

Telematics-Supported Education for Traditional Universities in Europe

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ABSTRACT

Telematics is the combination of information technology and communication technology. Telematics applications to support educational delivery and participation in traditional European universities are rapidly becoming part of the educational setting. Sometimes they are used specifically to increase distance flexibility in participation, but this is not their only value. Telematics applications are also associated with other forms of flexibility, as well as with heightened efficiency and enrichment of the learning process, both for those in full-time traditional attendance and those participating in increasingly variable ways. In this paper, we first give an overview of the pressures for change in traditional universities in Europe and then define the change domain as involving much more than distance. Then, an overview of a variety of ways that telematics applications are being used in traditional universities in Europe will be given, including categories relating to various aspects of the course-participation experience in the individual course (such as aspects relating to lectures, self-study, and project-type

group work). This will be followed by examples of new forms of course organization involving one or more institutions and also of new forms of activities in which traditional universities are becoming involved outside of their core business of mainstream course delivery. The impact on a particular institution, the University of Twente in The Netherlands, will be discussed in more detail. Issues demanding serious attention include staff and student engagement and support and technical decisions relating to the infrastructure and interface of the technology needed to make the new flexibilities possible. These are described and illustrated with examples. The difficulties in supporting this evolution in traditional universities with cost-effectiveness analysis are also noted. Finally, a reflection is made on the changing state of the division between traditional universities and universities organized around distance and open delivery. In some ways, this division is rapidly losing meaningfulness, but certain differences that are more profound than "distance" still remain.

Introduction: Telematics Applications in Higher-Education Institutions

Telematics applications to support educational delivery and par-

ticipation in traditional European universities are rapidly becoming part of the educational setting. Sometimes they are specifically used to increase distance flexibility in participation, but this is not their only

value. Telematics applications are also associated with other forms of flexibility, as well as with heightened efficiency and with enrichment of the learning process, both for those in full-time traditional attendance and those participating in an increasingly variable number of ways. However, before illustrating a variety of such examples, the scope of this article should be clarified.

First, the article restricts itself to European universities and, within this, to universities which could be called traditional. Thus, universities founded as distance and/or open are not included in the analysis. By a traditional university is meant one which assumes that course participation involves regularly scheduled activities occurring within the physical location of the university. These regularly scheduled activities include lectures, practical sessions, and examinations. Also, traditional universities typically have relatively fixed programs of study in terms of courses to be completed, usually in a fixed sequence, all leading to a degree. At the post-first degree level, traditional universities vary considerably from each other, and the experience of earning a higher degree, usually the Ph.D., differs from country to country in terms of the expectation that candidates attend courses and be present on a campus. In Europe, the major business of traditional universities is what North Americans would call undergraduate education. Unlike North American universities, there is generally not a pre-planned program of courses for post-undergraduate studies in most traditional European universities. In The Netherlands, for example, Ph.D. candidates are not con-

sidered students but rather researchers-in-training and receive a salary for their contributions to the research project with which they are associated. Only in the last few years has the idea begun to take root that it can be useful to the Ph.D. candidates to participate occasionally in some courses. But these courses are optional, and performance is generally not evaluated with a grade or in terms of some other summative judgment. (The courses are seen more as professional development modules than courses.) Thus, when speaking about the educational program of European universities, most likely it is an undergraduate program that is meant.

Also, almost all of the references cited in this article are written by faculty members in traditional European universities, and almost all were published in 1998.

A second definition is also important. The term "telematics applications" will be used throughout this analysis instead of the term distance education. Telematics is the combination of information technology and communication technology. Telematics applications relate to the instrumentation handled by the user related to the use of telematics. Table 1 gives an overview of telematics applications in use in traditional European universities, grouped according to five major sorts of educational functions.

All of the telematics applications indicated in Table 1 are in use in various combinations in a large number of traditional European universities. Sometimes this use is motivated by the individual instructor who is curious or convinced that such an application will enrich his or her

Table 1
Types of Telematics Applications Related to Categories of Educational Use in Traditional European Universities (Collis, 1998)

Major Educational Use	Examples of Telematics Applications
1. Publication, information, dissemination	HTML editors; WWW sites and the browsers to access them, WWW sites associated with database environments; software to facilitate file transfer and document attachments to E-mail; tools for cross-application format retention (i.e., pdf)
2. Communication	E-mail systems, computer-conferencing tools, including WWW boards and other forms of WWW-based conferencing; WWW sites offering communication options including <i>mailto:</i> for the direct sending of E-mail and <i>CGI</i> [Common Gateway Interface] forms for structured communication; software for Internet telephony; software environments for audio-video desktop conferencing, for voice-mail, for creating video attachments for E-mail; software systems for text-based chat
3. Collaboration	Groupware, which includes application-sharing software, shared workspaces, WWW-based shared workspaces, WWW-based application sharing, workflow tools; computer-conferencing sites; WWW sites designed for collaboration support; tools to allow collaborative writing on documents that are then commonly available to a group
4. Information & resource handling	WWW-based search engines; distributed database systems (WWW- and proprietary); WWW sites designed for information organization, access, and sometimes creation; tools to retrieve and display distributed multimedia resources stored as digitized audio and video (including audio-on-demand and video)
5. Specific for teaching & learning purposes	Applets for interactive software (such as tutorials, quizzes, simulations) accessible via WWW sites; testing systems accessible via WWW sites; video-capture tools for lecture or presentation capture; video-conferencing (point-to-point and multicasting) for lecture participation; WWW-based course-support environments

course or improve its efficiency. Other times, the use of such telematics applications is a result of pressures from the institution for change. In the next section, we look briefly at such motivations for change and the role that telematics applications can play in such change.

Telematics Applications in Traditional European Universities: Motivations for Change

From many different sectors—scientific, social, political, and educational—the message that traditional European universities are or should be in a process of change is a common theme. But why, and how? For ex-

ample, the Paris-based Director of the Information Centre of the International Association of Universities, summarizing the results of a Task Force commissioned to study these pressures for change on the traditional European university, has indicated (Langlois, 1997, p. 7):

New information technologies, and particularly the Internet, in dramatically transforming access to information, are changing the learning and research process, how we search, discover, teach, and learn.... Universities must face up to this challenge....The future of universities depends on the capability to adapt to the new information society and meet the needs of an ever more demanding professional market.

But even while accepting such statements at the general level, the individual faculty member in a traditional European higher-education institution, with probably many years experience in teaching her or his courses, may not be convinced of the immediate need or feasibility of changing his or her own way of teaching, of organizing his or her courses, of lecturing, handling student assignments, or giving examinations. The faculty member quite sensibly may be skeptical of general statements indicating that he or she should change his or her way of teaching. Change for change's sake? Change because of technology push? Change because of metaphor-push? (Becoming a "virtual university"?) Change because of politicians, who may be using "the need to change" as a misnomer for reducing funding to the university?

To respond to this skepticism, there do seem to be at least three compelling clusters of reasons why faculties in traditional European universities need to re-examine their instructional practices and change their didactical methods (see Collis, 1998b, for an analysis). The three general clusters relate to a) basic principles of good teaching and learning, b) pressures related to the increasingly changing demographics of the student population with the corresponding increase

in the diversity of their needs, and c) factors relating to the need to provide more flexible education.

The Need to Re-Affirm Some Basic Principles of Good Teaching and Learning

Probably, the majority of instructors in traditional universities believe that they are following basic principles of effective instruction. However, many (outside of faculties of education)

may not be aware that there is an extensive base of theory and research related to the science of teaching and learning in higher education (see, for example, UK researchers, Somekh & Davies, 1991) and thus can benefit from becoming more aware of certain key principles. Even those in faculties of education can benefit from occasional critical

There are at least three compelling reasons for universities to change: principles of good teaching and learning, changing demographics of the student body, and demands for more flexible education.

reflection on their own implementation of the theory that many of them are teaching (Laurillard, 1993). Although opinion can vary on what the key principles may be for good teaching and learning in higher education, the following consistently emerge in the literature cited in Europe (for a current synthesis, see Norman, 1997):

- Learning arises from the *active engagement* of the learner.
- This engagement involves cognitively active roles of both in-

structors and learners, "since knowledge is constructed and reconstructed through heuristic processes of creative thinking and *interaction*, as well as the acquisition of appropriate information" (Norman, 1997, p. 51).

