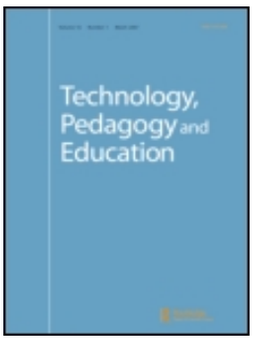

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Six case studies of information technology-assisted teaching and learning in higher education in England

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Six Case Studies of Information Technology-Assisted Teaching and Learning in Higher Education in England

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ABSTRACT In August 1996 the Higher Education Funding Council for England (HEFCE) commissioned a six-month research study of IT-assisted teaching and learning (ITATL) in higher education. This was to inform policy and also to provide evidence to the Review of Higher Education in the United Kingdom (Dearing, 1997). The research study was led by the Telematics Centre at the School of Education at the University of Exeter, working in collaboration with the NatWest Financial Literacy Centre at the University of Warwick and the Institute of Learning and Research Technology at the University of Bristol. A key element of the research was the case studies of ITATL undertaken in six HE institutions. This article reports the case studies. It provides a more comprehensive view of the educational outcomes of the research than the final report published by HEFCE which placed a greater emphasis on the economic aspects (Boucher et al, 1997). The outcomes are discussed in terms of the educational costs and benefits of ITATL for higher education. The paper also considers the framework within which ITATL is most likely to be effective, and notes the implied staff and institutional development required for this to occur. The paper concludes by describing the most effective types of ITATL observed.

Introduction

In the United Kingdom (UK) the changing nature and delivery of higher education had been given impetus by publicly funded investments into the development of IT within the sector. The Teaching and Learning Technology Programme (TLTP), the Computers in Teaching Initiative (CTI) and the Joint Information Systems Committee (JISC) New Technologies Initiative are three examples of this. As HEFCE state:

> these initiatives, along with complementary activity throughout the sector, are leading to the development of a different type of higher education than in the past in terms of the process of teaching and learning and what is delivered within this process. (HEFCE, 1996)

It was within this context that the research into IT-assisted teaching and learning in UK higher education was undertaken.

For the purpose of the study, broad objectives were identified for the development of technology-assisted teaching and learning. Primarily these were:

- to make teaching and learning more productive and efficient;
- to enhance the learning experience of students;
- to widen access to HE through its delivery in new and different locations.

The information for this research study was gathered in collaboration with the higher education community. There were four main strands to the educational aspects of the data collection:

- a literature review: a comprehensive inventory, analysis and review of published and unpublished materials;
- case studies of ITATL in action: visits, questionnaires and interviews in six English HE institutions where IT was used to assist teaching and learning in a specific course or module;
- invited seminars and papers: a collection of the views of the HE community through small group structured discussion and specially commissioned papers;
- a questionnaire on the World Wide Web (WWW): users within and beyond the HE community were invited to respond to key issues via a proforma on the Internet.

The case studies and their outcomes which are the main focus of this paper attempt to provide a rich picture of typical ITATL activities rather than leading-edge practice.

The Case Studies

Case studies were captured at six universities across England (see Table I) during the autumn of 1996. The universities included a representative range including former polytechnics and the Open University to complement older university structures. Each case study focused on a course where IT was used to assist teaching and learning, and covered a different subject area. The project team visited each of the sites where they interviewed staff and students as well as collected data by observation and student questionnaires.

From the outset of this study the research team, having worked in the field of IT in education for many years, endorsed the view that this research was concerned with complex educational innovations. In HE these innovations were extended over courses, departments, institutions and sectors. In gathering and understanding data, the research team worked to ensure active participation of all those involved in order to increase the reliability both within and beyond the current research study.

The content of the reports from the case studies, which offered a rich description of the courses, their circumstances and contexts within the

institution and outcomes of interviews with staff and students, were checked and agreed with the participants to increase their validity and were in line with ethical considerations. In the cases which follow, an initial description is given followed by a table in standard format giving an overview of key aspects of each and ending with a summary of the benefits and drawbacks of the use of ITATL in that course. Within the confines of this article it is not possible to provide the rich description of the case from which the overview and outcomes given have been taken.

