital resources by academic staff was also reported by subject librarians to vary markedly within subjects and disciplines. The use of resources was reported to be influenced by the history of each department and by the external demand that exists within the subject area and relevant professions.

- Subjects reported to have low use of digital resources: languages, politics, arts, philosophy and religious studies.

- Subjects with moderate use of digital resources: linguistics, american studies, psychology, educational research, geography, biology and environmental science.

- Subjects with a notably high use of digital resources: management, law

The evaluation reports from EDNER indicate that further research needs to be conducted if we are to understand the complex and contingent factors that influence academic practices in relation to the use of digital resources for teaching and learning.

Academic staff used digital resources in a variety of ways and a clear aspect of this variation was that for them “information” was much more than “published information”. One of the significant uses of digital materials was the use of networked digital resources to "bring the world into the classroom". Tutors using digital resources in this way were interested in access to primary materials but not only from government sites and reputable organisations that provided primary resources. It was clear that some of these staff were also interested in the unregulated aspects of the digital environment. This use of information resources was also a way of introducing students to powerful and potentially dangerous sources in a way that would help to develop the students' skills in how to read and handle such information.

When tutors were asked how they find out about information resources, it emerged that they not only used published information such as professional journals, conference papers, newspapers, government and other agency reports. They also rely heavily upon less formal information sources. One significant aspect of this was the use of a digital version of the 'invisible college' – the social network of collegiality that facilitates academic practice. Academics often use colleagues' personal Webpages to keep up to date with developments in a particular field. Other sources of information were the Webpages of prominent academic units and research centres and email discussion lists.

There was evidence that teaching academic staff included links from their Virtual Learning Environments (VLEs) to the institutional library, and to library resources. However, these were often simple links to the library home page or to subject databases. This was true even in instances where there is a good working relationship between the tutor and their department and the library. A surprising number of tutors did not link from their VLEs to library resources at all, some stating that student induction sessions are sufficient to inform students of what the library has to offer, or indeed simply because they had not realised that they could do so. The evidence of academic use of library resources in VLEs suggests that a major difficulty and restraint on their use is the technical environment allowing such links to be made simply.

New roles: the emergence of learning technologists

One new role that has emerged to support technology-enhanced learning is that of the learning technologist. Recognition of this role is quite recent, although it was described as far back as the early days of the UK Open University (Lawless and Kirkwood, 1976). They describe how 'pioneer' educational technologists learnt their trade through immersion in practice alongside the first course developers, whilst newer educational technologists faced the problem of "plunging […] into course teams and [having to] find out for themselves what was expected of them and how the system worked" (*ibid*: 54). The issues they faced are still familiar today:

- The diverse backgrounds of these individuals;
- The common commitment to the improvement of learning;
- The problem of establishing a 'discipline' when so many disciplines were drawn upon; and
- The pressures of work associated with an ever-growing range of commitments to courses and departments.

Related papers from this period note issues such as varied and inconsistent job titles and the diverse locations where such individuals might be located within institutions (Harris, 1977), the necessity of educational technologists questioning the assumptions and views of learning of the academics with whom they work, their role in advising academics about the media best suited to particular teaching strategies and their need to 'mug up' on courses in fields in which they have no personal experience (McCormick, 1976).

However, few practitioners or researchers have any awareness of this heritage. Instead, recent awareness of learning technologists in the UK was raised through the Dearing report (NCIHE, 1997), which identified a group of 'new professionals' working in Higher Education whose roles are hybrid, marginal and yet central to institutional processes of change. These jobs, in the growth areas of higher education – student services, marketing and information services, for example – seemed to share common features. They were typically held by people aged under 35, with five or fewer years of experience of the role and whose qualifications were not always related to the post they held. These jobs appeared to be ill-defined and often outside of the mainstream of institutional support structures – features which appealed to the postholders, who had been attracted by the variety and challenge that these roles presented, and who wished to develop their own posts in distinctive ways.

The term Learning Technologist has, since, come to be used to describe a specific sub-set of these 'new professionals' (Armitage and O'Leary, 2003):

> The term learning technologist has been used to describe staff involved with any of the functions and activities associated with the embedding, development and support of learning technologies or e-learning in HE. This can range from those with a learning technology role e.g. staff developers, technical developers, project managers and educational researchers, to those 'with a learning technology role within a different role' (Beetham et al., 2001, p.67) e.g. lecturers, senior managers, librarians, technical support staff and administrators.

However, the inclusive nature of such descriptions provides little insight into the role that such individuals perform. Gornall (1999) re-visited these descriptions to explore their role in the processes of change taking place in Higher Education institutions, identifying an apparent contradiction, in that these posts were both marginal (typically being fixed-term and insecure) yet powerful (in that they were directly linked to strategic priorities). These roles did not fit neatly into existing organisational structures, mostly being based in central units and having a range of job titles.

> This emergent group is employed in roles clustered around the changing forms of support for teaching and learning. These staff often have non-traditional job titles, cross-role posts and non-traditional contracts and conditions of service. […] They engage… in tutoring (or training) that is not lecturing, and may be one-to-one, *ad hoc* and unassessed, and in learning support that is resource based. (ibid, p. 45)

Gornall asserted that they "do not yet see themselves as a group, as a *new* group or as a *professional* grouping – nor is this attribution generally made about them" (*ibid, p.45*). However, subsequent research contradicts this. A national survey (Beetham *et al*, 2001) identified around 4,500 centrally-located and 3,000 departmentally-located specialists currently working as learning technologist in UK universities, plus around 8,000 departmentally-based academics, working in three roles:

- New specialists, including educational or technical developers, researchers and managers, who are likely to be young (in their twenties or thirties) and on fixed-term contracts, often supported by external funding. They have typically been in their current post less than two years and at their current institution less than four. New specialists tend to be multiskilled and peripatetic, but with learning technologies as the core of their professional identity.

- Academics and established professionals who have incorporated an interest in or formal responsibility for learning technologies into their existing professional identity. Academic managers are generally older than the new specialists and have worked at their current institution for a longer period of time.

- Learning support professionals are staff in non-academic roles (including technical support and library professionals) that support access to and effective use of learning technologies. Unlike new specialists they do not regard learning technologies as the defining focus of their professional identity but as the context in which they are now working.

The first of these groups *has* developed a sense of its own identity. In 1996, for example, a mailing list was created; in 1997, members of this group met as part of a CAL Support Officers Forum in Manchester, organised by the Computers in Teaching Initiative Support Service; and the forum has since established itself as a Special Interest Group of the national Association for Learning Technology (ALT).

The work of this group was described in greater detail by studying learning technologists' accounts of their practice (Oliver, 2002). Whilst this focused on individuals and their particular role, several comments shed light on the nature of this group as a whole. For example, participants felt their role ought to be a professional one (and was in the process of becoming so), and sought to distance themselves from being seen as being in a simple service position. An example of this professionalism involves using specialist knowledge to influence institutional decisions. There was also evidence that whilst the work of learning technologists might vary widely, their values were shared. For example, although it was hard to say what made a good learning technologist, there was agreement about what made a 'bad' one:

> I would categorise a bad learning technologists as someone who is a geek, to be honest. And by geek I mean somebody who is totally involved with software and hardware products and wasn't interested in establishing relationships. That would be a bad learning technologist. A good learning technologist is the other thing, the opposite to that.

Further questions of professionalism have been raised by Lisewski and Joyce (2003), who describe how many of the current tools and practices adopted with learning technologists align them – often unwittingly – with managerial discourses and practices. This, they suggest, would be one way of legitimating and thus securing their position within institutions, but it would be an essentially servile one, acting as agents of management. Another option would be to 'go native' and position the profession as a quasi-academic community by seeking to legitimise its work through journals and peer review. Either might serve to secure the position of learning technologists – but only a low-status position. A possible alternative – or certainly a method to informed progress down either path – would be for the community to debate and develop their own tools and frameworks, using these to form a distinctive professional expertise of their own.

Within Oliver's 2002 study, the focus was primarily on the way in which learning technologists interacted with the communities within their institutions, rather than on them as a community crossing institutions. Studies of the community itself are lacking, although a review exists of the kinds of topics presented at the association's conference (Jacobs, 2001) which comments that there has been a shift from "academics dabbling in learning technology" to "staff employed specifically to promote and support it within their institutions" who, "by and large, […] do not have a discipline affiliation". Jacobs infers from this and other discussions that "the move away from discipline-based presentations is, at least to some degree, a reflection of the increasing professionalisation of learning technology" (p. 5).

There have been several analyses of the impact of professionalisation on this group. Oliver (2003a) noted that several positive outcomes could be achieved. Presently, individuals find themselves in a 'dead end' – a job, rather than a career, with little sense of opportunities for long-term progression (Beetham *et al*, 2001; Oliver, 2002). Professional structures could be created to sustain continued movement through the community, developing individuals' sense of professional identity. However, such a development also carries risks. Creating a closer-aligned constellation of practice would reduce the lively, spontaneous development of new practices that currently takes place. This problem would be particularly acute if recognition requirements for levels of membership restricted the current easy entry into the community, since it could inhibit the inflowing of new ideas and perspectives. Additionally, it would be all too easy for specific communities within the network to gain dominant positions, allowing them to exercise power and thus impose their understanding of practice onto other communities (for example by imposing particular interpretations of standards or consistently rejecting certain people who sought advanced membership). Such influence could only be tempered through ongoing debate and consultation, with processes that remain open to critique by the membership.

The accreditation work foreshadowed by this research has since been piloted. ALT commissioned a study that reviewed existing relevant accreditation schemes and then piloted one designed for learning technologists (Oliver *et al*, 2004). It also produced (and critiqued) a draft job description and identified an extensive range of qualifications, frameworks and programmes in this area, none of which was a good match to the practices of the group. (One, however – the FERL Practitioners' Programme, designed for Further Education – was fairly close, however.)

The review of literature and schemes that scoped this work identified that comparable roles existed in the U.S., emerging as an alternative to the dominant tradition of instructional design (see, e.g., Surry and Robinson, 2001; Peruski and Mishra, 2004; Rieber, 1998), and the suggestion that similar roles do exist in Europe, Australia and New Zealand. Documented evidence of this is sketchy, however.

This work has led to an accreditation scheme being developed, the details of which are available (Oliver, 2004b).

Designing interventions in teachers' practice

The Joint Information Systems Committee (JISC) has recently funded a programme of research and development around e-learning. As part of the foundation for this programme, research studies were commissioned that were intended to frame the projects that followed. One of these included a report that reviewed theories of learning and identified what the implications of each position should be for practice (Mayes and de Freitas, 2004). A parallel strand of work explored how teachers' practice could be changed.

This work involved studies of the effectiveness of the following in helping practice to develop:

1. Tools (software applications, hardware, etc.; Conole, 2004b)
2. Resources (texts, digital learning objects, etc.; Littlejohn and McGill, 2004)
3. Institutional services (staff development, technical support, etc.; Oliver, 2004a)
4. National services (support networks, national datasets, etc.; Franklin, 2004)

Each review identified cases of successful practice and analysed these to identify the features that seemed to explain success. For example, the review of institutional services found that no single format – training, service provision, *etc* – could be identified as "best" practice; there was no 'magic bullet'. Instead, different forms of support are needed in response to varying patterns of need, interest and institutional pressure. Consequently, what was recommended was that institutions develop a broad repertoire of approaches to support so that staff can gain access to what they need, when they need it. In addition, however, certain stylistic points were identified that influenced the level of success of a particular intervention:

- Approaches that focused on academics' wider perceptions and values (such as disciplinary identity or concern for their students) were more likely to be effective than approaches that seek to instruct academics in unfamiliar, 'alien' processes, even if these are more rational than existing practice.

- There is a tension between raising the profile of e-learning (which requires distinguishing and segregating it) and providing a unified service (avoiding fragmentation between e-learning and 'normal' practice).

- Support is not taken up 'for its own sake'; most individuals seek support only when they perceive that they have a need. The main exceptions to this arose when individuals were obliged to consider their teaching practice, for example as part of a quality audit or as part of initial training for new lecturers (which is now compulsory in most UK institutions).

- The most important way that academics felt that their practice could be valued would be to give them the space that they need to try new pedagogies out in a safe, playful way and learn from (reflect upon) these experiences and mistakes.

- Services that provide ongoing one-to-one support in response to individuals' own problems, such as Learning Technologists or ILT Champions, are effective but costly. (However, it was suggested that many other forms of intervention are so ineffective that although they seem cheaper 'per user', their net impact may be poorer.)

- Services tend to be most effective when a relationship can develop between its staff and those they are supporting, which means that they need to be 'small enough' to allow such relationships to form. There remains a risk that such a form of organisation will lead to fragmentation and de-centralised operation, although this is more likely to be a concern for managers than for teachers.

- There is a tension between the short-term efficiency that arises from a neat division of labour (for example, where staff hand work to a dedicated service) and the long-term effectiveness of services that seek to develop staff understanding of new practices (for example, producing web-based materials). The implication of this is that services will be effective where they are 'disruptive enough', so that staff continue to learn without having their work halted by problems.

- Support staff have their own expertise, which is protected by keeping staff ignorant of the detail of these forms of practice. (For example, academics can delegate copyright clearance to library specialists when producing course packs.) This expertise is often developed informally, on the basis of experience.

- Perhaps most importantly, and underpinning several of these conclusions, academics must recognise the relevance of the support or service that is provided or they will simply not take it up. The implication of this is that services will need to pursue an ongoing policy of discussion with specific communities (in the sense of mutually-recognising groups of individuals, rather than 'types' such as 'lecturers', or even 'lecturers in geography') to ensure their relevance. Staff perception of needs may not always be accurate, but nevertheless it remains the basis for their decision over whether or not to engage with an offer of support.

The conclusions from this report, and from the remaining three, were synthesised (Sharpe, 2004). This synthesis led to the identification of stylistic qualities that were associated with effective interventions in practice in each of the four areas. Overall, five qualities were identified:

- Usability: this term was not intended to be restricted to the technical Human-Computer Interaction sense of the term; instead, it referred to interventions that were available, relevant and understandable to its intended users. This included reflecting the language of the users in the presentation of the intervention.

- Contextualisation: practitioners favoured tools designed specifically for them, or which they had been involved in producing/adapting. Interventions were *less* effective where they failed to recognise the day-to-day experiences of staff, the values and practices of the discipline (or profession) or failed to tackle current issues.

- Professional learning: effective interventions provided the opportunity for – and actively encouraged – practitioners to rethink their practices; this was especially true for interventions that prompted teachers to rethink their concepts of teaching and learning.

- Communities: there are advantages to working with *existing* communities (by which is meant self-recognising groups, not 'types' of people as might be identified through a role analysis).

- Designing for learning: the intervention should support practitioners in planning new ways to work with learners.

These qualities were arranged as rows in a table, with columns dedicated to different levels of granularity at which such qualities might be present: (1) representing and sharing knowledge; (2) developing staff; and (3) developing organisations. This table was then demonstrated to have value in analysing examples of practice and also in planning new or developed services. It may thus be possible to use this as an analytic framework for some of the research to be undertaken as part of this JEIRP.