- "The assessment of competence depends on listening, observing, and responding to learners reflecting on their products" (Norman, p. 51), processes best served by *communication-oriented* pedagogy (Somekh & Davies, 1991).
- Models of good learning should shift from knowledge-based, instructor-transmission models to models which are process-based and learner-oriented (Wright & Cordeaux, 1996). A well-designed instructional environment involves considerable instructor preparation and monitoring but is aimed at learner self-regulation and self-responsibility (see, for example, Luft & Tienes, 1997).
- And there are other less-conceptual but nonetheless important basic principles to consider: Students want to move *efficiently* through their studies, in both time and energy; students do not automatically have good study skills, discipline, or motivation (Collis & Meeuwse, in press); and instructors in higher education must work within decreasing budgets and higher *demands on their own time* and energy. We must do more with less (Moonen, 1994).

Needs Relating to Changing Student Demographics

While principles relating to good teaching and learning in traditional higher education in Europe may be

constant over time, the characteristics of the students in higher education are not. Students in the normal intake routes, directly from secondary school and resident at or living nearby the physical campus, are being joined by increasingly diverse cohorts, diverse in age, educational backgrounds, experiences, distances in which they live from the campus, and even cultures and native languages (for an European analysis, see Langlois, 1997). *Lifelong learning* will be not only a desire but a necessity in a context of increasing career mobility (Krempel, 1997). Increasingly, students will require educational programs and the way of experiencing those programs tailored to their own situations, rather than fitting a standard model of the young full-time student, living on the campus and needing a full range of courses for a certain degree. There are moral, social, and financial reasons to adjust traditional university programs to these increasingly diverse cohorts. But how to maintain a commitment to the principles of good teaching and learning described above as students have increasingly different needs and situations? How to do this while retaining respect for students' needs relating to efficiency and clarity and to instructors' constraints relating to time? The answer being suggested throughout Europe is in more flexible university education.

The Need for More Flexibility

Flexibility means allowing the learner some critical choices in the learning situation so that it better meets her or his needs and individual situation. While flexibility is most frequently equated to allowing the

learners choice in the location in which they study (for example, allowing them to choose between a course offered on campus or the same course offered at a distance—the traditional “distance education”), there are more than 20 other aspects of flexibility that can be associated with more individualized instruction (Collis, Vingerhouts, & Moonen, 1997). These relate to time flexibility, content flexibility, entry and completion flexibility, instructional-approach flexibility, learning-resource flexibility, technology-use flexibility, interactivity and communication flexibility, course-logistics (such as participating in group activities or working individually) flexibility, as well as location flexibility. In a recent research study involving a number of traditional European universities (the *TeleScopia Project*, Collis, 1996; Collis, Vingerhoets, & Moonen, 1997), relating to the feasibility of these various forms of flexibility in actual practice, it emerged that learners already in the workplace and returning to courses particularly valued a) not having to relocate from their homes and work in order to attend required sessions (although they do not mind occasional travel to a remote location for various course activities); b) having flexibility within the pre-determined time frame of a course with respect to completing assignments; c) being able to omit aspects of a course that were inconvenient or judged not directly relevant to them (particularly group meetings); d) being able to vary the amount of communication that was required of them with other students or the need to physically get together with other students or the instructor; and e) flexibility in being

able to adapt assignments to better relate to their workplace duties (Collis, 1996).

Given all the possible permutations on individualization that can fall under the category of making instruction in universities more flexible, the following frequently are appearing within the framework of the traditional course or institution:

- Improving *flexibility in location* of where the learner can carry out *some* of the different learning activities associated with a course.
- Improving *flexibility in program*. Assuming the learner has relevant previous experience, subgroups of courses can be chosen in terms of the learner’s needs and interests.
- Improving *flexibility in types of interactions* within a course. For example, not all students need to work in groups, and also not all group members need to be in the same place at the same time to work together. Choices can be offered.
- Improving *flexibility in forms of communication* within a course, so that learners and instructors have a wider variety of ways for more targeted and responsive communication than is the case when communication is limited to what occurs during face-to-face sessions such as lectures or incidentally in the hallways.
- Improving *flexibility in study materials*, so that the students have a wider choice of resources and modalities from which to study.

In each case, telematics applications, combined with new approaches to course participation and

institutional delivery, can be identified. Calls are being heard for a "multimodal university, responding in a flexible way to different types of customers" (Van der Perre & Claeys, 1998, p. 238). Revans (1998), from the UK, hypothesizes that for a university to survive, its own rate of learning must be greater than or equal to the rate of change in its external environment.

Also, in Europe, there are unique pressures for change on universities relating to the desire to bring a European dimension into national education. The European Union [EU] stimulates this internationalism regularly by making project funds available to consortia of universities, if these consortia involve partners from a variety of countries. The European dimension is strong in the overall culture and correspondingly has a strong effect on higher education. For example, in 1997 and 1998 there have been a number of international conferences with a heavy representation of academics from traditional European universities occurring in Europe, all focused on the changing role of the university and the role of telematics in this change. These conferences have included *RUFIS 97* [The Role of the University in the Future Information Society] (Prague, September, 1997); *The Virtual Campus* (Madrid, November 1997); *Networked Life-Long Learning* (Sheffield, UK, April 1998); *Universities in a Digital Age: Transformation, Innovation, and Tradition* (Bologna, Italy, June 1998); and *Teleteaching 98* (Vienna and Budapest, September 1998). In addition, the US-based ED-MEDIA '98 Conference, held in Freiburg, Germany, in June 1998, was attended by

a large number of faculty members from traditional European universities.

Thus, there is a strong current of interest in traditional European universities for the use of telematics for a variety of changes in their educational practice. In the following section, a selection of examples relating to the sorts of changes that individual instructors are introducing into their own courses will be given. This will be followed by an overview of activities at the institutional level.

Telematics Applications within the Traditional Course

Although there are many ways to categorize the use of telematics applications in traditional courses, categories relating to course organization, to lectures, to self-study, to individual or group assignments, to testing, and to general communication are convenient, as the majority of traditional courses involve some combination of these categories (Collis, 1997). In each of these categories, there are many examples of the use of telematics applications to make the learning situation more efficient, to enrich the learning situation, and/or to increase the flexibility of the learning situation. In general, however, even when there is flexibility in some aspects of a course, the course is not considered "distance education."

Enriching and Extending Lectures

Telematics applications offer many possibilities to support the traditional lecture setting, beyond the obvious benefit of allowing students

to participate from a distance via some form of videoconferencing or use of a common blackboard (several examples of this type of telematics use will be mentioned in a later section of this article). Three examples which are becoming popular in Europe are a) making lecture notes available before and after a lecture via a WWW [World Wide Web] site, often with extra study material and annotations; b) using a WWW site for presentation support during a lecture (and also having the presentation materials available for further individual study after the lecture; and c) retaining the lecture as digitized video and making it available for review via the course WWW site. An example of (a) is described by Göschka and Riedling (1998) from the Vienna University of Technology. Students in their courses gave a high valuation to having the possibility of downloading lecture notes. Like students at the University of Twente (Van Rennes & Collis, 1998), however, the Vienna students do not want to study from the computer screen but instead prefer to use the lecture materials as a convenient way to access the notes. The use of prepared resource materials available via a WWW site not only brings visual stimulation into a lecture but has other benefits. Geyer and Effelsberg (1998), at the University of Mannheim in Germany, note that materials can be annotated during the lecture, audio comments saved during the lecture, and the entire set of materials made available after the lecture for review, locally as well as at a distance. The latter technique—capturing a lecture and making it available later for review via a WWW site—is also being used at University

of Freiburg (Hurst, Muller, & Ottmann, 1998); at the Delft Technical University in the Netherlands (see <http://dutoi06.io.tudelft.nl:8900/public/NRC/index.html> for a public view of one of the lectures); and at the University of Twente.

At the University of Twente, we have developed a technique whereby the instructor's presentation can be accessed either as video-on-demand via the course WWW site after a presentation or can be accessed interactively, in a form that is synchronized with the PowerPoint slides that were being shown as the instructor's remarks were made. We use this technique not only with the instructor's comments but also to capture students' discussions and comments during a face-to-face session and have them available for review and reflection after the session. In this way, students can jump immediately to the point in the discussion or lecture that they want to review without needing to re-sit the entire sequence. Also, students can choose to have the full synchronized presentation—screen contents, audio, video—or they can choose any subset of these. A student wishing to review what was said about a difficult statistics formula during a lecture, for example, can jump immediately to that portion of the stored presentation (identified by a series of thumbnail images of what was on the screen at each different phase of the lecture), perhaps choose to listen to the instructor discuss that formula again, or study the formula without sound or video, even downloading just that screen for off-line study or printing out. Similar work is also being carried out at the University of Freiburg in Germany (Bacher & Müller, 1998).