75mm

Table I. Overview of ITATL case studies.

Case 1. Orthodontics at the University of Bristol

The focus of this case study was the use of high-quality computer-assisted learning packages providing case medical work for dentistry students taking the Orthodontics course. Students were able to access these materials in a purpose-built facility within the School of Dentistry.

One package for example provided students with additional practice in the assessment of orthodontic conditions through a series of interactive case studies. High-quality real images including photographs and X-rays, were used throughout, making this an authentic simulation. There was another package which augmented the standard and compulsory textbook for the course by generating interactive questions on topics from the book.

Two visits to the institution were undertaken by the research team. The case study evidence was collected through interviews with two members

of staff, observation of students working in the facility and questionnaire data from a sample of forty-four students. An overview of key aspects of the case is given in Table II.

90mm

Table II. Overview of the Orthodontics case study at the University of Bristol.

The benefits of using ITATL on the course were:

- reduced staff teaching time, releasing them for the development of a new postgraduate course;
- this ITATL resource was transferable to other courses in Dentistry and could also be used for professional development for practising dentists;
- the provision of authentic and valuable tutorial guidance through use of the Computer-Assisted Learning (CAL) materials;
- the development of this course had brought considerable kudos for both the institution and department for the use of CAL in Orthodontics;
- this particular course was organised in such a way that access to hardware was good (98% of students described access as being good or adequate) and technical problems with the software were also not raised as an issue.

Although the focus of this article is on educational, not economic issues, it should be noted that this case study provided a good example of one where

the financial benefits of investing in ITATL outweighed the costs. The economic case rested on being able to recruit fee-paying students to a new course, a situation not readily transferable to other departments where student numbers are controlled.

In general the feedback from all concerned with this case study was positive. It was the most established of the cases the team studied, having been operating with the use of CAL for seven years. The main drawback noted was the significant amount of tutor time required for the course development.

Case 2. Postgraduate Certificate in Education (PGCE) at the Open University

The focus of this case study was the Open University's (OU) postgraduate certificate in education course which has an enrolment of over 1500 student teachers studying at a distance. All students are provided with a computer, modem and printer, together with computer conferencing software (FirstClass). This is just part of a whole package of course materials provided in a range of formats including paper, video and tape.

The main purpose of the computer conferencing facility was to create a 'virtual community' among students and teaching staff who only meet face-to-face occasionally during the year. It should be noted that use of this facility was not obligatory.

90mm

Table III. Overview of the Postgraduate Certificate in Education at the Open University.

The ITATL team visited the University and met with seven members of staff. They were provided with large quantities of data collected by the OU, including questionnaire data from student returns for the previous year. An overview of key aspects of the course is given in Table III.

Some of the particular benefits of using ITATL on this course were:

- The creation of an on-line HE community for a geographically dispersed student population. This addressed the problem of isolation when studying in this way. 81% of Primary PGCE students and 78% of Secondary students rated having an OU computer in their home as 'very valuable'.
- The discussion that took place by being able to communicate through the use of the technology facilitated reflection on professional practice and dissemination of teaching ideas across all phases and subjects. Participation rate in discussion groups was over 85%.

At the outset of the course 50% of the students described themselves as not very or not at all confident in the use of IT. By the end of the course this figure had dropped to only 8%. These statistics are interesting given that in this case all students were given access to a computer at home.

There were also some drawbacks in this case on the financial side for both institution and student. The use of the technology was an additional expense for the course participants who had to pay, for example, the line charges from home. From the institutional aspect the provision of hardware for students and also server hardware and software, network provision and maintenance, helpline support and conference moderation was very costly.

Case 3. Environmental Law at the University of Bradford

The focus for this case study was a module on Environmental Law. Until 1995 it had been delivered in traditional face-to-face mode. This became an issue when the availability of the lecturer for the following year was in doubt. In order to allow the module to continue to run, the course coordinator worked with an in-house multimedia developer to produce a CD-ROM. This was used to deliver the course content in 1996, supplemented with two face-to-face lectures and email support.