However, the JISC project did note the irony of recommending the wider use of this table for planning and analysis: distribution of a ready-made resource runs counter to several of the qualities that the table itself endorses; indeed, a pilot study exploring whether the table was helpful to designers demonstrated that they could not simply appropriate the table in its current form (Bostock and Smith, 2004). Consequently, if the table is to be taken up here, it would be prudent for it first to be discussed and modified to suit the purposes of this work.

The impact of technology-enhanced learning in Bulgaria

Bulgaria has made progress in reforming all of its structures and institutions after 1989. Yet the process of reforms needs to speed up in the conditions of preparation of Bulgaria's Accession to the European Union in 2007. One of the key domains determined for reform is the sector of higher education. In accordance with the treaty agreements at the Bologna Process, all EU member states have launched considerable changes in their HE structures by adoption of common models and practices.

The irresistible development and the advent of new knowledge areas, in combination with the competition growth and the global labour market development, poses new challenges to the higher education system. This ought to provide increasingly higher quality of education, adequate to the contemporary demands. The accelerated introduction of new technologies in the education system lies at the foundations of this process. Thus current problems include training in information technologies, on the one hand, and the dissemination of new technology in the teaching/learning process on the other. A challenge like this is one of the milestones in the process of building the European dimension of higher education. In this sense, it is of crucial significance to make an effort and investigate the impact of technology-enhanced learning in the Bulgarian HE system.

A review of the educational system in Bulgaria

Bulgarian state policy in the field of education and science is pursued by the Ministry of Education and Science. The ministry is responsible for, and observes the status of, the system of education and science, elaborates forecasts of its future, launches programmes and determines priorities with a view to the strategy for its development. There are two major legislative acts that regulate the structure, functions, management and financing of the school and higher education systems in the country: These are the Public Education Act for the school system, and the Higher Education Act for the HE system.

School education

In Bulgaria, the school education system has two levels; primary (grades 1 to 8), and secondary (grades 9 to 12), each culminating with a state certificate, namely the certificate for completion of primary education, and the secondary school diploma. Each child can start his/her initial education at age 6 or 7. According to Bulgaria's Constitution, education is compulsory up to the age of 16. The secondary level of education consists of two educational branches; general education, and vocational education. The general secondary education is general comprehensive (non-specialized), or specialised (named officially "profile education"). Vocational education at the secondary level can be obtained in a vocational gymnasium or in a vocational school. The duration of study in secondary vocational schools is 4 years.

Higher education

Higher education is acquired in higher schools (state and private), which are established under legal conditions and procedures, and accredited. According to the Higher Educational law, there are three types of higher schools: universities, specialised higher schools and independent colleges. A university is a higher school providing education in a wide range of specialties from the professional directions in at least three of the four main areas of science: the humanities, natural sciences, social sciences, technical sciences. The specialised higher school provides training in one of the main scientific areas. The independent college offers training and professional qualification in the educational qualification degree "specialist". Bulgaria is among the first countries to adopt the Bologna Process requirement for a three-stage structure Bachelor / Master / Doctor instead of the preceding one-stage structure of higher education in three or four years resulting in the scientific degree of Doctor.

One of the peculiarities of the Bulgarian higher education is the large number of institutions, compared to the country's scale, together with the fact that many of them are rather small in size. For instance, 17 of these institutions train less than 1000 students, and 32 have less than 5000 students. According to the State Registry of higher schools, by February 1, 2005 there were 51 higher education institutions. Only 7 of them provide training for more than 10 000 students. In 2003-2004 there were approximately 228,500 students in Bulgaria.

At the end of 1999 the Ministry of Education and Science adopted a strategy for the development of higher education, focusing on improving the quality of education. The Strategy determines that the primary factor that impacts higher education to be considered is the rapid development of information technologies. Their introduction is a stepping stone for the formation of the Information Society, which provokes the advent of the Learning Society, and hence necessitates fundamental changes in higher education.

The diffusion of modern technical equipment and technologies in higher education

One of the hindrances in the higher education system is the low quality and amortization of utilised equipment and libraries, and insufficient access to scientific information and information networks (Strategy for the development of the Bulgarian higher education, 1999). The reduction of financing for the higher education system in recent years affects the maintenance and renovation of the technical equipment necessary for higher education. At present 91% of the scientific appliances require renovation, and only the computer hardware and software equipment, supplied mainly via international EU programmes, essentially meets the standard but is yet insufficient to provide a quality educational process.

As a result of an investigation carried by IDG Bulgaria, the Ministry of Education and Science and the Council of Rectors (Danchev, 2005), which covered 31 (state and private) universities, that in the 2004/2005 educational year provided training to 145,600 students, it was ascertained that 24 of the higher schools teach disciplines from the field of ICT and that there are 14,500 graduates in technological disciplines. The results indicate that information technologies are the focus of the higher schools' management bodies. 94% of the higher schools have developed or are currently developing strategies for introducing ICT. 71% consider that their infrastructure for utilisation of IT is partially built, and according to 29%, is fully built.

The inquired institutions manage 25,256 personal computers and 252 servers, 49% of the desktop systems are used by the lecturers, and 51% by the students. The contemporary configurations represent 53% of the personal computers available to the lecturers and 59% of these available to students.

65% of the higher schools operate a relatively stable and fast Internet connection (more than 1 Mbps). 87% of the students use computers and Internet for educational goals, but barely 6% of them highly appraise the extent of the introduction of IT in their university, and only 12% consider their university's technological equipment to be up-to-date. One third of the students report improvement in their computer skills, but attribute this to self-preparation.

E-Learning platforms have been established in 68% of the inquired higher schools. There are various applications in use, but the most common case (19%) is represented by the universities that have developed such platforms by themselves.

Most of the higher education institutions have implemented systems for management of the educational process. 84% of the institutions cover information related to specialties and master programmes, the training disciplines and plans, 68% provide the means for storage and processing of data related to students and lecturers. 90% of the investigated institutions have automatised the activities connected to the reception of new students and 74% make use of information systems for personnel information. Almost all higher schools (94%) have automated accounting services, as well as paying salaries, fees and scholarships. Relatively few universities have implemented information systems for document processing management, but several higher schools are currently implementing or plan to implement such a solution. Only 23% of the higher schools have at their disposal integrated information systems, and 39% work on such a project at the moment.

On the whole, the cited investigation indicates that ICT specialties are widespread in the Bulgarian higher school network. The majority of students (70%) in computer specialties maintain that the taught material forms only basic competences and skills, without taking into account contemporary trends in the field of IT. A quarter of the students specify that the taught materials fully correspond to the contemporary trends and 5% determine it to be fully out-of-date. Estimations of the quality and actuality of taught knowledge and skills are relatively higher among the institutions in the capital. In these higher schools the share of students who claim genuine gained knowledge is 35%, which is 10 points higher than the average for IT students (25%).

Enhancing the use of technology in the higher education

State Policy

Many external and internal factors as well as analysis of results of various investigations have imposed the adoption of measures for enhancing the utilisation of contemporary technical equipment and technologies in higher education. The following external factors can be enumerated: the considerable socio-economic changes in Bulgaria after 1989; transition from planned to market economy, which required reforms in all spheres of the social sector, including the educational system; Bulgaria's Treaty for Accession to the European Union; the rapid development of information technologies, which is bringing significant changes to the global economy. At the same time some negative changes have taken place within the higher education system: institutional fragmentation and specialisation, reduction of financing for higher education, low quality and amortisation of the necessary equipment and library fund, insufficient access to scientific information and information networks, lowering the quality of education. These factors and many more have created prerequisites for the Higher education development strategy to outline strategic objectives for surmounting the emerged difficulties:

- Improvement of financial management in the higher education sector;
- Preserving accessibility to higher education in Bulgaria; and
- Improvement of the educational process.

Measures for fulfilment of these objectives are related to raising the quality of teaching by the reform of education plans, reform of the unified state requirements, financing of scientific investigation linked to the training process, betterment of the management information systems, and modernisation of the utilised equipment. This was initiated by a state strategy for development of technology enhanced learning in Bulgaria. Meanwhile, by the end of 2004 the Regulation of the state requirements for the organisation of the higher school distance form of education was put into operation.

Actions performed by higher schools towards the implementation and utilisation of contemporary technical equipment and technologies

Regardless of the differences that determine the branch specialisation of the higher education institutions (economic, medical, technical, etc.) all of them prioritise the introduction of contemporary technical equipment and technologies in the process of education and management (reflected in their management policies). All of them direct efforts towards improvement of their educational plans and programmes on the basis of increasingly fuller utilisation of contemporary technical equipment and technologies; and take measures for raising their pedagogical, administrative and management staff's qualification in utilisation of new technologies. The higher schools are gradually moving to introduce distance education on various subjects, strive to improve the access to and the quality of internet services, to develop intranet-system, to implement automatised systems for library and information services, etc.

Instruments for realising the utilisation of technology

Legislation

The legislative documents, aimed at reforming the higher education and raising the quality of education, including the stimulation of technical and technological equipment in higher schools, are the:

- Higher Education Act;
- Bulgarian Higher Education Development Strategy;
- Regulation of the proceedings of the National Agency for Rating and Accreditation in its capacity of specialised state organ for assessment, accreditation and quality control in the sphere of higher education;
- Regulation of the application of a system for credit accumulation and transfer within the higher schools;
- Regulation of the state requirements for the organisation of the higher school distance form of education.

Realisation of Project "Modernisation of education"

The realisation of the general strategic objectives, formulated in the Higher Education Development Strategy, is laid in the Project "Modernisation of education", subject of loan agreement from 2000 between the Republic of Bulgaria and the International Bank for Reconstruction and Development. In the frames of this project the centre "Competitive system for training and management of higher education" has been established.

The Centre's ultimate goal is assisting the Ministry of Education and Science and the state higher schools in their efforts to reform and harmonise Bulgarian higher education with the EU in two general directions: (1) performing self-assessment and improving the quality of education in Bulgarian higher schools, and (2) elaboration of strategies for development and raising the management effectiveness in higher schools.

For the sake of raising the quality of education in higher schools, there was envisaged:

- The establishment of internal systems for quality assurance in higher schools;
- The improvement and modernisation of the training plans and programmes;
- The improvement of the educational methods by utilisation of contemporary technical equipment and technologies;
- Strengthening students' practical training;
- Raising the lecturers' qualification; and
- Improvement of equipment, etc.

The stated objectives are fulfilled by the financing and implementation of projects submitted by the higher schools themselves. Two open calls were organised and approved. During the first call 183 project proposals were submitted, 34 of which were funded. During the second call 97 project proposals were submitted, 47 of which were funded.

The positive impact of the project implementation can be illustrated by the following figures:

- 12 university systems were established for quality provision and assurance, 6 of which obtained certificates for ISO 9001. At the same time 22 higher schools set up other specific systems and sub-systems;
- 550 education plans and programmes in 19 higher schools were improved;
- Training methodologies in 24 higher schools were improved by the introduction of contemporary technical equipment and technologies through 40 projects;
- Projects were developed for strengthening the students' practical training in 7 higher education institutions;
- Lecturers' qualifications were raised by means of more than 75 disciplines and about 50 training courses, seminars, etc.;
- Necessary equipment was enhanced by the establishment and modernisation of 115 centres, laboratories and studies in 19 higher schools and provision of more than 70 new pieces of training material;
- Management units were established for quality assessment and assurance in 12 higher education institutions;
- 6 virtual societies were founded between 28 higher schools for the purpose of training in various subjects and perfection of the System for quality assurance; as well as 2

alliances between 12 higher schools gathered to enable joint provision of library and information services;

- 1 regional, 6 university and 1 faculty management information systems were set up.

Start of the national programme "i-Bulgaria"

In order to overcome the considerable lag in the ICT field, in May 2004 the national initiative "i-Bulgaria" was started. Its aim is to accelerate in Bulgaria the process of reaching the average indices of Information Society Development in the EU. The work within the frame of this programme is concentrated on five significant projects, three of which are crucial for the Bulgarian education and science and the implementation in which the Bulgarian government (the Ministry of Transport and Communications and the Ministry of Education and Science, in particular) have already invested considerable resources:

- "i-Class" – a project for the computerisation of Bulgarian schools;

- "i-University" – a project for building computer laboratories and websites for e-learning in the state universities;

- "i-NET" – a project to establish the information highway between the Bulgarian universities and scientific institutes, as well as make connections with European research networks.

The national project for the creation of a Virtual Education area, an implementation in which almost all state universities and institutes from the Bulgarian Academy of Sciences take part, is a natural and logical continuation of the "i-Bulgaria" initiative.

The project's ultimate enterprise is to create premises and introduce innovative educational technologies, e-learning in particular, in the higher education system. The project comprises 6 main stages: a pilot virtual department of computing "John Atanasoff", virtual faculty of ICT, network of virtual libraries, Bulgarian Virtual University, Regional virtual universities, Network of virtual libraries, and Integration of the Bulgarian educational space in the European and the World education space. The project officially started at the end of 2002, when the virtual department of computing "John Atanasoff" was established as an alliance of 11 universities and 4 institutes of the Bulgarian Academy of Sciences. As a result of the project more than 50 computer laboratories for e-learning have been equipped. The project participants raised the speed of their Internet connection to 2 Mbps. The academic society has gained access to the pan-European research network GEANT. The Virtual Faculty was established during the next year 2003, and in December 2004 the agreement for foundation of the Bulgarian Virtual University has been signed by the rectors of 37 Bulgarian universities and the Directors of 26 Scientific Institutes of the Bulgarian Academy of Science.

Participation of higher education schools in educational and RTD projects, funded by the European Union and other donating organisations.

Higher education schools do participate in a number of educational and RTD projects, funded by the European Commission (the EC programmes FP5, FP6, TEMPUS, COST, eTen, Socrates Minerva, Erasmus) and by other donating organisations (The World Bank, NATO, UNESCO, etc). The financial resources, technical support and know-how obtained through such programmes are of great importance for the supply of new technologies, the improvement of academic research and teaching competencies, enhanced by technology and thus for the improvement of the quality of education. At present a National strategy for scientific research is in the process of development.

Conclusions

In conclusion, it is noteworthy that Bulgarian higher education institutions have a noticeable drive to accelerate the introduction and active deployment of contemporary technical equipment and technologies. The role of e-learning is becoming increasingly important, though it shall not be seen as an alternative to traditional approaches. The presumption is that, on the basis of more effective usage of new techniques and technologies, high quality education will be provided to highly competent students who are adaptive to the requirements of the information society and share the common European socio-cultural values.

The impact of technology-enhanced learning in Norway

In this section, we first describe the Norwegian education system with an emphasis on higher education, determine policies and strategies on the use of information and communication technology (ICT) in education from the view of relevant policy-making agencies, try to identify interesting cases of actual use of ICT in higher education, and review the field for available literature on comparable research

An elemental overview of the educational system in Norway

"Forsknings- og utdanningsdepartementet" (FUD), or The Ministry of Education and Research, is the highest public administrative agency of education in Norway, and thus responsible for implementing national educational policies. Below we give a brief overview of how the educational system was organised as of January, 2005.

Compulsory education in Norway starts at the age of six, lasts for ten years and consists of three levels: Lower primary (grades 1-4), Upper primary (5-7) and Lower secondary (8-10). Upper secondary has been a statutory right for everyone between 16 and 19 years of age from 1994. It covers courses that qualify students for higher education, vocational qualifications or partial qualifications.