Enriching and Extending Study Activities

Typically, study activities in higher education do not take place with the instructor present. Students read pre-set materials, sometimes do exercises, perhaps take part in a practical session to try out what they are

learning, and work over a period of time on an assignment such as a report or group design project. Telematics applications are making strong contributions to the increased flexibility of such activities and also to increased opportunities for feedback from the instructor and peers. Table 2

Table 2
Applications of Telematics to Enrich and Extend Study Activities

Location and Reference	Type of Telematic Application
Kiev Polytechnic Institute (Demchenko, 1998)	Students make extensive use of the WWW as they carry out collaborative projects. Results of the projects remain available on the WWW for other students.
Vienna University of Technology (Goschka & Riedling, 1998)	Interactive study materials, available via the course WWW site, generated by an associated database.
University of GH Paderborn, Germany (Hampel, Ferber, & Muller, 1998)	Animation, simulations, and visualizations available via course WWW sites using Java for self-study of mechanics.
University of Twente, The Netherlands (Min, 1998)	Students create Java-based instructional simulations as course assignment and make these available to via the WWW to others.
University of Aveiro, Portugal (Firmeza, 1998)	Students interact with a WWW-based "virtual mechanics laboratory," in order to save the costs and difficulties of having to access a full-scale laboratory for their exercises.
University of Sheffield, UK (Toynton, 1998)	Students make use of a WWW-based resource collection to support problem-solving activities related to geological periods.
University of Wales, Aberystwyth (Ratcliff & Davies, 1998)	Network tools are used to facilitate students' getting fast help from a tutor or from other students when working on programming tasks.
University of Vigo, Spain (Llamas, Anido, & Fernandez, 1998)	Students work with a Java-based simulation and can use a variety of communication tools for discussion or to ask for help.
University of Twente, The Netherlands (Collis & Winnips, 1998)	Students, working in groups, use the course WWW site to make available draft versions of their design products and give each other structured feedback via the WWW.
University of Helsinki, Finland (Meisalo, Sutinen, Tariho, & Terasvirta, 1998)	Students use a Java-based interactive algorithm animator to get immediate feedback on their work (in computer science and also in biology).
University of Twente, The Netherlands (Collis, Winnips, & Moonen, 1998)	Students find additional study resources for the course, submit their summaries of these resources via the WWW for comments from the instructor, and after approval from the instructor, the student-selected study materials (available via the course WWW site) are added to the instructor-selected materials as required reading for the course.
University of Twente, The Netherlands (Van der Veen, Collis, & Jones, 1998)	Students working in groups on design projects use WWW-based workflow tools to keep up to date on the progress of their group.
University of Tampere, Finland (Hietala, 1998)	Students in a computer course use WWW-based conferencing system for discussions.

gives a variety of examples from traditional European universities.

Integrated WWW-Based Course-Support Environments

The examples noted in Table 2 are only a very brief sample of how telematics applications are enriching and extending student study activities in traditional university courses. Many other examples can be noted that involve not only support of specific study activities but also integrated support of the entire course. For example, at the Janus Pannonius University in Hungary, an integrated course-support site allows students convenient access to the MAPLE algebraic computing system and a variety of other study aids as well as pre-tests, lecture notes, mailboxes for communication, and other forms of interactive quizzes (Klincsik & Sarvari, 1998). At the Robert Gordon University in the UK, the WWW-based support site for a course in research methods brings together tools to use in research activities, links to external sites which provide databases and examples of survey research results, links to tutorials and additional study materials, search tools, and locally-made study materials, which together form a "WWW Resource Centre for Acquiring and Accessing Open Learning Materials on Research Methods (ReMOTE)" (Newton, Marcella, Middleton, & McConnell, 1998). At the University of Barcelona, a number of communication tools, such as a "Private area" and a "Public area" are integrated within a WWW site to support an environmental education course (Barajas, Chrysos, Bosco, Fonollosa, Alvarez, & Sancho, 1998). At the Technical University of

Braunschweig, Germany, a course in advanced computer networks makes extensive use of an integrated WWW-based support environment (Zitterbart, Böger, Harbaum, & Brand, 1998). At the University of Malaga in Spain, the problem of how to test students in courses requiring the use of a computer for the final test (such as computing courses), when there are not enough computers available and students must use computers in different parts of the campus, is being solved by an Internet-based secure test system (Mana-Gomex, Villalba-Sanchez, & Lopez, 1998). At the Vrije University of Amsterdam, students use WWW-based "virtual learning environments" to support team learning, to be informed about course-related issues, to communicate with each other and the instructors, to publish their results, and for evaluation of their assignments (Huysman & Gerrits, 1998). At the University of Twente, such WWW-based integrated course environments have been in use since 1994, evolving from very simple publication, communication, and collaboration support environments in 1994 to complex, database-driven systems serving the entire faculty in 1998 (we will discuss this in more detail shortly) (Collis, 1997; Collis & De Boer, 1998).

All of the above examples are telematics applications for the benefit of the students in traditional universities. However, the flexibility they allow makes it easy for students to make use of them from wherever they have WWW and Internet access. Students do not have to be at the university to interact with these resources and with each other. Face-to-face interactions may in fact occur little more than the

face-to-face interactions organized by distance-teaching universities.

In this section, the focus has been on examples of individual courses, usually designed, motivated, and taught by their instructors. In the next section, examples of telematics applications facilitating institutional change will be highlighted.

Telematics Applications Related to New Forms of Activities at the Institutional Level

In this section, we look at the following categories: a) telematics used by the traditional university to serve students at a distance; b) telematics as a tool for multi-partner collaborations among universities; and c) telematics as a tool for faculty-wide change for more flexible delivery. The first of these categories may refer to traditional courses but may also refer to new courses made possible because of experimentation with telematics-supported delivery. The second category typically refers to project-type activities, in which any course developed is "something special" and not likely to be part of the mainstream practice of any of the participating institutions. The third will be illustrated by an example from the University of Twente.

Telematics Used by the Traditional University to Serve Students at a Distance

Many traditional universities now are delivering some of their courses and programs to students who are considered "at a distance." Sometimes this is done on an evolutionary basis, with respect to a small number of courses. In these cases, there may be a motivation on the part of the instructor in-

involved to try new forms of telematics support. The courses involved are seen as experimental. In other cases, enough experimentation has occurred so that some kind of stable setting is in place to support a form of distance-delivery within the traditional university setting. This distance-oriented setting, however, is not typical of the rest of the university. In Table 3, an overview of examples of such distance-education initiatives within the traditional European university is given.

Table 3 shows some of the diversity now occurring in traditional European universities that are turning their attention to attracting distance students or offering their own courses in a more flexible way to their existing students. In the next section, activities that focus more on new collaborations with other institutions, rather than being activities primarily intended for their own students, are illustrated.

Telematics as a Tool for Multi-Partner Collaborations among Universities

There are three general ways that traditional universities in Europe become involved in non-traditional experiments and partnerships, facilitated by the use of telematics. These are a) pairings between similar courses in two (or sometimes more) universities for collaborative course delivery; b) regional collaborations involving universities and a variety of other partners; and c) international collaborations, often within the framework of a project funded by the European Union. In most of these cases, it should be noted that it is usually not the entire university that is involved but only one department or even one small group of individuals.