This initiative was driven by the need/desire to keep a high-quality popular course running despite the difficulty of access to the necessary expertise. Environmental Law is relatively new and expertise in the

area is not widely available, particularly outside London. Even more rare is the availability of practising environmental lawyers willing and able to teach on degree courses.

Following a small pilot study, the course starting in September 1996 to postgraduate and final-year undergraduate students was offered via material available across the University network (also made available to course students on CD-ROM). This was supplemented with two four-hour face-to-face lectures and email tutorial and technical support from the overall course leader. Students were required to spend between fiftenn and twenty hours studying the multimedia materials, with additional time to prepare for assessments. Initially the assessments were not undertaken directly through the computer-based materials.

To collect evidence for the research the team visited the institution twice. Six members of staff and six students were interviewed. Twenty-five student questionnaires issued by the research team and twelve questionnaires previously used for evaluation were also analysed. An overview of key aspects of the course is given in Table IV.

80mm

Table IV. Overview of Environmental Law at the University of Bradford.

The benefits of using of ITATL on the course were that:

- it allowed a unique module to continue;

- it offered flexible study opportunities for students. (64% of students 'agreed' or 'strongly agreed' that the use of IT made their study of the course more flexible);
- tThe focus of the course development onto CD-ROM transpired to be a good discipline for lecturers to have to reflect on the course objectives and think through appropriate learning strategies and materials from scratch.

Other issues which arose were that students were more critical of the electronic material than the lecture material. They were more ready to attend a lecture which was not as clear and focused as it could have been, but the computer-based materials, which remained static and could not be interrogated, were open to more criticism if they were not comprehensive, interesting and clear.

In this particular course, followed by a large number of students (109) although the contact time with the lecturer was reduced considerably, the extra tutor time required to administer the course, resolve technical issues and answer individual students' questions on the course by email was considerable.

A particular drawback which was realised well into the development was that the dissemination of the materials on CD-ROM or as a CAL package over the network resulted in a subsequent awareness that the materials in this format were cumbersome to update and also that technical expertise requirements were high. The Bradford team are currently considering the possible delivery of the materials over the WWW which it was felt would address to some extent these particular problems. It was recognised that such a decision raised other organisational issues.

Case 4. Mathematics for Science and Engineering at Sheffield Hallam University

Three courses were reported on at Sheffield Hallam, all in the School of Science and Mathematics. Here staff were using a range of IT in their teaching and had specifically restructured courses to take full advantage of the technology available.

In particular the use of IT in three first- and second-year undergraduate courses in the engineering department was reviewed (see Table V). One of these had a learning objective of the use of IT itself, but the others were focused on subject-based outcomes. The course was driven partly through an institutional requirement to cut contact time for 'service courses' (e.g. the teaching of mathematics to engineers). It was also undertaken as an initiative by one of the lecturers who wanted to use this opportunity to reflect on and revise his teaching methods, and research new modes of learning and teaching.

To collect the evidence the research team visited the institution and interviewed nine members of staff and two students. Returns from twenty-seven students were analysed. An overview of key aspects of the course is given in Table V.

The benefits of using ITATL on the courses were that:

- it brough considerable kudos to the institution/department through innovative and appropriate use of graphic calculators and spreadsheets;
- this style of course offered increased flexibility. (Fifty-two percent of students agreed that the use of IT made their study of the course more flexible);
- the students were able to focus on the problem-solving aspect of the subject, allowing them to work at a higher level without getting side-tracked by too much routine algebra and computation;
- the course became less dependent on paper-based resources;
- this use of IT provided an opportunity for the development of a completely new approach to the teaching of mathematics on this course and had required staff to 're-think what they were doing'.

Again this was in general a very positive development. From the institutions' point of view all three courses were developed at low innovation cost to the institution and a certain amount of personal and institutional kudos had been gained.

100mm

Table V. Overview of Mathematics for Science and Engineering at Sheffield Hallam University.