Higher education is organised in universities or state university colleges, and entrance is gained on the basis of upper secondary education. Higher education is, with a few exceptions, a state-controlled matter, and currently about 210,000 students are enrolled.

Higher Education

There are six universities in Norway. They were founded in Oslo (1811), Bergen (1946), Trondheim (1968), Tromsø (1972), Ås (2005) and Stavanger (2005). There are five specialised university institutions, as well as two national institutes of the Arts. (80,000 students).

Furthermore there are 25 state university colleges (100,000 students), and 33 private university colleges (30,000 students). The state administers all institutions of higher education, except for the private university colleges, although the state supports some of these financially.

Institutions in higher education are engaged in both teaching and research. However, research is a more common activity in the universities and specialised university institutions. Nevertheless, the university colleges have played an important role in providing higher education to the public, also in rural areas. Courses taught at the state university colleges are more practice-oriented, and the length of study shorter (2-5 years) than in the universities. The disciplines taught in the state university colleges are typically more vocationally oriented. It is quite common for students to combine degrees from different institutions with university degrees. Even though teaching is the main objective, the state university colleges are involved in research and development, and four of the state university colleges have doctoral programmes.

In 2003, a three year period of introducing the "Quality reform" (Kvalitetsreformen) was concluded. The reform was aimed at higher education and three main intentions have been identified; higher quality in education and research, more intensive education and a higher degree of internationalisation. These aspects are reported to be highly influenced by the key goals of the Bologna process. The current policy is to await the effects of this comprehensive reform before new measures will be considered.

Besides the Bologna process driven forward by the Council of Europe, the Nordic countries have a long tradition for cooperation in the area of higher education. The latest agreement is the Reykjavik declaration of 2004, a 'Nordic Declaration on the Recognition of Qualifications Concerning Higher Education', which states the mutual recognition of the Nordic education systems. The Nordic cooperation in higher education is so far largely unaffected by the more recent initiatives for internationalisation in higher education such as the Bologna process, although there is a threat that it may become less relevant (Maassen and Uppstrøm, 2004). The Nordic cooperation has an intrinsic nature, and is based on a somewhat different rationale than for example the Bologna process, such as geographical closeness and cultural and political commonalities (ibid).

Who teaches in higher education?

Table 2 shows the number of employees in the different types of institutions involved in higher education in Norway, private state university colleges excluded.

Type of Institution	**Number of staff**
University	16,899
State university college	9,700
Specialised university college	2,089
Total	***28,688***

Table 2: Total number of staff in Higher Education in Norway, 2004.

Generally, staff in higher education are divided between administrative and academic positions, the latter being responsible for teaching students. In the universities there are in principle three different categories of academic positions; professor (professor), amanuensis (associate professor), universitetslektor (assistant professor). Almost all of the teaching staff in the universities are involved in research, and the academic positions are supposed to differ with respect to the extent of time available for research (Vabø and Aamodt, 2005). The idea is that the higher the position, the higher the amount of time available to spend on research. However, there are more significant differences to be found when distinguishing teaching from tutoring. As a whole, academic staff in institutions of higher education in Norway spend approximately 30% of their time on research, 30% on administration and similar activity, and 40% on teaching and tutoring (Smedby, 2001). Distinguishing between the positions, the professors spend less time on teaching and more on tutoring and administration than the amanuenses. The amanuenses spend more time on teaching, and less on tutoring and administration. The figures have been largely stable since 1981, with a slight increase in the time spent on tutoring at the universities (ibid.) There are notable differences between professors and amanuenses in reporting how good the general opportunities for research are, where the professors report a far better opportunity for research.

There are indications that the distinction between research and teaching with regards to the staff positions is increasing. The background to this is that the amount of students in Norwegian universities has increased tenfold since the 1950's, described as a shift "from elite education to mass education". This has necessitated more teaching resources (Vabø and Aamodt, 2005). Secondly, the demands from the "Quality reform" of a closer follow-up of students as a method of ensuring the quality of education, has led to an increase in the hiring of "universitetslektor", or associate professor, at the universities (ibid).

It is difficult, if not impossible to give an exact answer as to who teaches in higher education. From an historic perspective the organisation of roles seems to have emerged, and been locally adapted, to meet changing demands. On the individual level, practitioners report extensive autonomy (Toska and Arneberg, 2003). Hence the current status may seem mainly under the influence of inertia. However, policy makers have launched several initiatives to structure and formalise such matters, mainly through the aforementioned Bologna process and the "Quality reform". For the remainder of the text, we shall put emphasis on teachers and instructors at the four main university institutions.

Formal pedagogical requirements for teachers at the universities

Until about 10 years ago, no formal pedagogical training was required for academic staff at the universities. However, from 1989 onwards a basic course in university-pedagogics was mandatory for academic staff at UiO, and new members of staff needed to complete the course within two years of the date of employment. Starting from 1996, a new and more comprehensive course model for teaching according to university pedagogics was introduced, including a module on the use of ICT in teaching, and all academic staff needed to complete the common part of this. A similar development can be found at UiB. From 1990 and onwards there has been a basic course for new members of the academic staff at UiB. Since 1995 this has been mandatory for academic staff without basic pedagogic training.

Initiatives for increased use of ICT in education

From a governmental perspective, there is a certain belief in, and clear demands for the use of ICT in teaching in higher education. The Parliamentary report nr. 27 (2000-2001), by Department for Church, Research and Educational affairs (now FUD), which is the basis for the "Quality reform", states that:

> ICT are instruments that support learning. International research documents that use of ICT in education leads to new forms of learning and evaluation, new forms of organisation and cooperation, and new roles for students and teachers. The use of ICT also has positive effects on quality development of learning environments. Research indicates that ICT increases student motivation and concentration on learning, which in turn affect achievements. A well considered use of the new technologies has become a prerequisite for the institutions of higher educations' ability to create relevant, updated and flexible learning environments. (Parliamentary report nr. 27 (2000-2001), p. 17, our translation.)

Furthermore, the Document for the Strategic Plans of Action for the area of ICT and Learning from 2003-2005, FUD makes explicit the need for including ICT in all levels of education, and major strategic goals points out that "[...] ICT technology will shape new forms of learning, and the role of teachers will change accordingly". Below we describe some implications of the strategy, specifically how teachers are prepared for this proposed change.

Compulsory education

LærerIKT is a state-initiated, continuous and complementary education programme for teachers in compulsory and upper secondary education. LærerIKT was initiated by FUD in August 2002, and the content has been developed by several state university colleges, led by "Høgskolen i Agder", or Agder State University College. FUD granted approximately 100 million NOK to the development of the project, and 18,000 teachers are reported to have completed the course. The aim is to build teacher competence in educational use of ICT, as well as raising the general level of computer literacy.

Higher Education

There are no equivalent national initiatives for teachers in higher education. However, by looking at four major universities (UiO, UiB, NTNU, UiT), we find that making use of ICT in education is often covered in the institutions' strategic plans.

The Strategic Plan Document for 2003 – 2007 for UiO, states that moving towards a more ICT-based education has a clear foundation in the "Quality reform". Visions and goals covered in the plan states that UiO will integrate ICT in the teaching, and that the university will support development of staff competence and motivation in using ICT in their teaching.

UiB mentions in Section 9 of the strategic plan document for ICT (2003-2007) that the main goal is "[...] that the users have the required skills/knowledge/competence to make good use of such (ICT based) systems". Each faculty was obliged to work out plans of action to implement this strategy. One such example can be found at the Faculty of Law; stating that they do "[...] not plan any mandatory courses in ICT, but will offer support, ad-hoc training, and potentially courses offered by external institutions."

NTNU, by "Utvalg for IKT og læring", or the Committee for ICT and Learning, proposed plans to give courses to academic staff in using the Learning Management System (LMS). Two courses were planned, an introductory course, and an extended course. The introductory course was to take the form of a presentation lecture with grounding in actual use cases, accompanied by an "instruction manual", and the extended course was to focus on useful tips and hints. The courses were to last two hours each, and take place when the instructors planned their teaching activities for the coming semester. The Board also suggested establishing a FAQ for use of the LMS, administered by two persons, one with technical skills and one with pedagogical skills.

The Section 5 of the strategic plan document for the University of Tromsø (UiT) towards 2001 states that ICT will play a central role in the development of the courses offered at the university.

The quality reform and virtual learning environments

The "Quality reform" may to a large degree imply an introduction of a digital learning environment at the institutions of higher education. In working with adapting to the "Quality reform", the Student Section of the Human Resource Department (Organisasjonsavdelingen) at NTNU concludes that:

> Demands from the "Quality Reform" about student-centred methods of instruction, communication and co-operation, continuing evaluation and frequent feedback to the individual student during the entire learning cycle, can hardly be fulfilled with reasonable use of resources without an ICT-tool. Learning Management Systems (LMS) is such a tool. In addition to being a tool for instruction and learning, it is also a tool for administering the instruction. Another important aspect of LMS is that they are Internet-based, and thus represent a border-less infrastructure.
> (http://www.ntnu.no/kvalitetsreformen/dokumenter/org.av_internopplr._og_sttteapparat_for_ikt_i_lring.doc)

The Strategic Plan Document for 2003 – 2007 for UiO, states goals that commit the institution to integrate ICT as a tool and pedagogical support in educational offerings, and to develop competence and motivation of faculty and staff to explore and exploit ICT in teaching (Lanestedt, 2004).

Governmental demands on the use of ICT for teachers in higher education are present. (Dysthe and Engelsen, 2003) It seems that it would be fair to conclude that although there are no concrete state initiatives for the introduction of the use of ICT in teaching in higher education, aside from statements of policies that express will to include it, the university institutions still find it necessary to plan the transition towards more ICT-based teaching environments.

Introducing the Faculty of Law, UiB, as an interesting case for empirical work

The faculty of law at the University of Bergen has made fundamental changes in the structure of education. These have in many respects been in compliance with the "Quality reform", and hence in line with goals of the Bologna process. In 2004, the Faculty of Law received a prize from NOKUT, marking them as an example of 'best quality of education', through carrying out a "deep and thorough process of change compared to earlier practice", by executing their project "New Plans for Study at the Faculty of Law: From Reading to Learning". A central issue was " [...] using ICT as a mediator to move away from the traditional 'individual learning through memorising' to 'learning by problem solving in groups'". The Faculty has made efforts to structure the students activities, a process guided by 'Problem based learning', mandatory group activities, and by using ICT as a central tool.

An interesting point noted by the NOKUT prize jury, is that the reform marked a distinct break from the tradition, rather than adding incremental supplements to the existing *modus operandi.* Even though no details about earlier practices are offered by NOKUT, several studies have documented a history of a highly competitive and individually oriented culture (Lian, 2003; Nygård and Jensen, 2000; Wilhelmsen, 1991, 2003), and similar findings have been reported in the press. Salomon's (1995) concept of genuine interdependence as a necessary prerequisite for successful collaborative distance learning can be said to be contradictory to terms met by students in this culture. On the role of the instructors, Lian (2003) points out that they were, from the planning side, requested to ask questions and promote student discussion and activity, as opposed to “going through a manuscript”, or pouring from their “basin of knowledge”, as have been the case earlier.

A second point is that the literature study on teacher's use of ICT in higher education in Norway reveals the characteristic of the “early adaptor” or “technophile” (Wolcott, 1981, cited in Cuban 1986) in many of the studies of teachers that use ICT in education so far (Eide, 2001; Stensaker et. al., 2002; Hansson, Ludvigsen, Säljö and Jalling, 2001). Many of the initiatives to include ICT as a tool for instruction are a result of personal interest, rather than institutional enterprise. The reform made by the Faculty of Law represents a different approach to and initiative for the use of ICT in instruction, thus making it an interesting case for the study of teacher's use of ICT in instruction from a different perspective.

Therefore, when the Faculty of Law has 'revolutionised' its education with ICT as an important instrument, and even won a prize for being in the leading edge there is no question that they have introduced noticeable changes. Thus making it a potentially interesting case for digging deeper in the way that ICT has been used in teaching.

Related literature and empirical work

The following section on related studies contains a short summary of a survey of comparable empirical work, relating to the field of the roles and practices of the teachers in higher education, and the introduction of ICT in the teaching environments. The Impact project investigates the impact of introducing new forms of technology on the roles and practices of teaching in higher education, so the centre of interest in surveying the literature is teaching in higher education, the introduction of new technology in the learning environments, and on transformations in roles and practices of the teachers, related to a Norwegian, or Nordic context.

Initially, a general note on the field in question is made. When surveying the area of studies concerning the impacts of introducing technology to teaching and learning in higher education in Norway and the Nordic countries, it can be found that the studies centred around the effects that concern students outnumber the studies that concern effects and impacts of introducing technology to teaching for teachers and instructors. It seems that many of the studies either focus on students exclusively, or focus on students primarily and teachers secondarily. Similarly, the number of studies on teachers in compulsory education outnumber the studies of teachers in higher education. Thus, disregarding all work that doesn't concentrate exclusively on teachers in higher education would leave this section on related work and literature very short. Instead, an inclusive strategy is chosen, with the goal of giving a broad overview of the field in question, without giving detailed accounts of all surveyed literature.

As a part of her doctoral dissertation, Jedeskog (2001) analysed the relationship between computer and the role of the teacher as described in international research. The background for this, is her study of the use of computers in the Swedish compulsory school system from the mid -1980's to 2000, where she points out the difference in understanding between the computer programmers and technologists that deliver educational technology and often are agents for introducing technology to the area of education, and the teachers that use the technology. A central goal for the thesis is to bridge this gap, and the perspective taken is that of the policy agents for introducing computers into education, whether they be national agencies of education, providers of educational software or what she calls “pioneer teachers”. She views the classroom or the educational arena as a micro-setting, consisting of various actors with different roles, mainly the teachers, students and computers.

Hansson et al. (2000) have studied 91 projects on learning and teaching in higher education funded by “Högskolans Grundutbildningsråd” (National council for higher education) in Sweden from 1991 to 1999. The goal of “Högskolans Grundutbildningsråd”, founded in 1990, is to advance the development of higher education in Sweden by funding projects that are developmental and experimental in nature, and to gain and spread knowledge about institutions involved in the development of education in Sweden and abroad. In all the projects studied by Hansson et al., ICT was a central tool, and they were described regarding issues such as pedagogical ideas behind the use of ICT, nature of the ICT and its use, and how the projects were evaluated. One finding was that until 1996, most of the experiments were centred around developing CDs with pedagogical content, or developing content for distance learning. After 1996, most of the projects were Internet-based. A second interesting finding was that the projects were divided along an axis of a small group of teachers, or single teachers with a strong interest in pedagogical development, and personally created material on one hand, and projects with an cross-scientific nature, and a clearly identified need for development of ICT tools on the other hand. The projects driven by a small group of teachers, or a single teacher, were the most common of the projects evaluated (ibid.).

A study of a project driven by a small group of teachers with a special interest in pedagogical development, has been performed by Wake (2001), who has, in his Masters dissertation, described a collaborative telelearning scenario from the perspective of an instructor or teacher, using an Activity Theoretical approach, within the context of Computer Supported Collaborative Work. The activity described was a collaborative effort between the teaching institutions of UiB, Stord and Haugesund State District College, and Nord Trøndelag District College, and was funded by ITU, a Norwegian counterpart to Högskolans Grundutbildningsråd in Sweden. The technology used in the telelearning scenario was TeamWave Workplace.