Table 3
Distance/Flexible-Education Situations
within the Traditional University

Location and Reference	Type of Distance/Flexible-Education Situation
Darmstadt University of Technology, Germany (Anderl & Vogel, 1998)	All courses in mechanical engineering supported by distributed lectures, lectures on demand, hypermedial information environments, and Java-based multimedia tutorial sequences.
University of Strathclyde, Scotland (Whittington & Sclater, 1998)	A university unit is responsible for the "Clyde Virtual University," described as a "testbed for exploring, developing, and evaluating techniques for delivering learning materials, supporting collaborative learning, and carrying out assessment over the Internet."
University of Helsinki, Finland (http://www.helsinki.fi)	The Vantaa Institute for Continuing Education, associated with the University, focuses on making education more efficient through the use of telematics.
University of Lancaster, UK (http://www.lancs.ac.uk/users/ktru/ktru.htm)	The "Knowledge Technology Unit" focuses on "the use of telematics for the exchange of professional knowledge," both for persons working both on-campus and off-campus.
Aalborg University, Denmark (http://virt.auc.dk)	Aalborg is a "dual-mode" university, in which face-to-face activities are integrated with distance study (making use of computer conferencing) for many of its students. The "VIRT" Project (Virtual Learning Environment) works to bring faculty members from all disciplines together to exchange experiences with the use of computer conferencing for dual-mode support.
The Queen's University of Belfast, Northern Ireland (http://www.icbl.qub.ac.uk/tltsn); University of Twente, The Netherlands (Stanchev & Nedkov, 1998); Henley Management College, UK (Smith & Birchall, 1998)	These are some of the European universities that have now started Masters Programs, aimed at non-traditional students relative to their institutions. They involve a mix of face-to-face and distance participation, supported by WWW environments or computer conferencing.
Oxford University, UK	Oxford will begin in January 1999 to offer two courses via the Internet, not as part of its degree program but within its "lifelong-learning program."
Technical University of Gdansk, Poland (Grabowska, 1998)	Students in this course can participate "in distance education mode via the local area network."
University of Plymouth, UK (Rodd & Coombs, 1998)	A module involving the use of the WWW and Internet is being tried out for students at a distance from the university.
Nicholas Copernicus University (http://www.telem.uni.torun.pl)	The "Telematics and Teleteaching Centre" develops distance teaching technology, is a base for new forms of flexible delivery, and realizes projects relating to distance learning.
National Technical University of Athens, Greece (Rigopoulos, 1998)	A continuing-education seminar on technical drawing with AutoCAD was offered to 260 professional engineers and architects from all areas of Greece. A <i>Lotus Notes</i> network application was used.
Gjovik College, Norway (Rognstad & Tosterud, 1998)	Videoconferencing is used for students in its decentralized nursing education program, which features a mix of one start-up meeting, several local meetings, and videoconferencing sessions.
Technical University of Sofia, Bulgaria (Shoikova, 1998)	A new model for the engineering program features a mix of self-learning sessions, face-to-face sessions, and the use of a WWW-based support environment.
Universidade Católica Portuguesa, Portugal (Pereira & Tavares, 1998)	Since 1994, a management program has enrolled more than 1000 managers from more than 450 organizations. The program features a mix of E-mail, multimedia materials on CD-ROM, and videoconferencing.

Table 3 (continued)
Distance/Flexible-Education Situations
within the Traditional University

Location and Reference	Type of Distance/Flexible-Education Situation
Kiev Polytechnic University, Ukraine (Dovgiallo, Kolos, & Kudrjajtseva, 1998)	A WWW-based course for masters students and staff members of the university was developed to teach distance-course design.
Katholieke Universiteit Leuven, Belgium (Reynolds, 1998)	The Audio-Visual Centre has developed into an expertise center for the use of videoconferencing for teaching purposes, not only for its university but also in participation in a number of European collaborative projects.

In the first category, the motives are usually content-specific: two or more instructors teaching a similar course at different institutions decide together that they would like to experiment with some form of mutual course-giving for their students. For example:

- The group involved with architectural education at the Swiss Federal Institute of Technology have combined with a number of other such groups at other European (and outside Europe) universities for the participation of some groups of their students in common “global design studio” activities involving extensive use of both synchronous and asynchronous communication, shared blackboard use for common design tasks, and the use of WWW sites for access to graphics and 3-D modeling tools and for information access and presentation (Bharat, 1998).
- The computer science departments of the Universities of Lübeck and Kiel in Germany share a number of courses through the use of MBone (“Multicast Backbone on the InterNET”) technology, which allows distribution via the Internet of videoconferencing to multiple sites (Hogrefe, 1998).
- The Universities of Mannheim and Heidelberg in Germany also exchange lectures on a regular basis using MBone technology and provide a number of commonly available interactive learning resources for their students via the WWW (Kuhmünc, Fuhrmann, Schöppe, & Heerman, 1998).
- Similarly, graduate students in Informatics and Educational Science and Technology at the University of Twente and the Delft Technical University in The Netherlands are carrying out a collaborative design project involving 3-D modeling using desktop videoconferencing and various groupware tools integrated into a specially developed interface for distributed collaborative work using an ATM connection [a technology for sending multimedia signals quickly and efficiently through networks] between the institutions (Koua & De Diana, 1998).
- Students in the Informatics departments at the University of Linz in Austria and the University of Zurich, and later the University of Liverpool in the UK, have joined in various “Internet seminars”

(Schauer, Muehlbacher, Leng, Shave, & Aiken, 1998). The seminars have the following pattern: A WWW site is established at the coordinating center (Linz); teams are formed, sometimes including students from the different institutions who will only communicate with each other via the Internet; a problem is established for which the teams have to develop a solution; the WWW is used for gathering of relevant information, for contact with experts, for shared workspace support, and for communication and feedback. Final presentations of the teams are presented as WWW sites and then discussed asynchronously by all members of the seminar, via a listserver. The materials produced by the teams remain available as resources for subsequent cycles of the Internet seminar.

Partnerships such as those mentioned above are typically motivated by the efforts of individuals from the different institutions who know each other professionally and work out the possibility of a collaboration. On a wider scale in Europe, consortia including departments within traditional universities are frequently involved in experimental projects funded (in part) by the European Union. Such collaborations are by definition short-term, and few are able to sustain their interaction after the project funding concludes. However, some appear more likely to be sustainable. For example, the "Web University" Project continues to grow after its EU funding has ended (Rinta-Filppula, 1998). This initiative is led by CERN (a Swiss research institute for physics and informatics) and began

by a partnership with FUNET, the Finnish academic network, so that lectures by specialists at CERN could be transmitted to participating groups in Finnish universities. The technology used is IP-based [Internet protocol] video-conferencing, over ISDN [Integrated Services Digital Network], then over ATM, with associated use of WWW sites. Also, transmissions are recorded digitally allowing access-on-demand. While the collaboration was focused on Finnish universities initially, in the 1997-98 academic years, other European universities have also participated. Funding from national research councils in Finland and by organizations continues to support the evolution of the "Web University."

Another European-Union-funded consortium, which may have enough momentum to continue some of its services after its project time officially concludes, is the "Telematics for Teacher Training (T3) Project," led by the University of Exeter and including the University of Oulu in Finland, Utrecht University in The Netherlands, as well as several other universities. Each of the partners has taken responsibility for a particular type of telematics-supported collaborative activity in which students in the respective faculties of education can participate. All activities make use of WWW environments (Pulkkinen & Ruotsalainen, 1998; see also <http://www.ex.ac.uk/telematics/T3/>).

Even if projects are not sustainable without external funding, they do contribute to the increasing growth of contact and cross-Europe community among many academics in traditional universities. The TEN Project, for example, involved experiments with one-way video broadcasting via satellite and return communication

possibilities, also via satellite but also via ISDN networks or standard data networks (Gallud & Gonzalez, 1998). Universities in six European countries participated in 30 courses delivered within this framework, involving over 700 students between 1996 and 1998, allowing a large amount of contact and experience-building to develop among those involved. The CEFES Project (Creating a European Forum in European Studies) offers students in traditional universities in Denmark, Germany, Portugal, Spain, and the UK the opportunity to participate in a specially developed course called "What is Europe" in a series of phases which began in early 1998. Participation is based on the use of computer conferencing via the Internet (Chambers & Winck, 1998). A similar project was HUMANITIES, which in 1995-1996 brought together more than 30 traditional European universities for experimentation with shared (portions) of course activities in the humanities subjects and in law (for a summary, see Dondi, Boninsegna, & Cavina, 1998).

It is particularly interesting that a number of traditional universities in Europe have become involved in regional consortia, making use of telematics applications to bring increased educational opportunity to underserved groups in the respective regions. Examples include the "Resource Centre for Multimedia Teaching and Distance Learning" in the Emilia-Romagna region in Italy, in which the Department of Educational Sciences at Bologna University collaborates with regional educational agencies and training centers. A WWW site is the link between 10 physical teaching-room facilities in the region (Pasotto, 1998). In Sweden, a

similar sort of initiative involves the Luleå University of Technology, but with more advanced networking technology than the Italian example. In the Swedish case, broadband networking brings multimedia presentations, real-time and on-demand, to the northernmost part of Sweden (260,000 persons sparsely distributed over a large area). ATM technology, over which multicasting IP runs, links the University to locations such as community centers and local secondary schools, allowing all the computer science courses of the university and a large number of the other undergraduate courses to be available for participation at a distance. Courses and seminars are also offered to other groups of clients, such as persons needing to upgrade their technical skills and secondary-school teachers. The WWW-based environment used to support all of this is called "mStar" (<http://www.cdt.luth.se/mstar>) and includes tools for audio (communication and on-demand), shared blackboard collaborations, chat, video-on-demand, tools for participation in real-time discussions, and a variety of tools for presentation authoring and session editing (Schefström, Widen, Parnes, Synnes, & Söderlund, 1998).

Table 4 indicates several other regional consortia involving traditional universities and making extensive use of telematics applications.

