Mindtools for Teacher Communities: a European perspective

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ABSTRACT Programmes for teacher training should train (aspiring) teachers to be able to make use of information and communications technology as mindtools. Mindtools are not pieces of specialised software that 'teach' a subject, but computer programs and applications that facilitate meaningful professional thinking and working. Teachers can use these programs and applications to engage their students in critical thinking and to help further their own professional development. In the latter case mindtools can be applied for cooperation (between teachers, teacher educators and student teachers) and collaboration (with other teachers, experts, designers, etc. on pedagogical projects). In this article we focus on electronic networking technologies (conversation tools) as mindtools in communities of practice for teacher professional development. Examples of good practice from teacher training institutions in Europe illustrate how to prepare (aspirant) teachers for working with mindtools that enhance teacher professional development.

Introduction

Information and communications technology (ICT) appears to have found its niche in education. Research on the incorporation of ICT into European educational systems indicates that ICT is at the centre of national educational policies in all European countries and that the integration of ICT into school systems is widespread (Eurydice, 2001). The majority of teachers say that they make regular use of ICT in their teaching and an increasing number of countries include ICT in the curricula of initial teacher training. Three factors seem to influence this trend. First, new technologies are seen as a means for preparing the current generation of young people for the future workplace. New technologies provide tools for tomorrow's practice and the learner has to learn to use these tools. Tools can be specific, such as statistical packages for the social sciences in higher education, or computer-assisted design software in vocational training, or

generic such as word processors, web browsers, search engines, spreadsheets, databases, and so forth. Second, new technologies are looked upon as a way to make schools more efficient and/or more productive. This has led to a growth in the number and variety of tools to support and facilitate the teacher's professional activities. Examples of such tools are lesson preparation and authoring tools, test service systems, student tracking tools, portfolio systems, and complete educational packages/learning management systems (e.g. *Blackboard*©, *WebCT*©). Finally, new technologies are seen as a means to reform and innovate teaching. At present, there is a growing tendency to stimulate learners to learn actively, independently, in a self-directed way and/or in collaboration with others (Simons et al, 2000). New technologies (see, for example, Jonassen, 2000; Jonassen et al, 1999; Kanselaar et al, 2000; Lajoie, 2000) provide promising opportunities to make this 'new kind of learning' possible and guide the learner and the teacher in these 'new ways of learning'.

Although the growth of ICT use in education is considerable, this is not without criticism. Cuban (2001) and Salomon (2000) dampen the euphoria with a profound analysis of the current situation in education with regard to the use of ICT. When looking at the benefits of the substantial government investments for developing and implementing educational ICT policy, research reveals that new technologies are often oversold and underused (Becker, 2001; Cuban, 2001). Cuban (2001) states that until now, the three aforementioned goals that accompany the emergence of ICT in education have not been achieved.

With regard to preparing students for the future workplace, i.e. becoming sufficiently digitally literate to compete in a workplace that demands high-level technological skills, Cuban (2001) comments that there is no consensus on what digital literacy is (see Bawden [2001] for a review of concepts pertaining to information and digital literacies). Ergo, it is unclear what students must learn and unclear what has to be taught. Further, the contribution that current school courses have made to digital literacy and competitiveness in the workplace remains obscure, since technology knowledge and skills are also acquired at home and at work.

As for improved efficiency in schools, there has been no progress over the past decade that can be confidently attributed to wider access to computers (Cuban, 2001; Kirkpatrick & Cuban, 1998). An explanation for these low efficiency rates in education could be that on the one hand, new technologies facilitate work in schools, but on the other – almost paradoxically – provide administrators, teachers and students with new and more complex tasks to carry out. An example is the problem of plagiarism in education. Since it is very easy for students to copy work from others, teachers are almost forced to be competent users of systems that are capable of detecting plagiarism of other students' work and from the World Wide Web.[1]

Finally, with respect to ICT being a driving force behind educational innovation and reform, research indicates that the role of ICT is not as profound as one would expect. Although ICT use in the classroom has increased, this is almost completely limited to generic tools (Becker, 2001; Cuban, 2001). Cuban (2001) for example states that in a lot of situations 'e-learning has turned out to be word processing and Internet searches. As important supplements as these have become to many teachers' repertoires, they are far from the project-based teaching and learning that some technopromoters have sought' (p. 178). Also, ICT is too often used as a modern and efficient substitute for existing learning and teaching materials and seldom as a vehicle for innovation and transformation of education (Kirschner et al, 1995). Salomon (2000) refers to this as the 'technological paradox': 'A most powerful and innovative technology is taken and is domesticated such that it does more or less what its predecessors have done, only it does it a bit faster and a bit nicer'.