The fact that use of the graphic calculator had freed students (and course time) from focussing on routine tasks is quoted here as a positive feature. Previously, as in many similar courses, the ability to carry out some of these routine calculations was assessed as an outcome of the course. This element was now replaced with the focus on application of mathematics, a more demanding and most would agree more appropriate focus for degree-level work. However it was reported that for some of the less able students this was a considerable challenge which caused problems as now these students gained little recognition for being able to simply perform a calculation out of a real context.

Arguably there was a financial drawback for the students who required good access to a graphic calculator. Although personal ownership was optional, they were encouraged to purchase them and this could be done through the department at a cost of approximately £60. This was less than the usual retail price and there was also an optional 'buy back' at the end of the course. However at the time of the case study not a single student had opted to sell back his or her calculator.

The staff, particularly those who led the development, put in a considerable amount of extra time and worked with colleagues in the department to induct them into this new way of working. Although demanding on staff time, the outcomes of interviews and questionnaires suggest that there are clear educational benefits. For example 88% of students who responded to this part of the questionnaire felt this mode of working had prepared them for tasks they would face in future employment, 76% felt the use of IT had added value and 76% reported that it had extended the boundaries of the course. The subject leader noted a marked increase in the quality of learning, one member of the team said that '[this use of] spreadsheets had revolutionised the work that can be done later in mathematics using graphing functions or making calculations visible'. The issue of recognising the additional pressures and demands on staff, however, should not be overlooked.

One drawback in this experience was technical issues with the local area network (LAN). This affected several aspects of the study and delivery and increased the demands on tutor time to solve problems. This occurred at a time of major development at the University and this may have been a particular difficulty of the time or one of increased use of networks making new demands on a system.

Case 5. On-line Student-Centred Resource and Assessment Package at the University of Plymouth

This case study focused on three separate innovations in teaching and learning using information technology. These were:

- a module within the Environmental Science undergraduate programme in which students use various forms of IT to prepare for a face-to-face seminar;
- an 'Introduction to Marketing' module for undergraduate students at the Business School. The course employs high-quality computer-aided learning materials;
- 'WIRE', an EU-funded project, in which the University of Plymouth is a partner. 'Interactive' programmes are being designed and delivered employing ISDN and satellite technology.

Five visits were made to the institution in order to review each of the above courses, during which time a number of interviews and observation activities were undertaken. This report focuses on just the first of the named courses, which was reviewed through interviews with two members of staff and questionnaires received from thirty-nine students.

The focus for this course was a computer-based resource facility developed from the research students had undertaken for projects and seminar preparation. This material, in the form of WWW pages, is then available to students as a collective resource.

The course requires each student to work in a small group, and to research a topic, produce a summary and final report for presentation in a face-to-face seminar and also on-line version as WWW pages. The on-line version of the report has to be on the WWW at least a week before the seminar date to allow peers who will be attending the seminar to familiarise themselves with the topic. Students provide peer feedback in the form of critical review. The tutor responsible for the course uses the Internet to provide support for the students. Administrative details, references, reading lists and links to relevant sites are included on the course WWW site.

An overview of key aspects of this course is given in Table VI.

70mm

Table VI. Overview of the on-line resource and assessment package at the University of Plymouth.

Some of the benefits of using ITATL highlighted in this example were that:

- the new course style included peer feedback in the form of a critical review and actively encouraged reflection on ideas;
- the materials formed a vital archive for students who do not attend face-to-face sessions. Students are able to generate their own teaching/learning materials, the accumulation of which will automatically update the resource base;
- transferable IT skills were used in context. 70% of students 'agreed' or 'strongly agreed' that the use of IT in the course would prepare them for tasks they will face in the future;
- the course structure offered the students more flexibility of study;
- use of the WWW gave them access to a wider and richer source of information than conventional, paper-based study would have done (74% of students responding to the question reported this to be the case).

Use of a generic tool, in this case HTML/WWW, enables the relatively simple updating and development of materials over time. It also provided a student environment that proved, for the most part, to be flexible and relatively simple to use.

The course was reported to have required a large investment of development time with little academic kudos for the member of staff leading the initiative. However, now the course is set up, this demand on time should decrease significantly. The broad structure of the course is potentially scaleable across other departments and institutions.