Many more examples could be given in addition to those noted in Table 4. The conclusion clearly is that traditional universities in Europe are engaged in a large number of non-traditional activities involving flexible and distance-delivery of courses. However, with the exception of the University of the Highlands and Islands example, most of the ac-

Table 4
Examples of Regional Collaborations for More Flexible Learning

Location and Reference	Description
Universities of Hildesheim, Hannover, and Osnabrück, Germany (Wagner, 1998)	Jointly support the development of modules and the "creation of a proper social, organizational, and technical infrastructure" for collaborative course participation using the Internet.
Network NETTUNO, Italy (Garito, 1998)	A consortium of over 20 traditional Italian universities and eight Albanian universities, as well as telecom and industrial partners, for shared participation in engineering courses broadcast via television and supported in a number of ways involving both technology and face-to-face contacts.
Flemish universities, Belgium (Ketels, 1998)	In a consortium including industrial partners, the Flemish universities in Belgium collaborate on postgraduate courses in telecommunications and in information technology, involving a mix of face-to-face and telematics-supported activities.
Norwegian University of Science and Technology (http://www.idb.hist.no/nitol)	The Norwegian University of Science and Technology and three Norwegian colleges participate in the NITOL consortium, through which students in any of the institutions can participate in courses at any other of the institutions, via the WWW and with occasional face-to-face activities.
University College of London & a variety of other institutes in London, particularly teaching colleagues associated with hospitals (http://av.avc.ucl.ac.uk/livenet/)	These institutions participate in "Live-NET," "London's Interactive Video for Education Network," providing support and common services for for video-conferencing and inter-college teaching.
University of the Highlands and Islands, Scotland (http://www.uhi.ac.uk)	The UHI is a partnership of 13 tertiary education institutions, 8 associated learning outreach centers, businesses, service organizations, local governments, and regional development agencies in Scotland, enrolling over 22,000 students. Flexible course participation and heavy use of videoconferencing in local centers major characteristics.

tivities are not carried out by an entire institution or even an entire department within an institution but instead are set up as new service entities or involve subsets of participants. The step of changing the educational approach of an entire traditional faculty so that more flexible delivery of all courses occurs, using advanced telematics applications, is one not yet taken by many faculties (not only in Europe but worldwide).

At the University of Twente, this faculty-wide change is occurring. The next section examines it in more detail.

Telematics as a Tool for Faculty-Wide Change for More Flexible Delivery

Earlier in this article, a set of reasons for why a traditional faculty should change its educational approach to one emphasizing more flex-

ibility in participation was noted. All of these reasons are compelling for the Faculty of Educational Science and Technology at the University of Twente. And there is also another, more unique reason: we are a faculty which focuses on innovative approaches to educational problems; we have a duty to practice what we preach (Collis, 1998b; Carleer & Collis, 1998a). We also have extensive experience with the use of telematics applications to support our regular courses (see Collis, 1997, for a summary of the years 1994-1997). Thus, in the 1997-1998 academic year, our faculty has adopted what it calls the *C@MPUS⁺ Approach*, by which, starting in September 1998, we are offering our entire first-year program to two cohorts of students at the same time: the regular cohort, attending full-time on our campus, and a second cohort, already with a previous degree and work experience and maintaining this working and personal situation while studying our program part-time. In order for these groups to share common benefits of a course, such as convenient opportunities to interact with the instructor but at the same time carry out various of the course activities in a way appropriate to their situation, all courses are being redesigned, both didactically and organizationally. Telematics applications are the key facilitating tool. In particular, we use WWW-based tools and environments in the preparation of our education (organizing information about the courses, about the course activities, providing convenient ways for students wherever they are to communicate with others in the course), in the preparation and guidance of self-

study and collaborative activities, and also for testing and portfolio-type collections of student work. The key ideas of the *C@MPUS⁺* approach are:

- The general time-tabling of all courses is the same for all cohorts of students, in terms of when the course begins and ends and when certain key events occur, such as the final examinations.
- Study materials that are already in book and printed form will stay that way and will be the same for all students in their basic aspects, although the portions that are focused upon may differ from cohort to cohort, with the younger students paying more attention to textbook-based examples and the experienced students paying more attention to applying textbook examples to their own workplace situations.
- There is a “common day” every second Friday, when all students come together physically on our campus. On those “super Fridays,” a coordinated effort will be made to make the experience as valuable as possible for the students. Each new course will have an introductory whole-group session of approximately one hour during those common Fridays, so that the instructor can efficiently communicate her or his view of the course, and the students can better visualize her or him when receiving electronic communications. Also, the part-time students will meet separately and informally with faculty members, to discuss professional activities of mutual interest outside of any particular course structure.

- While the general types of assignments will be the same for all cohorts, students are able to choose between group-type projects and more individual activities, between various approaches to a general assignment and with variation in the way in which communication and submission of course work occurs.
- Although some traditional lectures will remain (on the common Fridays), the instructors will focus on guided self-study, primarily through the use of the WWW site and techniques such as fill-in forms for structured communication and reflective activities. Interactivity and communication between instructor and students will occur on a weekly basis, primarily with the support of WWW sites so that the place from which a student, or the instructor, participates in discussions or on-line activities becomes irrelevant, as long as a network connection is available.
- Collaborative group activities, supported by WWW-based tools, are being emphasized so that a social dimension is part of the learning experience. To facilitate this collaborative work, an “interactive classroom” has been opened, featuring advanced videoconferencing (both room-size and desktop), integrated with high-speed network access so that students can make common use of WWW-based tools such as shared workspaces as they discuss their work with each other. Students who were not present at the real-time collaborative sessions can “catch up” by studying the results of the sessions via the course

WWW sites and can enter their own comments and responses asynchronously via the WWW sites. The WWW sites in turn are generated by a sophisticated database system.

These and many other faculty-wide changes can occur only within a well-planned and coordinated implementation strategy. Part of such a strategy is having a strong team to carry it out. The implementation aspects of *C@MPUS+* are under the responsibility of the *TeleTOP* Team (*Tele-Learning T.O.*, where T and O are the initials of the Dutch version of our faculty’s name). The *TeleTOP* team not only involves 5 full-time instructional designers and 2 full-time technical-support persons but also the part-time service of several faculty members in leadership positions (the author of this article is the chair), the active involvement of over 30 faculty members whose courses and didactics are in the re-design process, and many of our students, involved in a variety of ways from student assistants to graduate students. All of the efforts of the *TeleTOP* team are in turn strongly supported by the faculty administration. Building faculty commitment is a major focus of our attentions, with weekly workshop-type sessions for all staff beginning in the 1997-1998 academic year and continuing in the 1998-99 academic year, as well as with a variety of ways to involve staff in the rapid prototyping of their own re-designed courses (see Collis & De Boer, 1998).

The implementation phase is fully on schedule, and the new form of faculty-wide teaching began in September, 1998. Most importantly, the cultural change that is occurring

throughout the faculty, among staff and students, as a result of working so closely together on an ambitious implementation process and through this opportunity becoming members of a *learning community* in a new sense of the word, also appears to be benefiting the faculty, although the indicators of such a change are intangible rather than measured.

For more information about the *C@MPUS* Approach and about the *TeleTOP* implementation activities, visit <http://teletop.edte.utwente.nl/> or send E-mail to teletop@edte.utwente.nl

Issues Relating to the Impact of Telematics Applications in Traditional Institutions

Given all of this experience with telematics use in traditional universities for teaching and learning innovation, there is also a growing base of insight with respect to issues that critically affect the implementation success of such activities. Issues that demand serious attention include staff and student engagement and support and technical decisions relating to the infrastructure and interface of the technology needed to make the new flexibilities possible. Some examples of these insights are described here and illustrated with examples. The difficulties in supporting this evolution in traditional universities with cost-effectiveness analysis are also noted.

Staff and Student Engagement and Support

As soon as telematics applications move from the pioneer-special-project phase to the institutionalization phase, a new set of critical issues

arises. These issues have to do with convincing and supporting new cohorts of users that change via the use of telematics is of advantage to them personally and that the time and effort it will take them to handle the change will not be unduly large (Collis, 1998a). Hammond and Karran (1998, p. 232), in the UK, identify "lessons learned" about staff engagement and indicate that "the crucial ingredient is the participation of staff at all levels in proposed development." Such full-scale participation is hard to secure unless staff are sufficiently stimulated, usually by the central administration. But top-down change is notoriously difficult to carry out in university contexts, so the balance between sufficient administrative stimulation and too much for academic acceptance is a delicate one. (Liber, 1998, gives an analysis of the difficulty in changing existing organizational structures with respect to educational delivery and philosophy.) Staff engagement, even when willingly occurring, takes time that many faculty feel to be excessive, given their many research-related responsibilities. Also, many academics feel strongly that the ways they have always taught are in fact the appropriate ways to teach their own discipline; change for abstract reasons such as the future of the university does not weigh heavily enough to convince them to teach in what they feel will be an "inappropriate way" for their course and habits. Many different initiatives are occurring in traditional universities to deal with these issues involving staff engagement, most typically through centrally situated "teaching and learning centers." One of the many ex-

amples is that of the University of Genoa, where a WWW environment is being built to assist instructors in making use of telematics applications in their teaching (Marzo, Estebanell, Fabregat, Ferrés, & Verdú, 1998). These centers, however, generally only deal with those who volunteer for their services, thus missing the hard-core of resistance that is confronted when an entire faculty must change.