According to Salomon:

> ... [the technological paradox] results from the consistent tendency of the educational system to preserve itself and its practices by the assimilation of new technologies into existing instructional practices. Technology becomes 'domesticated', which really means, that it is allowed to do precisely that which fits into the prevailing educational philosophy of cultural transmission. Hence the development of drill-and-practice programs, courseware, and such, which until recently have dominated the use of computers in schools. Learners are to learn *from* the technology just as they learn *from* teachers, but its uniqueness as tools of construction, communication and design to learn with, not from, is suppressed. Nobody wants to upsets the prevailing practices by rocking the educational boat. (pp. 12-13)

Gaver (1996) eloquently argues that new technologies seldom simply support old working practices with additional efficiency or flexibility. Instead they tend to undermine existing practices and to demand new ones.

Although ICT use in education gives rise to serious concerns, we must continue to invest in it. As Cornu (2002) describes it, our current society is changing into an information and communication society in which ICT plays an important role. Education has to prepare people for living in this society and therefore robust but realistic policies are needed to prepare teachers and schools for this task. These policies should not have a technocentric focus (Salomon, 2000). Instead, technorealism must be lie at the heart of the policies.[2] Or, as Salomon (2000) puts it: 'Education is far too important to society to be wiggled by a technological tail. Let technology show us what *can* be done, and let educational considerations determine what *will* be done in actuality' (p. 42).

The role of teachers in the success of the implementation of ICT in education is substantial. They can be seen as the gatekeeper for

technological innovations in the classroom, but only if there is a serious involvement of all interested parties in the development and implementation of it (Fullan, 1991) and if policy makers and administrators engage teachers fully in the deliberations, design, deployment, and implementation of technology plans (Cuban, 2001). Teachers not being consulted with respect to ICT policy, but also not having experience and expertise in using computers, not being professionally active among peers and not subscribing to constructivist philosophies of learning and teaching, are seen as important factors that hamper the introduction of ICT for innovations in the classroom (see, for example, Becker, 2001). Pre-service and in-service teacher education plays (or can play) an important role in dealing with the aforementioned factors. Unfortunately, teacher education generally doesn't adequately prepare (aspiring) teachers for working in an ICT-rich environment (Kirschner & Davis, this issue), nor does it adequately update and upgrade the knowledge, skills and attitudes of in-service teachers. Fortunately, teacher education can learn from good practice, and as the articles in this issue show, good practices abound (Collis & Jung, 2002; Kirschner & Wopereis, 2002).

This article emphasises the importance of learning *with* new technologies/ICT. We focus on the use of mindtools in education – computer programs and applications that facilitate meaningful professional thinking and working – because this is the epitome of learning *with* ICT. Mindtools help users represent what they know as they transform information into knowledge and are used to engage in, and facilitate, critical thinking and higher-order learning. Mindtools can be as simple as email or discussion lists and as complicated as argument mapping and visualisation systems (Kirschner et al, 2002). Because almost all ICT applications can be used as mindtools, we have chosen to highlight one category of mindtools, namely conversation tools, which enjoy increasing popularity in education (Jonassen et al, 1998). This popularity can be attributed to the interest in collaborative learning and working as a vehicle for constructivist learning pedagogies. Constructivist philosophies emphasise the importance of learning (and working) together to create knowledge. Conversation tools are seen as a means to create and facilitate the creation of technology-supported discourse communities – communities of practice – where collaboration can flourish (Jonassen et al, 1999). In this article we showcase conversation tools that help create networks for teacher professional development. We provide examples from pre-service and in-service teacher education in Europe.