Tangaard (2003) investigates in his Masters dissertation differences in the teacher-student relation between face-to-face interaction versus a distributed learning setting for medical students using the distributed learning system ClassFronter. One of four research questions in this thesis, is how the role of the teacher is managed in the distributed meeting when compared to the face-to-face meeting. The thesis is based on a case study of a course for 61 medical students at UiO, divided in groups of 8, during their period of experience-gaining in a practical context. The tool they used was ClassFronter. The study focused on one group, and one of the central findings was that the instructor became more of a coordinator and initiative-taker in the distributed setting.

One institution within higher education in Norway that is relevant to mention within this context is Norgesuniversitetet (NU). NU is a public body under FUD, and has the goal of stimulating the development of flexible and life-long learning in higher education. It merged with the Central Organ for Flexible Learning in Higher Education (SOFF) in January 2004, which was a similar institution with the goal of developing different forms of distance education and flexible learning based on pedagogical use of ICT. The name taken after the merge was Norgesuniversitetet, and it is lead by parties in industry, private and public institutes of higher education, and the student organisations. The goal of NU is to stimulate the development of flexible and life-long learning in higher education, in addition to strengthening the ties between industry and higher education.

Norgesuniversitetet frequently publish reports within the themes of ICT and education. A report by Eide (2001), comments on issues related to staff development on the basis of the increased demand for the use of ICT in higher education in Norway. She points out that many of the initiatives in the use of ICT for pedagogical purposes in higher education has been taken as a result of personal involvement and interest, and that an increase in the call for the use of ICT for purposes of education necessitates a different form of driving force behind the activity, an institutional one, which in turn necessitates organised staff development. She also points to the multidisciplinarity of this field, and distinguishes different roles associated with this field of study. The roles in isolation are teachers, technical, pedagogical, administrative and leadership personnel.

Norwegian Institute for studies on Research and Education (NIFU) and Centre for studies of Innovation (STEP) merged in May 2004, and took the new name NIFU STEP. NIFU STEP carries out contract research for institutions such as the European Union, FUD, Department for Trade and Industry and the Norwegian Council for Research. Typically they publish research on general themes relevant for higher education. The report "Use of ICT in Higher Education" (2001) is based on a European study of the introduction of ICT in higher education internationally. The empirical data gathering techniques were initial electronic questionnaires sent out to all institutions of higher education in Norway and Netherlands, and a selection of institutions in other countries, and thereafter case studies at selected Norwegian institutions. The perspective of the study is that of introducing technology to instruction in higher education as an institution-strategic process. The quantitative part of the study indicates that ICT is being used as an indirect aid in teaching and learning (Stensaker, Maassen, Oftebro and Borgan, 2002), while direct use is, on the whole, less common.

Finally, there is the PLUTO programme, organised by ITU. ITU was founded in 1997 by UiO, on behalf of The Ministry of Education and Research, to establish a national research and competence-network on the use of ICT in education. The PLUTO programme, lasting from 2000 to 2003 and consisting of 10 projects in 8 institutions, is anchored in FUD's plan for ICT in Norwegian Education 2000 – 2003, and is aimed towards students in higher education, although towards students who are to become teachers at a later point. Pedagogical, technological and organisational development of teacher education by using ICT is central in the programme.

Many of the findings in the PLUTO programme have been reported in the book Portfolio Assessment as a Pedagogical Tool by Dysthe and Engelsen (2003), and all the projects have submitted final reports. Many of the projects introduced electronic portfolio assessment as a central activity, and this greatly influences the reported findings and results. The reports are also student-centered. However, the point made by the "Quality reform" is the necessity for closer follow-up of students by teachers, and that the use of Learning Management Systems fortifies these circumstances (ibid).

Conclusively, there seems to be a trend that when describing teachers using computer technology for pedagogical purposes in higher education, the notion of the pioneer is often used. This may be a result of the fact that many of the studies conducted have been based on cased studies of small projects, where a single or small group of instructors have carried out a small project of experimental nature, on the basis of personal interest of the teacher, thus making the unit of analysis a small group of students and the single teacher situated in a teaching activity.

Assessing the Impact of Technology on Higher Education in the Netherlands

Under the intriguing title "Fool's gold" (Cordes and Miller, 2000), the Alliance for Childhood published a report in which they express their deep concerns that computers are reshaping young children's lives in profound and unexpected ways. Some potentially beneficial, others potentially harmful. The report further quotes Professor Turkle from MIT as asking, "are we using computer technology not because it teaches best but because we have lost the political will to fund education adequately?"

This review of technology enhanced learning in Higher Education in the Netherlands will, of course, not examine young children's learning, nor discuss the view that education is inadequately funded. Rather, it will consider the general warning of the report, which is that technology needs to be attuned to the audience it supposedly serves. Technology is not a panacea; it can have positive and negative effects. Also, the notion that any conclusions about the impact of technology should be based on evidence from soundly designed scientific studies will be considered. Neither issue is self-evident.

Studies on the impact of technology on education tend to emphasize its positive aspects and understate its negative aspects. In an interesting, ethnographic study Hara and Kling (2000) revealed that students in a distance education course repeatedly experienced periodic distress (such as frustration, anxiety and confusion). They further note that many studies of students who have experienced new technologies in higher education gloss over these negative aspects. Indeed, they found the issue so critical that their research question of "How people work with their innovations in practice" contained the caveat "without censoring that which is problematic."

There is no dearth of scientific research that reveals that the impact of technology often yields "no significance difference." For example, Phipps and Merisotis (1999) open their review on the impact of technology in Higher Education by stating that "With few exceptions, the bulk of these writings suggest that the learning outcomes of students using technology at a distance are similar to the learning outcomes of students who participate in conventional classroom instruction" (pp. 1).

When Phipps and Merisotis (1999) examined these studies more closely, however, they concluded that one has to take an even more cautious view. More specifically, they argued that "there is a relative paucity of true, original research dedicated to explaining or predicting phenomena related to distance learning" (pp. 2). Worse yet, the studies that exist are often "questionable", rendering many of the findings "inconclusive." Key shortcomings, from a quantitative perspective, are that:

- Much of the research does not control for extraneous variables and therefore cannot show cause and effect
- Most of the studies do not use randomly selected subjects
- The validity and reliability of the instruments used to measure student outcomes and attitudes are questionable

- Many studies do not adequately control for the feelings and attitudes of the students and faculty- what the educational research refers to as reactive effects

However, these arguments from Phipps and Merisotis (1999) reflect a natural science approach to research. It may make more sense to adopt a different paradigm, such as an engineering approach to assessing technology-stimulated changes. But before discussing these matters, the main research questions for this section will be discussed.

Main areas addressed in the review

An overview of technology use in Higher Education in the Netherlands

Several discussions on technology use in Higher Education in the Netherlands have been published very recently. These studies indicate that the large majority of institutes have realized the necessary infrastructure and have moved beyond the phase of exploration of the possibilities of technology. This puts them in a good position to put technology to use as part of their endeavour to optimize teaching and learning. The kinds of innovations that Dutch institutes aim for tend to be quite similar, namely: increasing flexibility, student-centred/problem-based education and competence-oriented education (Van der Veen, and Van der Wende, 2005).

Factors that influence technology stimulated impact on educational change

In addressing this question, several descriptive models will be advanced. Each offers some unique insights from which a systematic appraisal can benefit. Curriculum development in general, and hence also technology stimulated change, typically advances in various phases or stages. Two models depicting these are described. The model of Collis and Moonen (2001) looks at change from an institutional perspective. The model of Van der Veen and Van der Wende (2005) presents an instructional perspective. Among others, these models indicate that assessments need to be attuned to the development stage of the innovation.

Successful implementation always hinges on a dynamic interplay of various factors. The main actors, factors and the ways in which these interact can be examined with models from system dynamics, activity theory and total quality management, among others. The model of Van Tartwijk, Driessen, Hoeberigs, Kösters, Ritzen, Stokking, and Van der Vleuten (2003) will be presented in some detail to discuss this matter.

Assessing technology stimulated impact on educational change

In evaluating the impact of technology stimulated changes in education we are facing two major challenges. One major challenge lies in handling the problem of 'factorial explosion'. Institutes for Higher Education are complex organizations with many actors and factors that (can) all affect each other. When seen from the perspective of evaluation, this problem is further aggravated by the fact that instructors generally have considerable freedom in how they organize their teaching. This calls for robust mechanisms for making things work in a variety of contexts.

Another major challenge comes from the need to 'shoot at a moving target'. Teaching and learning in Higher Education is definitely in a "state of flux" (see the introduction to this report). Because many things (can) change from one moment to another, an objective assessment of the impact can be methodologically complex as well as practically meaningless. If relaxing norms of research methods is not an option, how can we advance our insights and produce reliable findings?

Within education there are three main research traditions: humanities, science and engineering. The latter approach seems most suitable for examining technology-stimulated change in Higher Education in the Netherlands. Within this approach, design research is most suitable for assessing impact (e.g., Barab, and Squire, 2004; Collins, Joseph, and Bielaczyc, 2004)

A focus for the next phase of research

The views presented in addressing the second and third research question of this review will be used to conduct in-depth analyses of three specific cases during the second phase of the project. Each case represents a special type of technology use in education, which has progressed into a stage of development that affords stable usage by participants, and has been described in various documents (reports, articles and the like). The three cases are: (a) Teletop – which is a course management system, (b) ZAPs – which are simulations about psychological phenomena such as the Ponzo illusion, classic conditioning, Stroop effect and the like, and (c) Digital portfolios – which are systems for creating, storing, and presenting students' products with commentaries and testimonials.

Technology in Higher Education in the Netherlands

Descriptions of technology and its impact on teaching and learning in Dutch Institutes for Higher Education have been presented in three recent publications (Collis, and Van der Wende, 2002; Mirande, Van der Veen, and Van der Wende, 2005; Van der Wende, and Van der Ven, 2003). What these publications share is that they offer recent and original insights in practices and research. The main findings from the publications will be summarised to sketch a general state of affairs.

The studies reported by Collis, and Van der Wende (2002) and Van der Wende, and Van der Ven, 2003) set out to discover major trends in technology use and the factors that contribute to these trends. The common basis of the two reports is an international survey on current and future usage in Higher Education. Data were gathered through web-based questionnaires distributed in seven countries (i.e., Netherlands, Germany, Norway, the United Kingdom, Australia, Finland and the USA). Informants were decision-makers, support staff and instructors from the involved Institutes. In total 693 persons responded to the questionnaire. These people represented between 20 to 50 percent of the institutions in the various countries, with the exception of the USA where the response was much lower. The large majority of reactions came from instructors. The main findings of the study will be discussed under the heading of 'Survey study'.

The publication of Mirande et al. (2005) contains individual accounts of key people from institutes for Higher Education involved in an educational innovation in their school. The contributions differ widely in research questions, theoretical foundation, data gathering methods and level of descriptive detail. Some of the contributions have been classified on the organisational level involved. Thus, a distinction is made between innovations that aim for a change of the whole institute and changes that take place in faculties or parts of an institute. The other contributions describe 'facets of transformation'. They present examples of 'good practices' or technology-stimulated changes that are relevant for all institutes. I will discuss the main findings from this book under the heading of 'Trend study'.

Survey study

There are about 80 Institutes for Higher Education in the Netherlands. These comprise 13 universities with a few university-related institutes, an Open University, and 60 institutes for higher professional education plus some related institutes. A total of 57 persons representing 26 different institutes responded to the questionnaire. In general the differences between countries were found to be minimal. Generally, the situation for Dutch institutes was quite comparable to those of institutions in other countries. In reporting the findings, the general picture that emerged will be sketched first, before ending with a short characterisation of some specific findings for the Dutch context.

The study inquires after five clusters of variables: (1) Environmental conditions and settings, (2) Policy, (3) Implementation, (4) Practice and (5) Experiences and Effects. Each cluster is assumed to be affected by its predecessor. The cluster of Experiences and Effects is assumed to affect current and future scenarios of technology use in an institute.

Environmental conditions and settings form a broad set of variables including the "mission and profile" of the institute, its leadership and some student and teacher characteristics. Key questions representing these variables are, "To what extent does teaching 18-24 year old students involve the use of ICT in your institution?" "How much is the internal ICT-related policy of your institution influenced by (policies of) the national ministry of education?", "To what extent does internally funded research involve the use of ICT in your institution?" and "To what extent will your institution's ICT-related policy be affected by student demands for more flexibility in times of learning events in the year 2005?" The cluster is considered to be the baseline upon which decisions about technology-stimulated teaching and learning will be taken.

Policy includes variables that include the plan or course of action of an institute with regard to (increasing) efficiency of operations, quality or teaching and learning, flexibility, cost-related payoffs, and access opportunities. Key questions representing these variables are, "To what extent will enhancing flexibility be a major objective in ICT-related policy in your institution in the year 2005?" and "To what extent is enhancing cost-effectiveness an objective of ICT-related policy in your institution?" Policy is treated as the result of the environmental conditions in an institution.

Implementation relates to the provisions made available in the institution to support instructors and students in their use of technology. Key questions representing these variables are, "To what extent is ICT use in education part of your institution's personnel policy?" and "To what extent does your institution cooperate with foreign for-profit partners with respect to ICT-related activities?" Implementation is seen as affected by the environmental conditions of the institution, and the policies that reflect those conditions.

Practice refers to actual technology use and instructional or pedagogical approach. The three aforementioned clusters form important preconditions but they do not constitute sufficient conditions for technology use in practice. Key questions representing these variables are, "To what extent is studying via a Web-based environment common in your institution?" and "To what extent is ICT being used in your institution to support communication between instructors and students?"

A variety of different types of *Experiences and Effects* can be involved, such as perceived importance of technology use on the institute's strategic goals and perceived effect on working practices. A key question representing these variables is, “To what extent is the use of ICT important for the quality of education programs and services in your institution?” These experiences and (perceived) effects are expected to impact on the eventual commitment to a delivery scenario.

The authors propose a two dimensional model for describing the kind of technology related usage. The first dimension in this model concerns the location and form of the interactions that take place. The second dimension refers to the issue of who is in control. In considering both ends of each dimension, this yields a two-by-two matrix with four scenarios (see Figure 2).