Case 6. Reportage at the University of Exeter

The focus of this study was French Media Studies, an option for second-year undergraduate students in the Department of French at the University of Exeter. During the academic year 1996/97 just under twenty students were registered for the course, although in past years larger numbers have been involved. Students are required to use various forms of IT in order to

produce a collaborative electronic 'newspaper' in French as part of the course assessment.

The course is a language, media and IT course. It is staffed by two lecturers, one from the department of French and one from 'IT Services'. Its stated aim is to 'enhance the teaching and learning process through the application of computer skills in the areas of language and cultural learning'.

Evidence for the case study was collected a number of visits undertaking interviews with five members of staff and questionnaires received from seven students. Data was also collected through observation and informal discussion. An overview of key aspects of the course is given in Table VII.

The benefits of using ITATL were that:

- it introduced a professional context for language use;
- transferable IT skills were used in context;
- it extended creativity, autonomy and learning.

When the course was first run, the requirement was for the production of a printed newspaper. The current electronic method of publication offers advantages in terms of cost of resources and also in terms of giving the students a global audience for their work.

The course is taught and assessed entirely in French, exposing students to a wide range of authentic materials on topical issues. It also challenges students to communicate directly with academics, business people, media experts, students and even celebrities from France through use of communications technologies. These aspects required the students to apply their written language skills in a whole range of settings as well as to learn about the media, cultural issues and the application of ICT skills. This made the course a rich and valuable learning experience for the participants.

The students reported spending extra time on this option compared with other options. This could be seen as a benefit or drawback depending on your viewpoint! The staffing time however was also extended, with input from two departments on the course delivery, making the running costs slightly higher. There is an argument which suggests that with the provision of some staff development, this course could be undertaken by the department themselves with IT support, rather than delivery time being the key factor.

70mm

Table VII. Overview of the Reportage course at the University of Exeter.

Discussion

This article focuses on the educational aspects of the ITATL study specifically related to the case studies. It must be remembered that this is just one facet of the whole study, and as such cannot on its own provide rigorous evidence for the overall outcomes and recommendations of the study.

The major outcomes of the ITATL research concerned:

- teaching and learning, and
- the management of change and staff development.

Teaching and Learning Issues

Three main issues emerged from the research which will now be discussed. They were: quality assurance and the encouragement to develop higher-order skills through using IT tools; providing access to authentic materials; and offering increased access to higher education, especially for challenged learners.

Quality Assurance and the Development of Higher-Order Skills

ITATL can play a central part in a process of change in which integrated courses that incorporate new information retrieval, assimilation, validation and dissemination skills become more commonplace in higher education. Similarly IT is used effectively for routine, repetitive and low-level activities, allowing students to focus on higher-level cognitive processes. A discussion of quality in ITATL may be found in Davis et al (1997).

Quality assurance looks for these higher-order skills in a variety of contexts because they move learning on from knowledge acquisition to its application and interpretation in ways which are socially and economically useful. The term ‘higher-order skills’ is used here to include both cognitive

and knowledge management skills. Both have a key role to play in preparing graduates for both the world of work and further research within HE.

There were examples in almost all the case studies of IT tools being used to develop higher-order skills. In the two second-year courses for engineering at Sheffield Hallam it was clear that students were better able to focus and apply the processes of mathematics to relevant engineering problems. In one case this was because IT removed the need to perform complex but routine calculations. In the other case students were able to extend their understanding of the application of numerical analysis through innovative use of the spreadsheet.

In the French course at Exeter use of email and the Internet gave students access to a wealth of advanced and authentic materials on a wide range of topical issues. Knowledge management skills were necessary to select, abstract and reformulate the information for new purposes and cognitive skills to apply it, making this a rich but challenging task. The outcomes of student work that were originally circulated only within the group or department, are now published on the Internet, giving students the additional stimulation of a global audience. Development of knowledge management skills was also present in the geography course at Plymouth where students researched widely for information and then created effective presentations and placed them on the World Wide Web (WWW) for others within and beyond their group to share.