It is also not automatic that students welcome change relating to telematics applications. New didactic approaches emphasizing more communication and interaction, as well as the handling of WWW sites and heavy amounts of E-mail and computer conferencing bring time and stress overloads to many students. Many students are not comfortable with non-traditional settings nor with the increased need for self-responsibility that many telematics-augmented learning experiences emphasize. Moreland (1998) at the University of Wolverhampton in the UK notes that self-managed learning can be difficult for many students; Collis and Meeuwse (1998) have studied this in courses at the University of Twente that make substantial use of WWW environments for student-centered activities. Pshegusova and Chislova (1998) at the Rostov State University in Russia also note the difficulty students have with han-

dling computer-mediated communication. While some of these difficulties will fade with improved technical facilities and increased experience, others will remain. Some students and some faculty will not want to depart from the familiarities of traditional course participation. (This conclusion is likely to be relevant outside of Europe, as well as within Europe; recent research from Australia corroborates these difficulties but will

not be cited here for reasons of space).

Issues Related to Technical Investments

To my knowledge, all traditional universities in Europe have some sort of network infrastructure and some sort of central service bureau for this infrastructure. Most faculty members have some way to access the university network and also the Internet (this is much more difficult in the countries of Eastern and Central Europe). There is usually some sort of computer laboratory for students, but the adequacy both quantitatively and qualitatively of access to such facilities differs widely among and within universities. It is increasingly likely that students have some sort of Internet access and have their own E-mail accounts, although again this varies widely, from low percentages to 100%, both between and within universities. Thus, every traditional university is making investments

As soon as telematics applications move from the pioneer-special project phase to the institutionalization phase, a new set of critical issues arises

with respect to telematics services and network connectivity. But as soon as the institution decides to become more proactive with regard to telematics usage, then serious and costly efforts must be made and continually upgraded. During this continual upgrading process, many new technical developments are also considered and tested. As a typical example, see Walter and Hänni (1998) for a discussion based on developments at the Swiss Federal Institute of Technology, and Sehovic, Skocir, and Peranovic (1998) for a discussion of inter-university collaboration for a pilot ATM network to support educational uses of telematics in Croatia. Also, issues with respect to the design, construction, and maintenance of the WWW-based support environments that are becoming widespread in traditional universities are demanding considerable attention. Should a university build its own system, or license a system maintained by others? (See Dietinger, Maurer, & Pivec, 1998, for an analysis.) A number of traditional European universities are investing in their own development of innovative tools and systems to support telematics applications in the teaching and learning process. Among many such examples are the Graz University of Technology in Austria (Dietinger et al., 1998); the University of Hagen in Germany (Roth & Unger, 1998); the University of Liverpool in the UK (Neilson & Smeaton, 1998); the University College London (Hardman, Sasse, & Kouvelas, 1998); and the Faculty of Educational Science and Technology at the University of Twente in The Netherlands (Collis & De Boer, 1998).

Issues Related to Cost-Effectiveness

In contrast to the abundance of reports on activities within traditional European universities regarding the use of telematics applications in education, cost-effectiveness analyses are very difficult to find.* [Footnote at end of article.] Partly, this is because the evolutionary nature of network-related developments in many universities makes a clear statement of costs difficult to isolate. Partly, it is because many costs are hidden or absorbed by the system, as, for example, the costs of the time of instructors and students making use of telematics for learning-related purposes. Moonen and Collis (1997) attempted to isolate costs within a well-defined collaborative project involving telematics for flexible delivery that included a number of universities, but even then had limited success in terms of obtaining appropriate data. Benefits are also difficult to quantify as so many of the applications of telematics are evolving within traditional courses with no control group possible to compare impact. In addition, the impact of telematics experiences is often the fact of doing something that could not be done before, or as comfortably before, such as searching libraries of hundreds of institutions via the WWW from one's study table. The impact of this increased possibility is not clearly measured in pre- and post-test scores. A typical evaluation report of a telematics-enhanced innovative course is that of Bernath, Von Ossietzky, and Rubin (1998, p. 144) who state that "clearly the seminar met its goals"—a conclusion based on self-report statements from the stu-

dents who said that they felt a high degree of satisfaction with the seminar and felt they had a positive experience. The instructors believed that the global-participation aspect of the seminar (it involved the University of Oldenburg and an American university) "gave depth to the learning and forced the participants to think beyond their own cultural and environmental constraints." While there is no doubt such aspects are valuable, measuring them and quantifying them relative to their costs is not a likely or perhaps not a possible activity. Thus, the ambitious title of this special issue can best be answered for traditional universities making use of telematics applications in terms of the new forms of learning opportunities possible, rather than by quantifiable results.

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Are Traditional and Distance Universities Converging in Europe?

Finally, a reflection is made on the division between traditional universities and universities organized around distance and open delivery. In some ways, this division is rapidly losing meaningfulness, but certain differences that are more profound than "distance" still remain. All of the examples in this article, and

many more, relate to traditional European universities and their activities relating to more flexible learning through the use of telematics. Given the fact that many distance-teaching universities require their students to come to face-to-face sessions occasionally (perhaps with a local tutor or at a study center) and are continually augmenting their own educational delivery to add more communication and interaction possibilities, the actual difference between their offerings and those of traditional universities seems to be getting less and less. The strengths of traditional distance-educational institutions have been their carefully developed study materials and the flexibility they offer in terms of at least some aspects of time and place of participation. These strengths are now being picked up

by traditional universities. (This is widely understood in Australia, where student statistics no longer include the term "distance education," but mode of study is classified as full-time and part-time). Karmel (1988, p. 617), of the Australian Department of Employment, Education, Training, and Youth Affairs, in noting the trends in universities in Australia, says, "The way in which a student studies will be a matter of personal preference and will not de-

pend to any important extent on where the student lives, which institution the student attends, or whether the student is on campus, off campus, full-time or part-time. Distance education is becoming an anachronism." The European situation is far less flexible than Australia, partly because of the different languages and cultures and national systems, but as the examples in this report illustrate, the last sentence of Karmel's analysis is already on the way to being an accurate statement for Europe. However, Evans (elsewhere in this volume of *PIQ*) points out that political pressures as much as or more than educational motivations in Australia are providing the driving force for changes in Australian universities, relating to the evolving boundaries of "distance education." What a comparable political mechanism in Europe might be is not clear as the European Union does not have jurisdiction to directly influence educational policy in the member states. Perhaps it will be multinational commercial interests which will lead the way in Europe in stimulating traditional universities to claim continually broader student catchment areas and thus lead to a comparable situation in Europe to what Karmel describes in Australia. The diversity of languages in Europe may serve as a natural barrier to this in non-English-speaking countries.

The opportunity to have an intellectual apprenticeship with an experienced senior academic is an important benefit of the traditional university

But given this convergence with relation to distance and other flexibility aspects, I believe there is one fundamental difference between the traditional distance-teaching universities in Europe and the traditional universities which is less likely to change. This is the distinction that relates to the role of the instructor in a course. In the traditional university, the instructor is typically the author, developer, manager, teacher, administrator, and evaluator of his or her courses. While this can and does have its weaknesses, it also has some important strengths. These strengths are often intangible—the opportunity for university students to become gradually "initiated into the profession" of being an academic, what the Dutch call "*academische vorming*," or being formed as an intellectual. This is a modeling process that overlaps but extends further than the experience of being in a course. The opportunity to have an *intellectual apprenticeship* with an experienced senior academic, the same person whose external scientific and professional work and research should be permeating his or her course-handling approaches, the same person who is expert enough to have written the course, is an important benefit of the traditional university. It has roots as far back as the master-apprenticeship relationships of the Middle

Ages. (Perhaps “mentor” and “junior researcher” are more acceptable words in current times.) Being part of an academic community is more than having E-mail discussions with other students and a tutor; it is the chance to learn the norms and absorb the energy and professional style of those who have leadership roles in the broader scientific world. Through the personal involvement of the experienced faculty member in her or his course, the pre-structured subject matter can be related to the new developments in the field and in the instructor’s own research, something more difficult to do in mass-produced study materials. While clearly not every course in the traditional university brings such serendipitous benefits to its students, enough do, so that the experience of scaffolded development as a member of a professional community occurs over time for many students. It is important that this strength of the traditional European university is not weakened in the attempt to become more flexible.