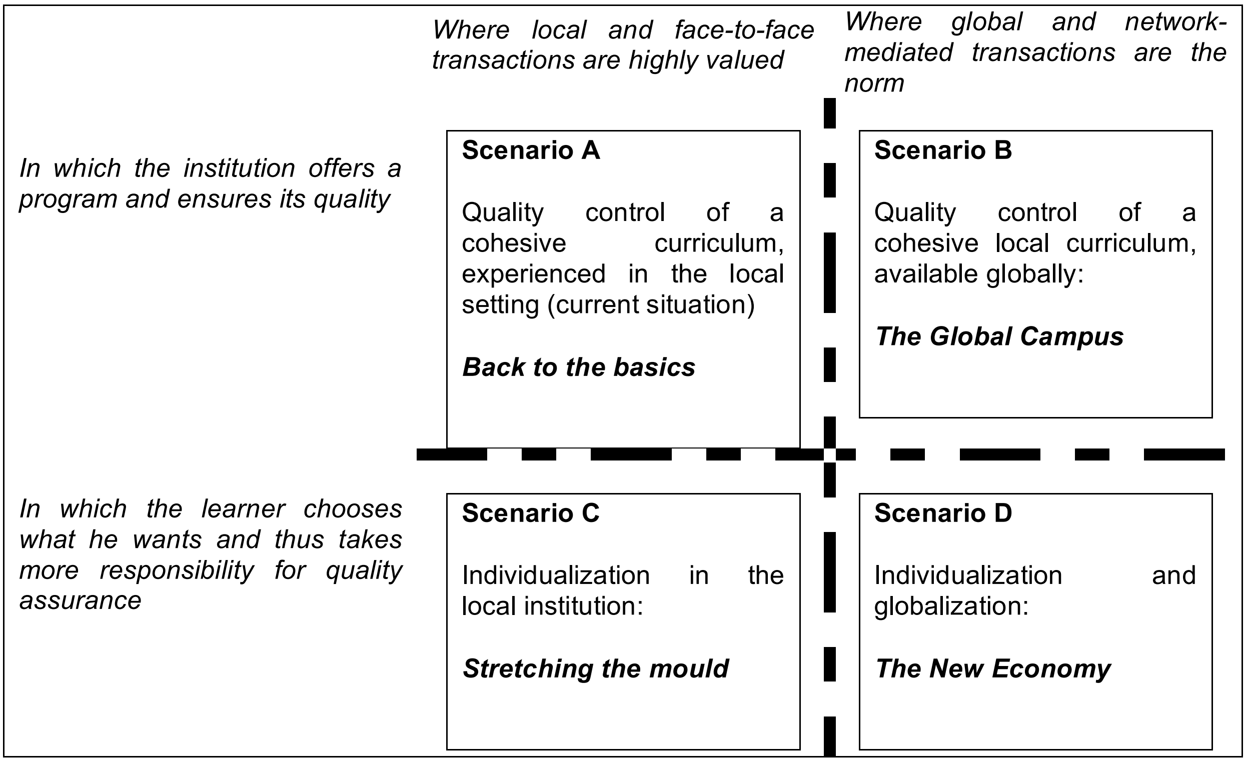

Figure 2: Four scenarios of use

The four scenarios can represent the current state as well as the future of an institute. These scenarios then formed the dependent variables in the study and it was examined how well the five clusters of variables predicted these of an institute. In doing so, factor analyses reduced the number of variables in the model and regression analyses followed these to see which combinations of factors formed the strongest predictors. The results can be summarized as follows.

The model predicts each scenario fairly well. All outcomes were statistically significant ($p < 0.001$) with values of R^2 ranging between 0.54 and 0.29. The factor Experiences and Effects was found *not* to predict any of the scenarios. The dominant model was the traditional ‘Back to basics’. The authors therefore conclude that “change is slow and not radical” (pp. 7, Collis, and Van der Wende, 2002). In addition, they note that there is no real concern about the need to change due to external forces or developments (only the Global Campus scenario is affected by these pressures). For mission, profile or market position, teaching and learning it is ‘business as usual’.

At the same time, 'Stretching the mould' is gaining in importance. This scenario appears to be evolving without deliberate plan or policy, however, and also it appears to be sensitive to the level of computer use that is common in the institution. This was also the only scenario in which differences were found between current and future usage. Respondents believe that significant changes are likely to take place here.

Another conclusion is that technology use in the form of e-mail, word-processing and the Web has become standard as part of the teaching and learning process. These have blended in with lecturing which remains the predominant instructional mode. Web-based systems in particular are seen as valuable and leading to more efficient practices, but not replacing traditional ways of teaching and learning.

The third main conclusion is that there were considerable differences between the Decision Makers and the Support Staff on the one hand and the Instructors on the other. The latter consistently voice a more negative sense compared to the other groups. Instructors are less technology minded than decision makers or support staff. Nevertheless instructors still are generally positive and they are doing more with technology. They are 'stretching the mould' but there are little or no systematic rewards to move instructors beyond this. The finding supports Simons (2002) when he says that "Time pressure and lack of facilitation have so far proven to be more important factors contributing to lack of change than (old) age, stubbornness or lack of volition."

Dutch institutes for Higher Education fit perfectly within this overall view. Here too the predominant scenario is that of the 'Back to basics' with 'stretching the mould' gaining field (see De Boer and Boezerooy, 2003). The majority of Dutch institutes use technology to achieve similar goals, namely: increase flexibility, student-centred/problem-based education and competence-based education (Van der Veen, and Van der Wende, 2005). In comparison with institutes from other countries, Dutch institutes more often signal that technology impacts general teaching practices. The main motivation seems to be an expectation of quality gain; technology is believed to improve education. Dutch institutes have a relatively weak strategic orientation on technology as a means to serve lifelong learners in the current mission of institutions.

Trend study

The book "from trend to transformation" (Mirande et al., 2005) differs from the survey study in that it presents mainly case descriptions of communities of practice. The book gives an impression of the various changes that institutes of Higher Education have gone through in recent years. Some contributions describe the changes that took place within a whole institute. Other contributions concentrate on change of a faculty or part of an institute. Yet a third type of contribution to the book comes from authors who describe 'facets of transformation'. First, I will summarize the main issues advanced in each of the three sections in the book. Next, I will present somewhat more detailed descriptions of the chapters that feature technology use and its impact on teaching and learning.

Change in whole institutes. There are two recurrent themes in the four chapters that discuss change on an institutional level. One theme concerns the choice for a top-down approach to the innovation. Authors argue that there are several reasons for electing this approach. One reason is the institutes' change of scale and the corresponding need for alignment of missions and visions. For several years now, educational institutes in the Netherlands have become increasingly bigger through mergers. In Higher Education this trend towards large-scale organizations is visible mainly in the institutes for higher professional education. Management needs to find ways to obtain alignment of policies, business strategy, and infrastructure, among others. Other reasons for choosing a top-down approach is that only such an approach can realize the required level of technical infrastructure needed for the innovation and to achieve an institute-wide adoption of a shared perspective on the strategic use of technology. With a shared view, an institute can benefit from an economy of scale to upgrade its technical facilities. Such a view also provides faculties and instructors with a clear, general perspective on the course that an institute plans to take for the goals it seeks to achieve, the audience it plans to serve, its instructional approach, and the use of technology therein.

Another theme that transpires in all contributions is that of the tension between management and the work floor (i.e., instructors). Just as noted in the trend study, the authors describe the changes that have taken place in institutes for Higher Education as evolutionary rather than revolutionary. But this is not considered satisfactory. The changes are also seen as a prelude to bigger, more radical reforms. In some institutes structural curriculum changes such as the division of the study into a major-minor program leading to bachelor and masters diplomas have formed the primary stimulus for change. Other institutes are reorienting their perspectives towards offering more flexible courses and competence-based education. Typically these new plans are added onto the ongoing and already taxing task of making use of technology in courses. One of the authors points to the production paradox, stating that the investments in technology and technology stimulated change yield considerably higher pass-rates for student learning while the efforts of instructors and organization increase disproportionately (Neggers, 2005, pp. 23). All these changes tax already taxed instructors. One of the authors described the dilemma that this causes for teachers as follows: "During remodelling sales must continue as usual" (Ogg, and Snippe, 2005, pp. 52). Clearly this leads to tension between management and instructors, a tension that was also noted in the survey study of Collis and Van der Wende (2002). In short, it is widely acknowledged that the possibilities to further tap instructors' time and talent are limited and that this forms an important bottleneck for the success of the whole enterprise.

Change in parts of an institute or a faculty. Even though their scale is smaller, concerns with mission, vision, market, policy, infrastructure and the like are similar to those of institutes at large. What sets these contributions apart is that they give a more focused view on an innovation that has taken place in a faculty, department or the like. In the various chapters one typically sees that a faculty aims for one of the recurrent themes for innovation (e.g., competence-based education, flexibility, and student-centeredness) and then organizes everything around it to achieve that goal. I will report three innovations.

Van Leijen, Koeman, Sas, and Benneker (2005) describe a rather unique program that helps pupils from the upper grades of secondary school in selecting the proper study. Pupils can participate in Web classes that acquaint them with the kind of scientific study that is usual in a particular field of study. In Web classes the Web is used as a platform for communication and exchange of information. Each Web class is also structured around one or more assignments about a core topic. Initially, only teachers from the university selected the literature that students must read, lead or initiate discussions about and provided feedback on worked-out assignments. Gradually some collaboration with teachers from secondary schools has emerged in selecting the literature and in judging final results.

Participation by pupils is on a voluntary basis. Web classes are offered twice a year. During the four weeks that a Web class runs pupils are expected to spend about two-and-a-half hours per week on it. Various departments from the University of Amsterdam participate (e.g., Biology, Law, Chemistry) each crafting the set-up of the Web class to its own profile within the general boundaries.

Departments report that the University teachers who conduct the Web classes tend to be forerunners in the use of technology in their teaching. A key factor in the success of a Web class lies in the communications that take place. Teachers spend considerable time stimulating these and giving feedback. In all, they consume seven hours every week that a Web class runs. An important benefit that is reported is that participation in Web classes informs the institute with valuable findings on the possibilities of and obstacles in distance education. Little is known about any knock-on effect, however. Another reported benefit is that the lesson materials from the Web classes serve as promotional materials for prospective students. The authors further report that there are signs that pupils who have participated in Web classes are better students in university. But there is no quantification of these data and neither are there any data that could directly link study success to Web class participation.

Ruijter (2005) describes the way they furnished a multifunctional study landscape for the study of Industrial Design in the University of Twente. The underlying notion was that the environment should support project-based work, teamwork and learning in a professional context. Thus a workplace (including tools) was created that offered students their own study cubicle, meeting rooms and presentation facilities.

A key issue in furnishing the study landscape was the choice for laptops rather than creating rooms with personal computers. Students must buy their own laptop that must satisfy stringent criteria for use. The laptop must be able to run the complex software that professionals working in the field also use. It must be able to handle taxing mathematics and simulation software. Laptops are connected to a wireless network maintained by the faculty.

As planned, students appropriated the landscape making it their own. Indeed this was such a success that nearly all teachers found it difficult to keep order. The laptop aggravates this problem as students can hide between their screens and thus fail to participate in group activities. In addition, there were complaints that students were all too easily tempted to be continuously online, engaging too much in online gaming. The author also mentions a special benefit of the use of the laptop for learning. “It proved to be very suitable for students to speed up the transition from a graphical calculator to a full-fledged math and simulation environment. This transition is important because many students are too focused on manipulating formula without the proper insight in concepts and relationships. The laptop affords them the opportunity to develop conceptual knowledge by using analytic and numeric software.” (pp. 145)

Blom (2005) reports on the introduction of educational programs for the Minor that students can select as part of their Bachelors education in Dutch institutes for Higher Education. The Minor has been introduced to stimulate and facilitate students in developing their own learning trajectory. Students can select a Minor to deepen their knowledge on a particular topic or to broaden it and look beyond the borders of their discipline of study. A Minor is a coherent educational package on a particular theme or topic. It consumes 30 ECTS, which is worth half a year’s study on a total of 3 years for a BA-degree.

The institute for higher professional education in Utrecht developed its Minors following a business plan as they saw these programs as a chance for institutes to profile themselves. They began with marketing research that focused on their potential clients. Sixty students were interviewed and another 800 filled in a questionnaire addressing questions such as, "What type of Minor would students want to have?" and "Whether they would like a Minor to broaden or deepen their knowledge?" The outcomes from this study led to the decision to develop 13 Minors, to roster these at the end of the BA-program and to deliver all content for the Minor through an electronic learning system. It is unclear whether the latter affected teacher participation, but the fact of the matter is that all teachers who developed a Minor were forerunners. A minimum of 15 students was set as the lower limit for actually giving a Minor. In the end only 3 of the 13 Minors were given. Most of the students opted for a Minor that broadened their profile.

The author concludes that the main lessons learned from the development were that the institute has started to give more thought to the learning trajectory of students. In addition, with so few Minors actually being selected, teachers became much more aware of the need to offer a Minor that would be of interest to students. Thirdly and finally, the author notes that the central course registration system was not yet fully operational when the Minors ran, causing a lot of frustration and problems.

A striking neglect in all reported studies is that they say next to nothing about the results of the change on the student or client as (s)he is called more and more. Although some of the authors in this section attempt to give some quantified data on cost-effectiveness, none of them report any change in pass-rate or student perceptions. One could argue that this absence is due to: (a) the focus of the study (e.g., reporting technology-stimulated change, or accreditation policy), or (b) rather big and complex curriculum changes (i.e., major-minor set-up), (c) incomparable parameters of assessment (e.g., changing from exam scores to portfolio assessment), or (d) complexity of getting solid evidence of a possible impact of technology use. But this does not alter the observation that none is reported. The absence is telling and a challenge for future reports about technology enhanced impact.

Facets of transformation. Just as in the other sections of the book, the chapters that are presented here form a diverse set of views on educational change, discussing the Digital Portfolio, Zaps (guided discovery learning through simulations), Computer Assisted and online Assessment (CAA) and Quality control. I will discuss only the latter contribution as the first two will be discussed in length later on in the project and the discussion of CAA largely concentrates on findings from the University of Dundee.

Boon and Firssova (2005) address the question "How can we assess whether qualitatively good innovation projects actually lead to the desired transformation of the institute?" They advance an analytic model for the assessment and present some findings of its application in three projects. In their model quality if defined as the degree to which an institute satisfies accreditation standards. The mains subjects of these standards are: (1) goals and final qualifications, (2) educational program, (3) personnel and personnel-policy, (4) physical infrastructure and study-counselling, (5) effective internal quality control, (6) results (level and pass-rate). These are judged for three main phases of development: activity-orientedness, process-orientedness and transformation-orientedness. Jointly this leads to the analytic model depicted in Figure3.

The model concentrates on change as seen from an organizational perspective. This also transpires in the description of transformation as a "dynamic dimension of quality" that relates to "the change and innovation capacities of institutes both with regard to themselves as well as on their impact on students and society" (pp.184).

The authors report that the three projects that were examined all scored high on the quality criteria and all were process-oriented. In addition, they note that their *diffusion* was equivocal and they indicate that key obstacles to a broader implementation mainly relate to external factors such as incompatibility of diverse learning environments, change of personnel, budget cuts and imposed implementation resulting in 'not invented here, hence not accepted'-syndrome.