Access to Authentic Materials

Access to authentic materials was another way in which use of ITATL enriched the learning experience. It was a key feature in most of the case studies. In Exeter's Reportage course this was provided through use of communications technologies that permitted students to access up-to-the-minute information in French to be incorporated into a collaboratively produced newspaper. Similarly, computer-assisted learning materials in the Bristol Orthodontics course gave students access to simulations of dental processes based on real images of patients' teeth. The use of the material was structured by the practical activities, thereby leading to development of sound practice from authentic materials. In the Environmental Law study the ITATL materials had ensured the course was based on authentic materials with artefacts and information from a leading practitioner in the field.

In the above examples rich learning experiences were offered as a direct result of deployment of IT. However, concerns were also expressed that use of IT in other situations may make the learning less meaningful. Examples of (poorly designed) multiple choice assessment were quoted here. In one case study there was concern that students might be involved in a less rich learning experience through the use of IT. This, it was felt, was due

to the design of the materials and other features of the new course mainly present due to lack of resources and awareness of the scale of the task which was being undertaken. Like any other resource, ITATL also needs quality assurance in HE.

Increased Access to Higher Education

Increased access to higher education was raised frequently across the whole study and in terms of the case studies. Perhaps not surprisingly, it was most evident in the Open University PGCE course. Here students were able to study from their own homes or at work, thus widening access to higher education to those who would not be have been able to study in a full-time or campus-bound situation. Widening access is linked to increased flexibility of time and place for studying. This feature was present in at least two other case studies, Engineering and Environmental Law. In each of these the majority of students (52% and 64% respectively) reported increased flexibility for study.

Although the case studies themselves did not encounter students with particularly challenging special needs, it is clear from the literature and seminar participants that IT is a vital ingredient in permitting access to continued education for challenged learners and those with particular needs. It should also be noted that all learners have particular strengths and weaknesses and IT can be used in the process of teaching and learning to address particular needs and motivation. Gilroy & Miles (1996) provide advice for students challenged by physical and special learning difficulties, including careful consideration of the effective use of IT. A prevailing view sees disability as relating to the environment rather than the individual.

Access is also important for students remote from the UK. The Plymouth WIRE case study of a course in multimedia uses a satellite and digital telecommunications to deliver a course directly into several study centres across Europe. Such innovative uses of new technologies are expected to increase. The report noted the UK's leading position in related research and development.

Situations for Effective Deployment of ITATL

The case studies, together with data from the other strands of the research study (the literature review, invited seminars and data collection through pro formas on the WWW) allowed the research team to suggest some generic situations in which use of ITATL can be deployed most effectively. The key factor in this is appears to be the ability to specify IT clearly over time. The situations identified were:

- where the topic was well specified and agreed among the discipline;
- where the topic is relatively static over time;

- where the IT requires little development;
- where IT is readily accessible to students and staff;
- where IT clearly removes impediments to learning or teaching.

The Orthodontics course is a clear example of the first two points. The topic has not changed significantly over the last ten years. Materials have changed, but not techniques and all fourteen courses in the UK use the same text book. Agreement among a discipline is fostered by a relatively specialist area or a professional body which sets standards and facilitates discussion on developing practice and research. Team teaching is also more likely in such situations, thus permitting the sharing of expertise across institutions within the UK.

IT requires relatively little development where the applications have been developed for many purposes and a large user group. One colleague used the term 'Worldware' to illustrate this. Examples are graphic calculators, word processors and the WWW. Teaching staff and students will become aware of the potential and use of these IT tools from many sources and seek support in developing their skills, thus reducing the steepness of the learning curve. The time required to learn to use a new piece of software and to develop associated concepts is not insignificant, nor is access to IT on a personal workstation necessarily easy. When IT becomes easy to adopt and easy to access with widespread ownership of personal workstations, a significant private contribution will be made to the resources available within publicly funded HE.