*It should be noted here that there are a number of studies relating to cost-effectiveness based on the situation at the Open University in the UK (see for example, Rumble, 1997) and other institutions organized for distance education (and various “framework”-type studies) relating to cost-effectiveness carried out in the context of projects sponsored by the European Union, but in this paper we are limiting ourselves to experiences within traditional European universities. In this context, the closest quantifiable indicator of effectiveness is the projection of obtaining more students, but the calculation of the costs associated with this is

difficult to carry out because of the naturally evolving technical infrastructures and types of instructor involvement that are occurring.

References

- Bacher, C., & Müller, R. (1998). Generalized replay of multi-streamed authored documents. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 1, pp. 87-92). Charlottesville, VA: AACE.
- Barajas, M., Chrysos, A., Bosco, A., Fonollosa, M., Alvarez, I., & Sancho, J. (1998). Virtual classrooms in traditional universities: Changing teaching cultures through telematics. In T. Ottmann & I. Tomak, (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 1, pp. 99-104). Charlottesville, VA: AACE.
- Bernath, U., Con Ossietzky, C., & Rubin, E. (1998). A virtual seminar for international professional development in distance education. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 141-144). Budapest: European Distance Education Network.
- Bharat, D. (1998). Global architecture design studios. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part I, pp. 119-128). Vienna: Austrian Computer Society.
- Carleer, G., & Collis, B. (1998, June 23). Extending good teaching with technology. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 368-371). Budapest: European Distance Education Network.
- Chambers, E., & Winck, M. (1998). Evaluation of transnational telematic teaching and learning: The CEFES Project. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 104-108). Budapest: European Distance Education Network.

- Collis, B. (1996). Does more technology mean more flexibility for the user? Experiences from the TeleScopia project. *European Vocational Training Journal*, 7 (1), 13-21.
- Collis, B. (1997). Pedagogical re-engineering: A pedagogical approach to course enrichment and redesign with the WWW. *Educational Technology Review*, 8(3), 11-15.
- Collis, B. (1998a). Implementing innovative teaching across the faculty via the WWW. In S. McNeil, J. Price, S. Boger-Mehall, B. Robin, & J. Willis (Eds.), *Proceedings of the 9th International Conference of SITE (Society for Information Technology and Teacher Education)* (Vol. 2, pp. 1328-1335). Charlottesville, VA: AACE.
- Collis, B. (1998b). New didactics in university instruction: Why and how? *Computers & Education*, 31, 373-393.
- Collis, B. (1998c, October 1). *Teleware: Instrumentation for tele-learning*. Paper/speech presented to commemorate the appointment as Professor of Tele-Learning, University of Twente, The Netherlands.
- Collis, B., & DeBoer, W. (1998). Rapid prototyping as a faculty-wide activity: An innovative approach to the redesign of courses and instructional methods at the University of Twente. *Educational Media International (EMI)*, 35(2), 117-121.
- Collis, B., & Meeuwssen, E. (in press). Learning to learn in a WWW-based environment. In D. French (Ed.), *Internet-based learning: Higher education and industry*. Sterling, VA: Stylus Publishing.
- Collis, B., Vingerhoets, J., & Moonen, J. (1997). Flexibility as a key construct in European training: Experiences from the TeleScopia project. *British Journal of Educational Technology*, 28(3), 199-218.
- Collis, B., & Winnips, K. (1998, June 22). Design guidelines for teaching about design guidelines for educational WWW sites. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 1, pp. 215-220). Charlottesville, VA: AACE.
- Collis, B., Winnips, K., & Moonen, J. (1998). *Student-supplied readings: Active involvement in the study materials*. Manuscript submitted for publication.
- Demchenko, Y. (1998). New trends in education in conditions of emerging global information infrastructure. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part I, pp. 251-260). Vienna: Austrian Computer Society.
- Dietinger, T., Maurer, H., & Pivec, M. (1998). Multimedia learning environment: Combining easier courseware production and new learning methods. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training and education* (Part III, pp. 39-49). Vienna: Austrian Computer Society.
- Dondi, C., Boninsegna, A., & Cavina, L. (Eds.). (1998). *Research perspectives on open and distance learning*. Bologna: Scier, & Commission of the European Community DG XII.
- Dovgiallo, A., Kolos, V., & Kudrjajtseva, S. (1998). Ukrainian experience of teachers' training on telematics: Distance case. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part I, pp. 281-290). Vienna: Austrian Computer Society.
- Firmeza, J. (1998). Designing a distance learning teleproductics system supported on the Web. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 1, pp. 310-317). Charlottesville, VA: AACE.
- Gallud, L., & Gonzalez, E. (1998). VSAT technologies applied to a pan-European network for tele-education. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 1, pp. 375-380). Charlottesville, VA: AACE.
- Garito, M. (1998). Distance teaching today: New technologies and new methods—The experience of NETTUNO [Network per l'università ovunque]. In A. Szucs & A. Wagner (Eds.), *Uni-*

- versities in a digital age: Transformation, innovation, and tradition* (pp. 203-212). Budapest: European Distance Education Network.
- Geyer, W., & Effelsberg, W. (1998). The digital lecture board: A teaching and learning tool for remote instruction in higher education. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 1, pp. 391-396). Charlottesville, VA: AACE.
- Göschka, K., & Riedling, E. (1998). Web access to interactive database training: New approaches to distance laboratory work at the Vienna University of Technology. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part I, pp. 349-360). Vienna: Austrian Computer Society.
- Grabowska, A. (1998). Teaching AutoCAD and teleworking. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part III, pp. 53-54). Vienna: Austrian Computer Society.
- Hammond, R., & Karran, T. (1998). Implementing a computer-mediated learning environment: People, problems, and practicalities. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 230-234). Budapest: European Distance Education Network.
- Hampel, T., Ferber, F., & Muller, W. (1998). MechANIma—New didactic concepts, visualisations, and arrangements for the teaching of mechanics. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 1, pp. 458-465). Charlottesville, VA: AACE.
- Hardman, V., Sasse, M., & Kouvelas, I. (1998). Successful multi-party audio communication over the Internet. *Communications of the ACM*, 41(5), 74-80.
- Hietala, P. (1998). Procedural facilitation in Web discussions. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part I, pp. 445-454). Vienna: Austrian Computer Society.
- Hogrefe, D. (1998). Enhancing the reliability of Internet-based tele-teaching applications through combined use of ISDN and Internet. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 455-464). Vienna: Austrian Computer Society.
- Hurst, W., Muller, R., & Ottmann, T. (1998). A method of integrating telepresentation and multimedia production. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, p. 1940). Charlottesville, VA: AACE.
- Huysman, M., & Gerrits, H. (1998). ICT [information & communication technologies] and project-based education: Some findings from an exploratory research study. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training and education* (Part II, pp. 495-505). Vienna: Austrian Computer Society.
- Karmel, T. (1998). Distance education and flexible delivery in the Austrian higher education context: Is distance education becoming an anachronism? In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 614-617). Budapest: European Distance Education Network.
- Ketels, M. (1998). Bridging companies and universities for postgraduate training: Two large-scale case-studies. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 62-64). Budapest: European Distance Education Network.
- Klincsik, M., & Sarvari, C. (1998). Modeling the open and distance learning methods in a face-to-face mathematical teaching environment. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 524-527). Budapest: European Distance Education Network.
- Koua, E., & De Diana, I. (1998). The collaborative learning system: Conceptual foundation and architecture of a