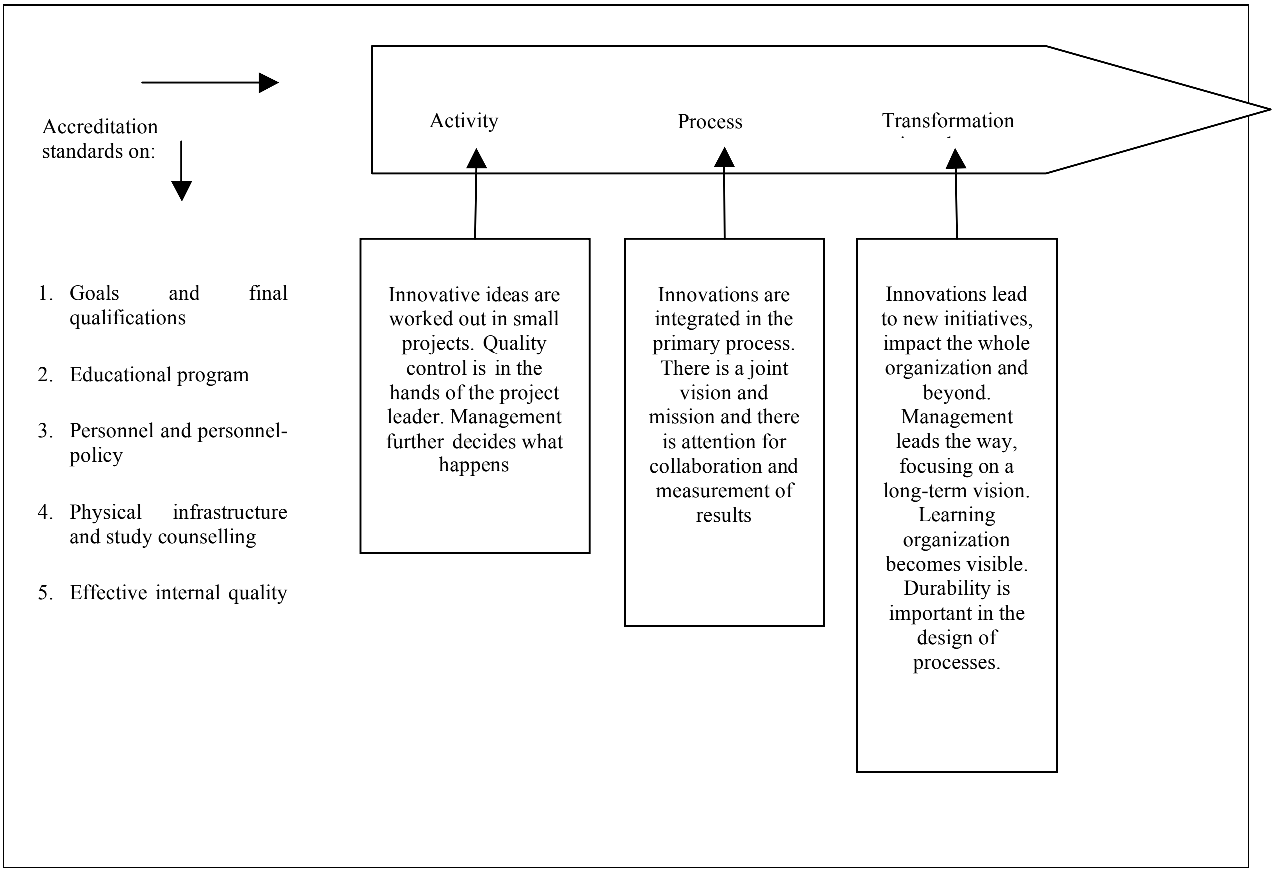

Figure 3: An analytic framework for describing the capacity for transformation

Development phases: An institutional and an instructional perspective

To get a handle on the complexities of the usage of technological innovations in education there are various models that describe phases of development. The models depicting these developments vary considerably in focus. Two complementary views from which change has been examined will be discussed, namely an institutional and an instructional perspective

From an *institutional perspective* change tends to be characterized as a three-step process that, if all goes well, generally progresses from initiation through implementation into institutionalization (e.g., Collis and Moonen, 2001; Van der Wende, and Van der Ven, 2003).

Phase 1: Initiation. This phase is carried out largely by pioneers and volunteers. Pioneers in the organization seek to change their teaching in the institute. Volunteers follow suit. The organization adopts the educational principle(s) behind the innovation and starts to work on creating favourable conditions for change.

Phase 2: Implementation. In this phase management shifts its attention to the effects of the innovation. Goals and targets are being (re)examined, the innovation is fine-tuned as is the implementation plan. The innovation is scaled up. It becomes widespread, extending beyond the volunteers.

Phase 3: Institutionalization. In this phase the innovation ceases to be a change. It has become part of the ordinary procedure within an institute. Any special start-up initiatives are withdrawn.

Within the main phases of this implementation cycle the path typically meanders. There are moves back and forth, detours, changes in participants and all kinds of obstacles that make it a rough path. To reach its final stage of institutionalization the whole cycle can be expected to take five years (Collis and Moonen, 2001). But often this phase is never reached due to obstacles such as:

- Failure to translate vision statements into operational terms or measurable goals
- Presence of innovations within innovations with a risk of leading into irrelevant sidetracks and loss of momentum
- Failure to remember the road map, forgetting that change takes a long time, that it is an iterative process and evolves in ways that are often not anticipated.

Another model that seeks to describe the ways in which technological innovations in education develop looks at the processes from an *instructional perspective.* Here too, the various stages of development are roughly characterized as a three-step change process that begins with affordances, progresses into (greater) functionality and ends in strategic specialization (Van der Veen, and Van der Wende, 2005).

Stage 1: Affordances. This phase concentrates on realizing the necessary technical infrastructure. Not without reason the phase is better known under fancy names such as 'technology push' and 'box dropping'. The support given to teachers tends to be meagre. Just as the term affordance implies, teachers *can* do something with technology. But whether they actually are willing to use the new technology and how they do so, is up to them by and large. The predominant initial usage of new technology typically is that of a handy 'add-on'. Teachers generally use it to facilitate some facets of their instructional approach. But the approach as such remains the same as ever.

This cautious, low-end usage of new technology helps in keeping teaching load within manageable limits, but there are also other advantages. It allows teachers to slowly acquaint themselves with the technology. Once they know it they may feel invited, knowledgeable and skilled enough to try to use technology for different purposes and as a vehicle for change in their instructional approach.

Stage 2: Functionality. In this stage, technology use is more optimized. There is a better exploitation of what technology can offer for various instructional approaches. Specific benefits of the new technology come more to the fore and there is a stronger educationally functional usage of technology. It is in this stage that technology helps 'push and pull' teachers into instructional innovations. Even so, there are considerable variations in how much the new technology impacts teaching. Along with optimizing existing teaching approaches, come changes that have a more fundamental impact on instructional design (including goals and attitudes or main players).

In this stage one can see innovations and transformations alongside each other. When used for purposes of innovation, an existing situation is enriched thanks to the usage of a new technology. When used for purposes of transformation, fundamental changes take place in an institute, including the formation of a new vision for the institution and of instructional designs that fit that perspective. Technology can play a pivotal role in this process.

There are at least two interdependent reasons why it can be difficult to draw a clear demarcation line between an innovation and a transformation in describing an educational change. One, development tends to be evolutionary rather than revolutionary. Radical changes in education are rare. The phenomenon is sometimes referred to as 'stretching the mould'. Quite often developments are characterized by a series of small steps or changes. One step is taken after the other because it makes sense in the new situation. Once an end point is reached, the conclusion can be that a drastic change has taken place. Midway, it's very hard to say. Two, 'old' habits sometimes are there for good reasons. Teachers are reluctant to throw overboard everything they have always believed in and know about how to teach. Teaching is a complex skill and art. Experienced teachers have good reasons to oppose the view that something fundamentally needs to be changed. It is for good reasons that the radical notion of pure e-learning has often turned into a form of blended-learning in educational institutes. Some of the intricacies involved in changing from being innovative to being transformative will transpire later on in this section, when I discuss the development of electronic portfolios in Dutch Institutes for Higher Education.

Stage 3: Strategic specialization. Institutions now focus their use of technology and aim for specific audiences and markets. In this stage transformation is the rule as a radical choice is made by an institute about its vision, the main goals it seeks to pursue, the audience it seeks to attract and the use of technology therein.

Key actors, factors and their interactions

To realize a successful implementation of new technology in education several factors must be attuned to each other. Van Tartwijk, et al. (2003) present a model that depicts the main aspects involved (see Figure 4). Surry, Ensminger, and Jones (2005) present a model under the acronym RIPPLES that is quite similar to the one that is presented here. RIPPLES stands for Resources, Infrastructure, People, Policies, Learning, Evaluation and Support.

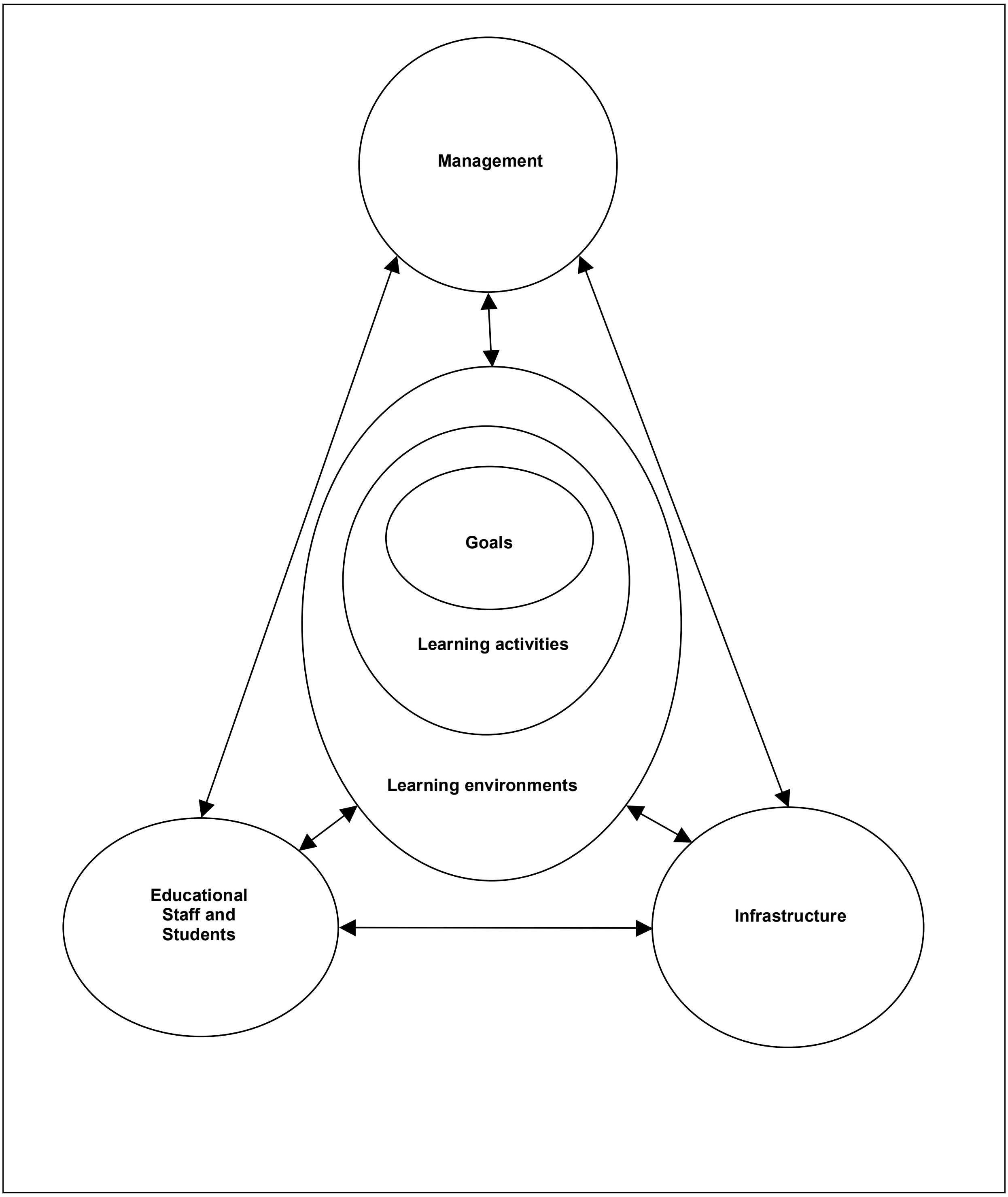

Figure 4: Key factors in educational innovations.

The central position in the model is taken up by the *Goals* defined in terms of (types of) knowledge and skill that students must acquire. Any change that is stimulated or afforded by technology must be judged on the question whether it achieves this goal effectively and efficiently. Defining the goal(s) of a planned change can be complicated by a variety of factors. One of these is that the affordances of new technology are often yet to be discovered at the onset of an innovation. Serendipity sometimes plays an important role as people discover that technology can do things for them that have not been foreseen in its original design. Another complicating factor is that forming and achieving these goals is a ‘joint enterprise’ (compare Clark, 1996). One does not establish learning goals in a vacuum. Goals must be attuned to what is desirable and possible.

The factors most directly linked with the goals are the *Learning activities* and the *Learning environment*. The first aspect refers to all actions that students undertake to achieve the learning goals. The second aspect is the context in which the learning takes place. This can be defined as the “physical, social, psychological and didactic” learning environment. New technology finds its place primarily within this factor. The three factors together comprise all aspects of the teaching and learning situation.

The inner circle of teaching and learning affects, and is affected by, what Van Tartwijk et al. (2003) characterize as ‘conditions’. The three main factors distinguished in the model are: Educational Staff and Students, Management and Infrastructure.

Two key players within the factor *Educational Staff and Students* are teachers and students. In considering the personal characteristics of teachers and students the two most critical aspects are public support and competence. Teachers must believe that the innovation is worth the extra time and effort. In addition, they must have the competence to carry it through. Students must see or experience that the advantages of using the technology outweigh the disadvantages. One of the ways of measuring this up front is by conducting an audience analysis. Just as their teachers, so should students already possess the necessary skill or be able to quickly develop these in handling the technology during classes.

The 4-E Model of Collis, Peters, and Pals (2000) provides an easy-to-use, intuitive guide to assess an individual’s likelihood of making use of new technology. In essence this model suggests that participation depends on four groups of factors: environment (the institutional context), educational effectiveness (perceived or expected), ease of use, and engagement (the person’s personal response to technology and to change).

The various roles that *Management* needs to perform in the development of an innovation are described extensively in the literature that focuses on change from an Institutional perspective. Collis and Moonen (2001) offer a very illuminative view on this matter when they summarize the research literature and blend this with their own extensive experience in the form of 18 lessons learned. Figure 5 presents a selection of the advice to management contained in these lessons.

Lesson 1. Be specific	We need to define our terms and express our goals in measurable form or else progress will be difficult to steer and success difficult to claim.
Lesson 4. Don't forget the road map	Changes take a long time and is an iterative process, evolving in ways that are often not anticipated.
Lesson 7. Be just in time	Staff-engagement activities to stimulate instructors to make use of technology are generally not very effective. Focus on just-in-time support for necessary tasks.
Lesson 16. Get a new measuring stick	What we are most interested in regarding learning as a consequence of using technology often cannot be measured in the short term or without different approaches to measurement. Measure what can be measured, such as short-term gains in efficiency or increases in flexibility.
Lesson 18. Play the odds.	A simplified approach to predicting return on investment (ROI) that looks at the perceived amount of relative change in the factors that matter most to different actors is a useful approach.

Figure 5: Some lessons (to be) learned about technology-stimulated change.

Even though the use of new technology in Higher Education appears to have an aura of inevitability ("You can't not do it", Collis and Moonen, 2001), this is no reason to relax standards for evaluation. Its impact on teaching and learning needs to be examined with (scientific) care.