Management of Change and Staff Development

The focus of this article is the case studies and educational outcomes of the ITATL research. The benefits of using ITATL and other teaching and learning issues are central to this. However the strongest evidence and opinion across the entire research study, including the case studies, related to staff time, staff development and understanding the management of learning where IT resources are a key feature of learning and teaching. Bridget Somekh in this issue undertakes further discussion on this following her presentation to an ITATL seminar. The literature review revealed extensive study and reporting on the management of innovation and change in education, but little that dealt specifically with the convergence between distance, open and flexible learning; information and communications; and the associated staff development. The staff interviews undertaken in the case studies, the questionnaire on the WWW and the discussion at the invited seminars all recognised that consideration should be given to the management of change processes and the re-organisation of teaching and learning. It was felt this was essential to ensure the effective and efficient deployment of ITATL resources, without it results could include increased cost and decreased effectiveness.

In the case of the Orthodontics courses for example, significant organisational changes were required. This in turn made new demands on staff who required training and support. Similar situations were reported in the Environmental Law case study, in the Reportage course and also in the Engineering course studied at Sheffield Hallam. These situations need to be foreseen, but more than that, they require supporting action to be put in place. Plans are needed to ensure a timely sequence in order to promote effective practice. The member of staff leading the development at one institution said he wished he had known more about the processes of teaching and learning prior to embarking on the initiative, in order to inform the development of new practice.

A lesson from this is perhaps that at the outset of planning and innovation there must be a clear distinction between 'change' (to make something different) and 'progress' (to do so in a desired direction), particularly when matters of 'quality' are at issue:

> One of the key problems faced by the quality movement in higher education is the same as that faced by people interested in promoting effective change management and evaluation. Individuals from different backgrounds and roles will inevitably bring with them different assumptions about what constitutes 'high quality' education, research and community service and, often unconsciously, will apply these criteria when making judgements about the performance of current activities or the value of particular proposals for improvement or innovation. (Scott, 1996)

Although the cost of staff time (including opportunity cost) was raised time and again, it was also recognised that staff were in some instances able to identify personal gains. At Sheffield Hallam there was evidence of increased self-esteem for tutors who improved or extended their own teaching styles. Similarly staff at Bristol gained external recognition for their work in this area.

Staff development outcomes related to ITATL development were generally reported in a positive light. As a direct result of collaborative working and a shared development effort, staff indicated significant quality improvement and increased consistency of presentation of teaching and learning materials.

There was some evidence that ITATL had a direct bearing on maintaining professional expertise nationally in some areas, e.g. orthodontics. The shortage of graduate orthodontists was a major factor motivating the development of ITATL and it enabled the creation of a new course for graduates, while retaining orthodontics within the undergraduate course. The fact that such courses are still running, when they might otherwise have been forced to close due to lack of expertise, is another example of how use of ITATL was used to the benefit of the learning community.

The main drawback frequently quoted across these case studies, and raised in other strands of the research was that of staff time. Not only was the initial course development costly and time-consuming, but running costs in terms of staff time were also reported to be high. Some, but not all of this time was linked to the need for staff development plus the additional time required to learn and implement new skills and working methods. It was clear that the learning experience for the students could be affected by a lack of time for technical, administrative and tutorial support. In most cases it was reported that the high demands on staff time were ongoing and continued beyond the developmental phase. For example, although there was reduced contact time at Bradford, the tutor spent a considerable time working with students through email or on-line discussion groups, and although it was felt some technical aspects would be improved, this would remain an ongoing requirement.

Conclusion

The recommendations of the whole research study are included in the final ITATL report (Boucher et al, 1997). In the short six-month timescale available a comprehensive review of ITATL in UK higher education was not realistic. The recommendations in the report are therefore necessarily founded on both evidence collected and an assessment of likely change.

The research study did uncover a clearer view of the educational costs and benefits of ITATL, including its complex and diverse nature. Analysis showed that the development of ITATL is an intricate and repeated set of innovations applied to extremely complex, rapidly changing and interdependent systems. A major recommendation was therefore for recognition of the importance of ITATL within and beyond UK HE as a field of interdisciplinary research and development. Teacher education is seen as a core within this and recognised as such by Dearing's recommendation that:

> all institutions should, over the medium term, review the changing role of staff as a result of communications and information technology, and ensure that staff and students receive appropriate training and support to enable them to realise its full potential. (Dearing, 1997)

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