- collaborative virtual learning environment. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 589-605). Vienna: Austrian Computer Society.
- Krempel, S. (1997). The virtual university: Education in the cross light between economy, politics, and society. In J. Hlavicka & K. Kveton (Eds.), *Proceedings of RUFIS '97: Role of the university in the future information society* (pp. 99-102). Prague: UNESCO International Centre for Scientific Computing.
- Kuhmünch, C., Fuhrmann, T., Schöppe, G., & Heerman, D. (1998). Java teachware: The Java remote control tool and its applications. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, pp. 761-766). Charlottesville, VA: AACE
- Langlois, C. (1997). Information technologies and university teaching, learning, and research. In J. Hlavicka & K. Kveton (Eds.), *Proceedings of RUFIS '97: Role of the university in the future information society* (pp. 183-187). Prague: UNESCO International Centre for Scientific Computing.
- Laurillard, D. (1993). *Rethinking university teaching: A framework for the effective use of educational technology*. London: Routledge.
- Liber, O. (1998). Structuring institutions to exploit learning technologies: A cybernetic model. *Advanced Learning Technologies Journal (ALT-J)*, 6(1), 13-18.
- Llamas, M., Anido, L., & Fernandez, M. (1998). Student participation and first results from SimulNet, a distance access training laboratory. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 615-625). Vienna: Austrian Computer Society.
- Luft, P., & Tiene, D. (1997, November). *Using instructional design principles to develop Web-based teaching units*. Paper presented at TELED '97, Austin, TX. [WWW document available] URL: http://www.educ.kent.edu/~pluft/instr_des/
- Mana-Gomez, A., Villalba-Sanchez, F., & Lopez, J. (1998). Secure examinations through the Internet. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 695-704). Vienna: Austrian Computer Society.
- Marzo, J., Estebanell, M., Fabregat, R., Ferrés, F., & Verdú, T. (1998). Support units for university teaching based on WWW. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, pp. 913-918). Charlottesville, VA: AACE
- Meisalo, V., Sutinen, E., Tarhio, J., & Terasvirta, T. (1998). Combining algorithmic and creative problem solving on the Web. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 715-724). Vienna: Austrian Computer Society.
- Min, R. (1998). *The Web as a working, doing, and learning environment and the strength of applets*. University of Twente. [WWW document] URL: <http://www.edte.utwente.nl/prj/min/papers/JavaWeb/>
- Moonen, J. (1994). How to do more with less? In K. Beatie & C. McNaught (Eds.), *Interactive multimedia in university education: Designing for change in teaching and learning* (pp. 155-163). Amsterdam: Elsevier.
- Moonen, J., & Collis, B. (1997). Cost of flexible and distance learning. In R. J. Seidel & P. R. Chatelier (Eds.), *Virtual reality: Training's future* (pp. 161-168). New York: Plenum Press.
- Moreland, N. (1998). The measurement and implications of ICT [information & communication technologies] capability of students upon entry to one university. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 589-591). Budapest: European Distance Education Network.
- Neilson, I., & Smeaton, C. (1998). WWW-based tools for capturing on-line communications as an educational resource. In S. Banks, C. Graebner, & D.

- McConnell (Eds.), *Networked lifelong learning* (pp. 2.62-269). Sheffield, UK: The University of Sheffield Centre for the Study of Networked Learning.
- Newman, R., Marcella, R., Middleton, I., & McConnell, M. (1998). Developing a WWW resource centre for acquiring and accessing open learning materials on research methods (ReMOTE). In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, pp. 1024-1033). Charlottesville, VA: AACE.
- Norman, N. (1997). Communication technologies and education: Lessons in the potential of innovation. *Journal of Advanced Learning Technologies (ALT-J)*, 5(3), 43-53.
- Pasotto, P. (1998). Resource centre for multimedia teaching and distance learning promoted by Emilia-Romagna region. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 429-432). Budapest: European Distance Education Network.
- Pereira, M., & Tavares, L. (1998). The distance learning in management in Portugal: The Doslogo case study. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 58-61). Budapest: European Distance Education Network.
- Pshegusova, G., & Chislova, A. (1998). Teaching communication skills: Increasing students' ability to participate in distance education. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part III, pp. 101-104). Vienna: Austrian Computer Society.
- Pulkkinen, J., & Ruotsalainen, M. (1998). Evaluation study of a telematic course for technology teachers (T3 Project). In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 815-824). Vienna: Austrian Computer Society.
- Ratcliff, M., & Davies, T. (1998). Supporting distance education. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 433-438). Budapest: European Distance Education Network.
- Revans, R. (1998). Action learning and the freshman. In Manchester Business School (Eds.), *The golden jubilee of action learning*. Manchester, UK: Manchester Business School.
- Reynolds, S. (1998). Telepresence—Setting up and using virtual classrooms. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 94-98). Budapest: European Distance Education Network.
- Rigopoulos, D. (1998). A tele-seminar on drawing with AutoCAD: Design, production, and pilot implementations. In S. Banks, C. Graebner, & D. McConnell (Eds.), *Networked lifelong learning* (pp. 2.78-2.93). Sheffield, UK: The University of Sheffield Centre for the Study of Networked Learning.
- Rinta-Filppula, R. (1998). WEB University: Experiments on videoconferencing over ATM. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 845-850). Vienna: Austrian Computer Society.
- Rodd, J., & Coombs, S. (1998). Distance learning with a difference: Using the Internet to deliver higher education. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, pp. 1169-1174). Charlottesville, VA: AACE.
- Rognstad, G., & Tosterud, R. (1998). Nursing and distance education in Gjøvik, Norway. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 542-545). Budapest: European Distance Education Network.
- Roth, J., & Unger, C. (1998). "Dream Team"—A synchronous CSCW [computer support cooperative work] environment for distance education. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, pp. 1185-1190). Charlottesville, VA: AACE.

- Schauer, H., Muehlbacher, J., Leng, P., Shave, M., & Aiken, R. (1998). Interactive seminars using the Web: An international experience. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 869-875). Vienna: Austrian Computer Society.
- Schefström, D., Widen, J., Parnes, P., Synnes, K., & Söderlund, A. (1998). Education direct: Entering the world beyond the Web. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, pp. 1230-1235). Charlottesville, VA: AACE.
- Shovic, E., Skocir, Z., & Peranovic, P. (1998). Education as a value-added service of the public ATM network. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part III, pp. 117-126). Vienna: Austrian Computer Society.
- Shoikova, E. (1998). Innovations in Bulgarian higher education in electronics. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 213-219). Budapest: European Distance Education Network.
- Smith, M., & Birchall, D. (1998). From delivery to development: Moving distance education from content dissemination to personal development through the use of groupware. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 363-367). Budapest: European Distance Education Network.
- Somekh, B., & Davies, N. (1991). Towards a pedagogy for information technology. *Curriculum Journal*, 2(2), 153-170.
- Stanchev, I., & Nedkov, B. (1998). The distance delivery platform of the Master of Science Program, "Educational and Training Systems Design," at the the University of Twente, The Netherlands: Virtual classroom environment model and technological realization. In G. Davies (Ed.), *Tele-teaching '98: Distance learning, training, and education* (Part II, pp. 961-972). Vienna: Austrian Computer Society.
- Toynton, R. (1998). The interactive Website as a medium for teaching and learning: A case study in presenting introductory science. In S. Banks, C. Graebner, & D. McConnell (Eds.), *Networked lifelong learning* (pp. 1.33-1.41). Sheffield, UK: The University of Sheffield Centre for the Study of Networked Learning.
- Van der Perre, G., & Claeys, C. (1998). ICT [information & communication technologies] and the university of the future: Proposal for a blueprint. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 235-239). Budapest: European Distance Education Network.
- Van der Veen, J., Collis, B., & Jones, V. (1998, June 15). Applying workflow in Web-supported projects. In C. Alvegard, (Ed.), *Proceedings of the 4th international conference: Computer-aided learning and instruction in science and engineering (CALISCE '98)* (pp. 216-226). Göteborg, Sweden: Chalmers University of Technology, Centre for Educational Development.
- Van Rennes, L., & Collis, B. (1998, June 21). User interface design for WWW-based courses: Building upon student evaluations. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, pp. 1139-1144). Charlottesville, VA: AACE.
- Wagner, E. (1998). Creating a virtual university in a traditional environment. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 333-337). Budapest: European Distance Education Network.
- Walter, T., & Hänni, H. (1998). Telepoly: A teleteaching scenario supported by high-speed networks. In T. Ottmann & I. Tomak (Eds.), *Proceedings of ED-MEDIA/Ed-Telecom '98* (Vol. 2, pp. 1434-1439). Charlottesville, VA: AACE.

- Whitting, C., & Sclater, N. (1998). Building and testing a virtual university. *Computers & Education*, 30(1/2), 41-47.
- Wright, N., & Cordeaux, C. (1996). Rethinking video-conferencing: Lessons learned from initial teacher education. *Innovations in Education and Training International*, 33(4), 194-202.
- Zitterbart, M., Böger, A., Harbaum, T., & Brand, O. (1998). Teaching computer networks across networks. In A. Szucs & A. Wagner (Eds.), *Universities in a digital age: Transformation, innovation, and tradition* (pp. 439-442). Budapest: European Distance Education Network.

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