Management could adopt a Total Quality Management (TQM) approach to conduct this evaluation in a systematic fashion. For example, a model for TQM applied to Higher Education is discussed by Mergen, Grant, and Widrick (2000) who distinguish three parameters of quality: quality of design, quality of conformance and quality of performance. To illustrate the breath and depth of adopting a TQM-approach in education, Figure 6 is adopted from their article (see Widrick, Mergen, and Grant, 2002).

Dimension examples	Measurement tools
Quality of design	
What courses to offer and sequencing	Survey, tree diagram, flow diagram, benchmarking QFD
What programs to offer	Survey, tree diagram, benchmarking, QFD
Determining appropriate faculty qualifications	Benchmarking, matrix of accrediting institutions guidelines, confirmation check sheet
Admission requirements	Benchmarking, matrix of accrediting institutions guidelines, confirmation check sheet
Course content	Benchmarking, matrix of accrediting institutions like AACSB guidelines, QFD, affinity diagram flow diagram
Quality of conformation	
Coverage of the topics (i.e. are the topics listed in the curriculum covered?)	Confirmation check sheet (i.e. yes/no-type tally)
Level of coverage	Peer review, student feedback
Are the courses offered in proper sequence?	Confirmation check sheet (i.e. yes/no-type tally)
Do qualified instructors teach the courses?	Confirmation check sheet (i.e. yes/no-type tally)
Quality of performance	
Employer satisfaction with coop or interns	Focus group analysis, depth interview, Pareto analysis to determine areas to improve
Employer satisfaction with final placement	Focus group analysis, depth interview, Pareto analysis
Type of employers recruiting for majors in your curriculum	Trend analysis, Pareto analysis, control charts, matrix
Starting salaries of alums	Trend analysis, on median starting salaries
Assess alumni positions and compensation over their career cycle	Surveys, period histograms on salary distributions, trend analysis on median salaries
Ability to achieve on standardized tests or licensing boards	Bar charts, histograms, trend analysis on average scores

Figure 6: Measures and tools for a TQM appraisal of curriculum development

Quality of design has to do with how well the design captures the consumer's requirements and determines the characteristics of a product or process at a given cost. Quality of conformance deals with how well design requirements are satisfied, including uniformity, dependability and cost requirement. Quality of performance deals with how well the product performs in the market-place, i.e. how well it is perceived and accepted by the customers.

In this brief characterization I have used the terminology of the authors. Notice that the consumers (students) are central and that the pivotal role played by the motivation of teachers more or less remains out of sight. Precisely on the latter point Rampersad (2003) offers a most refreshing critique on the TQM approach, arguing that knowledge intensive companies (such as Institutes for Higher Education) should cherish and support more their real capital, i.e. their workforce. Doing so will bring to the fore other concepts than those advocated in TQM, namely aspects like personal integrity and individual ethics that touch on core values of teachers.

The rubric of *Infrastructure* covers a wide set of components that must be in place to make it possible to realize the innovation. Apart from the presence of adequate physical space, special attention may be needed to bring the ICT-Infrastructure up to the required level. Four key elements in this ICT-Infrastructure are: Support, Hardware, Software and Administration. Support includes aspects such as training of staff and students, availability of a help desk and (paper or on-line) tutorials. The success of staff training sessions depends on how well these are integrated with the work that people need to do (see Lesson 7 in Figure 5). Hardware and Software include all of the required technical facilities such as (fast) personal computers for staff and students, fully equipped study and presentation rooms for staff and students and all the required software. Administration includes the actors and factors involved in system management (e.g., e-mail and web folders, network availability, access and security).

Conclusion

Nearly all reports reviewed here indicate that the teaching and learning in the institutes is constantly changing. “State of flux” is a euphemism. In recent years a fundamental change has taken place in institutes for Higher Education in the Netherlands through the introduction of the BA-MA structure. In addition, technology stimulated innovations are consistently calling for the instructors’ attention. With little additional support coming their way it seems most likely that technology will be used in other ways than for ‘stretching the mould’, if at all.

The use of technology in institutes for Higher Education in the Netherlands is mainly a matter of practice. Looking at the reported studies, it is clear that the various initiatives have focused on technology as a means to help realize and improve educational practices. However, factual data on teacher roles and practices and effects on student perceptions and learning are scarcely reported. There is an urgent need for assessment in this respect.

There are three projects in which we can perhaps find some of the badly needed evidence: Teletop, Zap and Digital Portfolio’s. Each of these projects revolves around a technological innovation that varies in how much it impacts teaching and learning. Teletop is a course management system, a ZAP is a simulation of a psychological phenomenon and a Digital Portfolio is an evaluation and registration system of a student’s design work. The implementation of each innovation has also been going on for several years including some up-scaling. As also several research reports are available from these projects, the description and analyses of these three projects will constitute the second part of the JEIRP-research.

Discussion

Much of the research internationally has focused on the impact of internet technologies through the examination of the effect of distance and on-line learning. Although research shows instances of technology adoption and an increase in technology enhanced learning in institutions where the majority of students are campus based, evidence is frequently based on case studies or where funding has specifically supported technology adoption. Based on this review, however, several common factors and issues can be identified; these will be outlined in this section.

Policy change

This review highlights the global extent of both governmental and educational policy to push for increased implementation and use of technology in higher education. Hand in hand with this drive is a belief that technology will improve education creating an underlying assumption that more and newer technologies will result in higher quality education. However, there is little or no research suggesting that such policies are justified empirically i.e. questioning what is promoted and whether it is warranted.

Hype versus reality

Much research on technology for learning has tended to "emphasise its positive aspects and understate its negative aspects". In addition, there is the danger that technology is implemented for the sake of it, because it is there, rather than because there is a specific need or benefit. Conole (2004a) raises the issue of the hype of technology and e-learning, i.e. the over expectation of what is possible with technology, rather than what actually is achievable and *worthwhile* with technology. This observation raises a tension between the place of creativity (the need for 'vision' of future education and technology use) and technology driven changes that may in some instances have a negative impact on good teaching practice, and highlights the importance of ongoing evaluation.

One complexity of rapidly developing technology is being able to integrate and accommodate the diverse sets of technologies that are available. Creativity and flexibility may become crucial skills for dealing with this and promoting effective design and implementation of technology-enhanced learning. Currently, technologies are often used where they support existing teaching practice, rather than creating experiences or activities that change the practice itself and create new ways of teaching and learning. Alternatively technology is seen to drive the changes in education and how learning takes place and may constrain or change current teaching practice in ways that contradict pedagogical values. Different technologies are argued to have different affordances, which make them more or less appropriate for various contexts and uses (Conole and Dyke, 2004). Conole argues that little is understood about these affordances and suggests that one way to develop the field would be to identify more clearly how affordances or features of technologies that support learning affect teaching practice. The ability to exploit technology features is an important concept for the effective integration of technology into teaching and may be key to staff development.

This tension between the different ways that technology can be adopted highlights the central role that ongoing evaluation plays in achieving effective technology-enhanced learning. High quality learning evaluation appears to be virtually non-existent, although this may be simply because it is not commonly published. In cases where some evaluation is carried out it is often at the level of whether students thought they found technology tools useful or motivating. Distinctions also need to be made between different perceptions of success. For example, is the success of the technology-enhanced learning perceived as being smooth running; or that it demonstrates particular learning benefits and therefore good teaching practice? Based on this summary, questions can be identified that would warrant further research. For example:

- What is the value of affordances in understanding how technology can be used?
- What values (or rhetoric) influences judgements about the success or failure of instances of technology implementation?

Complexity of association

The issue of hype versus reality and the discussion surrounding evaluation highlights the complexity of the link between technology and changes in roles and/or practices and particularly around disambiguating technology from other causal mechanisms in changing practice. No clear causal link is apparent between the two, as many factors contribute to use of technology and many others contribute to changes in roles and practices. Policy change, government reports, individual interest, hype of technology potential all affect the use of technology, while changes in society, demand for education, and 'normal' evolving change all contribute to transformations in roles and practices. One thing that does seem to have a link is that technology (just as any other new phenomenon or commodity) acts as a catalyst for change, providing a situation that prompts teachers and educators to explicitly rethink their pedagogical practice in terms of technological possibilities. Evaluation studies are required that look explicitly at whether the technology itself, or the created context surrounding the technology implementation brings about changes. For example, it is unclear from some studies (e.g. LTDI, 1997) whether it is the technology or the 'different kind' of sessions that were set up in order to accommodate the software packages that were effective. The same questions arise with the Math Emporium (Bates 2000), which provides 24 hour access to material, personal instructors on hand at all times, resulting in extra material extra time available for student consultation. Would the same learning benefits have been found with similar set up, but no technology? What is it that is benefiting the students – the technology itself or the learning activity/ setting/ support? Another example is the move towards more student centred teaching and learning, where technology has been implicated as a catalyst in this move, and research has highlighted the increased power for students in the process of their learning (Crook 2002). One question here might be – where does change in one particular direction stop? Can teaching/learning be too student centred? Can students always make the right choices for themselves? Such studies are helpful in avoiding technological determinism, and the naïve belief that simply introducing new technologies will cause changes (particularly entirely positive ones). In a further study the collaborative nature of student interaction as a result of network failure seemed to be instrumental in the success of the session. If this is so, is it the experience of the network failure or the package that was important? i.e. should we be focusing on the 'packages' or the fact that technology mediating collaboration is the important factor? These examples suggest one important area for research:

- What is the relationship between technology, use, context of application and the outcomes of use?

The adoption of technology

From general surveys and audits of technology use in higher education and from research studies specifically looking at adoption of technology, the embracement of and the process of technology adoption appears isolated and sporadic rather than a general trend. For example, early adopters of technology tend not to extend their technology use to incorporate more interactive complex tools (Shannon and Doube, 2004); only ten percent of academics were identified as technology 'innovators', having the motivation to incorporate technology into their teaching (JISC, 2003). (This may, however, be tautological – since it would make little sense to propose that, for example, 75% of academics were innovators since innovation implies moving beyond what is typical, which has to be defined in terms of prevalent practice.) This apparent patchiness may, however, be a consequence of the tendency for technology that has been embedded to be forgotten about, to become 'invisible' (Oliver, 2003a), making it extremely difficult for a developed picture of adoption to be provided.

Nevertheless, there are several reasons that contribute to teachers' reluctance to adopt technology tools for teaching: *(i)* real and perceived time pressures; *(ii)* the need for more technical support from IT services, technology-based innovations being particularly "sensitive" to this (Harris, 1998) *(iii)* the need for support through professional staff development, both in amount and quality; *(iv)* the awareness of all the major players on the purposefulness of the innovation, the 'why' of it together with ongoing dialog (Harris, 1998).

One issue relating to adoption concerns teachers' perceptions of using technology – whether it is seen primarily as a tool for admin purposes or whether they see it as a tool for teaching. One remaining question is whether this affects their motivation for adoption or how well they eventually use the technology.

Thus the following questions can be identified as needing further study:

- Can we adequately describe the process of adopting technology?
- How can we account for the integration of technology in a way that recognises 'forgotten' successes?
- How do academics perceive technology, and how do these perceptions affect their subsequent practice?

Staff development/professionalisation

A major issue that is emerging is the central role that staff development can play in effective development and implementation of technology for teaching. This is likely to have a significant effect on academic practice as well as those responsible for staff development. Staff development is seen as important for those involved in technology in education for several reasons:

- Keeping updated: One primary issue for teachers, technologists and instructional technologists is the need to keep abreast of the rapid change and development that is continually taking place in order to effectively adapt and integrate technology. This is important not only for appropriate adoption of the technology but also in terms of the 'vision' for its potential for technology-enhanced learning.
- Skill development: The need to acquire technological skills, together with pedagogical skills (JISC, 2003), to ensure that pedagogy is a focus and that teachers are able to usefully embed technology into good teaching practice.
- Creativity.
- Evaluation: the need to continually evaluate technology in teaching practice.

However research suggests that staff development is complex and fraught with problems, many of which it could be argued stem from lack of motivation.

- Attendance: Academics choose not to attend. This may be due to time pressures and constraints (JISC, 2003), or because it is not seen as a normal part of their current practice.
- Rapid technology advances create a number of problems: regular development programmes may be necessary, exacerbating the expense and time issues; teachers will be required to continually adopt new technologies or new ways of working with technologies; and institutions will be required to continually revise their strategies for technology use. Collectively this may affect motivation and investment. Shannon and Doube's (2004) study suggests that the motivation, desire or perceived need to accommodate continuous change and development is low.

- Research suggests that embedding technology use into teaching and learning practices is sidelined with more emphasis on training to use the technology (Gruba, 2001, cited Shannon and Doube, 2004). Combining the two is imperative if current teaching practices that are currently valued are not to be lost and if new teaching practices are to be developed.

- Evaluation of the implementation of technology in education (both for the learner and the teacher) is scant, and primarily focuses at the level of student motivation and engagement, feasibility for the teachers and support by the institution. Although these aspects of evaluation may be important they are insufficient for establishing the value of the technology for learning, and more importantly here for establishing the specific impact on teaching practice. More emphasis needs to be placed on finding out whether teachers were required to do different tasks, and if so what kind; what aspects of the technology were difficult to integrate into the teaching session/context; in what ways the technology changed the teaching context e.g. dynamics/ approach; whether they had to develop new evaluation criteria.

Addressing those problems may require fundamental changes to the importance placed on staff development, the quality of staff development or even the current concept of staff development. One move forward might be the explicit recognition of the importance of the central role that academics can and should play in technology development and implementation (JISC, 2003). One way to promote this would be for such involvement to be actively valued, for example by recognition through audit, promotion or reward schemes, or through accreditation. The same issues arise in relation to support roles, such as learning technologists in the UK. However, at least for this group, recognition through accreditation now exists.

In addition, the development of strategies to accommodate technological advances would be beneficial. This needs an understanding of the required role of technology in teaching and learning in higher education (Lazenby, 1998). One way to address this may be to embed into technology implementation the facility to enable academics and learning technologists to carry out ongoing research. This would begin to address the current problem facing researchers and practitioners: that there is currently great potential for the ongoing assessment and evaluation of technology use, but that this is not taking place (Oliver and Conole, 2003). If this situation were to change, it may enable the systematic examination of the benefits of technology use, and the consequent ability to change practice (either through disseminated information, staff development or some other intervention). It could also change the technology that is being used.

As before, there are several further questions that could be pursued in relation to this topic.

- How can academics be encouraged to engage with staff development? (Are particular forms of intervention or topics important to promote?)

- How can academics be supported in carrying out evaluations of their practice?

- Can academics and/or support staff be encouraged to become researchers of their own practice?

Emergence of team-based approaches

The complex demands of effectively designing and implementing technology for teaching, have given rise to the emergence of teams of people, each with different expertise and skills e.g. academics, graphic designers, HCI design, programmers, educational designers (Kennedy, 1998). Teams such as this exploit the roles of each expert to provide a collective expertise. This may preclude the need for those involved in technology development and implementation to be multi-skilled, and even shape the kind of staff development that is appropriate.

However, teams bring with them their own issues: they require collaborative interaction with other members of a multi-skilled team. For academics this means adapting their own roles to integrate as part of this kind of team. It raises questions about the academic's role: is it merely as pedagogical advisor, or as consumer, designer and evaluator? Such teams also raise the issue of integration of learning technologists and other specialist staff (JISC, 2003). One potential issue is in agreeing or defining how best to use technology, for example, with respect to the pedagogical approach underlying technology implementation for a particular learning activity. Another is that the move towards such teams has been used as the first step in a political argument that disenfranchises academics, reducing them to content providers and transferring authority over curriculum design and/or teaching to technical staff such as metadata experts (Oliver, 2004c).

Again, then, this summary raises a series of questions. For example:

- How does the formation of teams affect academics (and their relationship with others)?
- What is their role within such teams?
- Does it include all academics or will certain academics emerge as the 'technology team' experts?
- Does this have an impact on accreditation?

Models of learning and models of teaching

One of the main themes that pervades the conceptualisation of new technologies in education is the facility for new ways of *delivering* information. Rather than technology being seen as just a new means of delivery, it should perhaps be seen as a way of mediating learning. Conceptualising technology in this way helps us to understand the potential change in models of learning. Despite the espoused move towards constructivist style teaching and learning, the pervasive model in education is that of the teacher imparting knowledge to the learner – the teacher as giver, the learner as recipient. This model of learning seems to be ingrained from the beginning of school and pervades throughout the formal education system. Although there are changes to some degree in teaching practice and curriculum design to promote a more constructivist approach, e.g. learners engaging in more project based activities, the onus is still primarily on the teacher to be the 'provider'. One feature of the new technologies is their facility to support different kinds of interactions with the world and others. There is currently a push (in policy, and in some research) to promote independent learning, student initiated study, student driven learning, skills based learning (contrasted with factual knowledge) and experiential learning (purported to achieve conceptual understanding). If this is the way education is going these new models of learning tied in with the implementation of technology are likely to have an impact on the way educational practice evolves and on the many different roles of the teacher. So:

- What models of learning do teachers hold and can these be changed?
- To what degree does the teacher 'impart' knowledge?
- How does a teacher facilitate learning, for example in helping the student to undertake appropriate activities?
- How can learning objectives and forms of assessment be reconceived to reflect this broader understanding of what it means to teach and learn?

What are the appropriate research methods?

It is self-evident that technology-stimulated changes in education must prove their worth. In evaluating the impact of technology-stimulated changes in education we are facing at least two major challenges. One major challenge lies in handling the problem of 'factorial explosion'. Institutes for Higher Education are complex organizations with many actors and factors that (can) all affect each other. When seen from the perspective of evaluation, this problem is further aggravated by the fact that instructors generally have considerable freedom in how they organize their teaching. This calls for robust mechanisms for making things work in a variety of contexts.

Another major challenge comes from the need to 'shoot at a moving target'. Teaching and learning in Higher Education is definitely in a "state of flux" (see Price, and Oliver, this report). Because many things (can) change from one moment to another, an objective assessment of the impact can be methodologically complex as well as practically meaningless. If relaxing norms of research methods is not an option, how can we advance our insights and produce reliable findings?

The answer, so Burkhardt and Schoenfeld (2003) argue, comes from adopting an engineering approach. Within education there are three main research traditions: humanities, science and engineering. To describe these traditions, I will use an extensive quote from Burkhardt and Schoenfeld's thought-provoking article.

> The humanities approach to research is the oldest tradition in education. It may be described as "original investigation undertaken in order to gain knowledge and understanding; scholarship; the invention and generation of ideas ... where these lead to new or substantially improved insights" (Higher Education Research Funding Council, 1999, p. 4). There is no requirement that the assertions made be tested empirically. The test of quality is critical appraisal concerning plausibility, internal consistency and fit to prevailing wisdom. The key product of this approach is critical commentary.
>
> Much work in education is of this type. Ideas and analysis based on authors' reflections on their experience are often valuable. However, since so many plausible ideas in education have not worked well in practice, the lack of empirical support is a profound weakness. This has led to a search for "evidence-based education" and the significant growth in the education research community of the science approach.
>
> The science approach to research is also focused on the development of better insight; of improved knowledge and understanding of how the world works through the analysis of phenomena; and the building of models that explain them. However, this approach imposes in addition a further essential requirement: that assertions be subjected to empirical testing. The key outcomes are again assertions, but

> now with both arguments in support and responses to key questions that are built on empirical evidence. The common products are research journal papers, books, and conference talks. Such research provides insights, identifies problems, and suggests possibilities. However, it does not itself generate practical solutions, even on a small scale; for that, it needs to be linked to the engineering approach.
>
> The engineering approach to research is directly concerned with practical impact, understanding how the world works and helping it "to work better" by designing and systematically developing high-quality solutions to practical problems. It builds on insights from other research, insofar as they are available, but goes beyond them. It can be described as 'the use of existing knowledge in experimental development to produce new or substantially improved materials, devices, products, and processes, including design and construction" (Higher Education Research Funding Council, 1999, p. 4). It combines imaginative design and empirical testing of the products and processes during development and in evaluation. (Burkhardt and Schoenfeld, 2003, pp. 5)

A research method that fits perfectly within an engineering approach is the design experiment. Design experiments, introduced by Ann Brown (1992) and Allan Collins (1992), constitute research in practice that explicitly seeks to connect theory and practice. They are instructional interventions in which data are gathered for developing a profile or theory that characterizes the design in practice (Barab, and Squire, 2004, Collins, Joseph, and Bielaczyc, 2004).

Nowadays the term design research rather than design experiment is used to refer to the various research methods it subsumes. Design research is strong in: (a) exploring possibilities for creating novel learning and teaching environments, (b) developing theories of learning and instruction that are contextually based, (c) advancing and consolidating design knowledge and (d) increasing the capacity for educational innovation (Design-Based Research Collaborative, 2003). Barab and Squire (2004), building on Collins' work, present an illustrative scheme that summarises the main differences with experimentation in a science approach to research.

Burkhardt and Schoenfeld (2003) believe that design research can make educational research more useful, more influential and a better-funded enterprise because it can yield the sought-after "Evidence-based education". However, they also note that design-based research methods embody only the early stages of design. A further adoption of the engineering approach with extensive beta testing is then needed to reveal "How does one refine ideas and materials so that they are robust across a wide range of contexts of implementation?" (pp. 5).

Category	*Psychological Experimentation*	*Design-Based Research*
Location of research	Conducted in laboratory settings	Occurs in the buzzing, blooming confusion of real-life settings where most learning occurs
Complexity of variables	Frequently involves a single or a couple of dependent variables	Involves multiple dependent variables, including climate variables (e.g., collaboration among learners, available resources), outcome variables (e.g., learning of content, transfer) and system variables (e.g., dissemination, sustainability)
Focus of research	Focuses on identifying a few variables and holding them constant	Focuses on characterizing the situation in all its complexity, much of which is not known a priori
Unfolding of procedure	Uses fixed procedures	Involves flexible design revision in which there is a tentative initial set that are revised depending on their success in practice
Amount of social interaction	Isolates learners to control interaction	Frequently involves complex social interactions with participants sharing ideas, distracting each other, and so on
Characterizing the findings	Focuses on testing hypothesis	Involves looking at multiple aspects of the design and developing a profile that characterizes design in practice
Role of participants	Treats participants as subjects	Involves different participants in the design so as to bring their different expertise into producing and analyzing the design

Figure 7: A comparison of psychological experimentation and design-based methods

Conclusions

At the outset, it was stated that this report had two objectives, which were shared with the project as a whole:

1. To explore the impact of new forms of technology on roles and practices, and
2. To identify the kinds of intervention best suited to supporting staff within the processes of change that surround the introduction of technology-enhanced learning.

The impact of technology has been extensively explored in a series of national cases within this report. Although technology is being used differently within all of these contexts, a number of shared themes have emerged, as demonstrated by the preceding discussion section. These include:

- The policy push, internationally, for increased implementation and use of technology (although the assumptions and rhetoric employed are questionable);
- The tension between the hype associated with technology and the experience of using it;
- The complexity of the relationship between technology and changes in roles and practices;
- That 'early' adoption is common and frequently studied, but mainstream adoption is poorly understood;

- That there are a range of forms of staff development that may be suitable for supporting and changing staff practice, but there is no single 'best' way to approach this;

- That team-based approaches to development are becoming increasingly common, and these have implications for the negotiation of responsibility and professional identity between different staff;

- That teachers' engagement with technology is shaped by the models of learning and teaching that they hold, making it important to understand this perspective if we are to explain *why* technology is permitted to have a particular impact; and

- That there is no obvious research method to adopt in relation to this problem – instead, different approaches seem well suited to particular aspects of the area, and additionally it may be necessary to develop one or more new approaches.

A series of specific research questions were identified in relation to these themes; these are drawn together in the Appendix. This meets the requirement of the project to identify areas where further work is required.

Although this list of themes and questions represents a marked development in research focus, compared to the position prior to this report, it is still too broad to guide the remainder of this project. To position the forthcoming empirical work successfully, therefore, it is necessary to group these themes into clusters in order to provide a simpler, clearer framework. We propose that the issues related to the relationship between technology and changing roles and practices can be grouped as being:

- Anticipatory (discourses and rhetoric of policy, design or opinion);

- Ongoing (processes of integration); or

- Achieved (summative studies).

The underlying nature of each of these 'positions of technology' differs and suggests the employment of different methodologies for investigating the impact they each have on teachers in Higher Education. For example, to understand the impact of the *process* of integrating technology enhanced learning tools, a longitudinal 'step' method may be appropriate; to understand the *achieved* could take two forms, retrospective evaluation of the perceived (of those involved) impact of the process of technology adoption, or the impact once the technology is integrated, i.e. the actual practices surrounding the technology use now. The identification of viable methodologies for each approach has been highlighted in this report and will be pursued in greater depth at the start of the forthcoming empirical work.

In addition to helping us better identify appropriate methodologies, this framework also suggests the community that would best be informed from outcomes of each of the strands of empirical work. So, for example, studying the *process* would inform us of appropriate staff development strategies, whereas studying the *achieved* would inform us about the needs for support and support staff. This analysis of the topic, approaches and audiences is summarised in Figure 8.

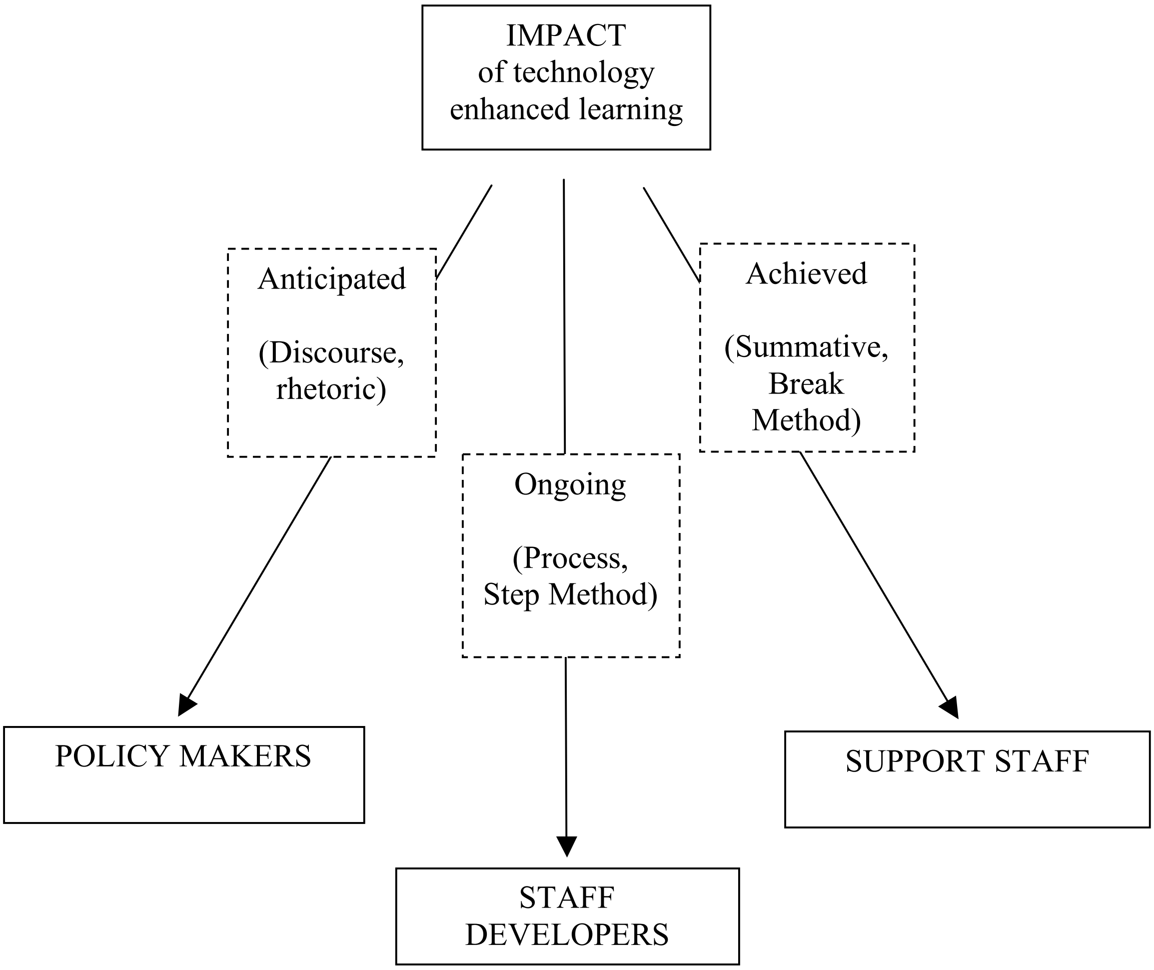

Figure 8: An overview of approaches to the topic, indicating example audiences

This structure will form the starting point for the work to be undertaken in the next phase of the project.

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Appendix: research questions arising from the review

Policy change

- Are policies justified empirically?
- What assumptions are made in policies, and how do they achieve their effect rhetorically?

Hype versus reality

- What is the value of affordances in understanding how technology can be used?
- What values (or rhetoric) influences judgements about the success or failure of instances of technology implementation?

Complexity of association

- What is the relationship between technology, use, context of application and the outcomes of use? (Should one of these be a priority for research?)

The adoption of technology

- Can we adequately describe the process of adopting technology?
- How can we account for the integration of technology in a way that recognises 'forgotten' successes?
- How do academics perceive technology, and how do these perceptions affect their subsequent practice?

Staff development/professionalisation

- How can academics be encouraged to engage with staff development? (Are particular forms of intervention or topics important to promote?)
- How can academics be supported in carrying out evaluations of their practice?
- Can academics and/or support staff be encouraged to become researchers of their own practice?

Emergence of team-based approaches

- How does the formation of teams affect academics (and their relationship with others)?
- What is their role within such teams?
- Does it include all academics or will certain academics emerge as the 'technology team' experts?

- Does this have an impact on accreditation?

Models of learning and models of teaching

- What models of learning do teachers hold and can these be changed?
- To what degree does the teacher 'impart' knowledge?
- How does a teacher facilitate learning, for example in helping the student to undertake appropriate activities?
- How can learning objectives and forms of assessment be reconceived to reflect this broader understanding of what it means to teach and learn?

Research methods

- What are the appropriate research methods for studying this area?