Mindtools

Computer owners frequently make use of applications such as databases (e.g. *File Maker® Pro*, *Access®*), spreadsheets (e.g. *Excel®*, *Lotus 1-2-3®*), intentional information search engines (e.g. *Google®*, *AltaVista®*), visualisation tools (e.g. *PowerPoint®*, *Inspiration®*, *Micrografx Flow*

Charter®), multimedia publishing tools (e.g. *Front Page*®, *Macromedia Flash*®), live conversation environments (e.g. *MSN Messenger*®, *ICQ*®), and computer conferences (e.g. *FirstClass*®, *NetMeeting*®). Most of these applications have been developed as aids in the execution of work; to make the users more productive. We call them, therefore, 'productivity' tools. Databases help company administrators manage information about employees and restaurateurs to manage their wine cellars; spreadsheets facilitate accounting in financial departments and addressing envelopes for the secretary; multimedia publishing tools support presenters in making presentations and advertisers in creating dynamic advertisements; and intentional information search engines help scientists find relevant resources and the rest of us to satisfy an information need like 'I'd like to go to movie X in place Y and I want to make a reservation so I need some names and telephone numbers of theatres in Y where X will be shown'. But apart from being a productivity tool, these same tools can also be used as an intellectual partner that enhances the cognitive powers of human beings during thinking, problem solving and learning (Jonassen & Reeves, 1996). In other words, as mindtools.

When used as a mindtool, databases help learners integrate and interrelate discrete bits of content, making them more meaningful and more memorable. Building databases requires that learners organise information by identifying the relevant dimensions of the content. In using a spreadsheet, learners design, use and fill in values and formulas requiring them to use existing rules, generate new rules to describe relationships and organise information, thus engaging critical thinking. Defining the organisation of values, formulas and functions in a spreadsheet involves analysis-level learning to identify relationships and describe them in terms of higher-order rules, thereby forcing learners to think more deeply (Blignaut, 1999; Jonassen & Carr, 2000).

Multimedia tools, for example those which entail the use of hypertext, a non-sequential, non-linear method of organising and displaying text designed to allow developers to link and readers to access information in ways that are most meaningful to them, gain user control over what is accessed and the sequence in which it is accessed. The organisation that the user (either as consumer or as producer) imposes on the information is more personally meaningful than the organisation that is imposed by another. It allows/stimulates the user to build structure in his/her own knowledge base.

Finally, the intentional information search engine can be used to address a complex information need, where students have to use complex search strategies for searching for relevant information and to evaluate and communicate the results of the intentional search (e.g. student teachers can use intentional search engines to look for information about the pros and cons of implementing new technologies in the classroom).

In this situation ICT applications are referred to as 'cognitive technologies' (Pea, 1985), 'technologies of the mind' (Salomon et al, 1991), 'cognitive tools' (Jonassen & Reeves, 1996; Lajoie, 2000) or 'mindtools' (Jonassen, 1996, 2000). In this article we will use the latter term for those ICT tools that play the role of intellectual partner.

According to Jonassen (2000), mindtools are 'computer-based tools and learning environments that have been adapted or developed to function as intellectual partners with the learner in order to engage and facilitate critical thinking and higher-order learning' (p. 9). We broaden the scope and include the facilitation of work (by knowledge workers) in this definition. Since critical thinking and higher-order learning can also play a prominent role during professional work, mindtools are also intellectual partners with the worker, especially in knowledge-intensive situations where working and learning are intertwined. Nowadays, professional workers must continuously develop themselves and teachers are (or at least should be) just this type of professional. As such, they have to learn continually and in this learning process, mindtools can play an important role. (Aspirant) teachers must therefore learn how to use mindtools both as a means of encouraging constructive learning in the classroom and as a tool for their own professional growth.

Jonassen (2000) distinguishes five characteristics of mindtools. First, they are 'cognitive amplification' and 'reorganisation' tools, which exceed the limitations of the human mind by doing things more accurately and at a higher speed, and extend the use of other (mechanical) tools. Intelligence Amplification is the 'science of getting humans and machines to work together to do things which neither could do alone. Typically this involves using machine intelligence to organise and present large amounts of information, which the computer outputs in a form that allows the human to use their pattern recognition capability to spot similarities and differences that are worth further investigation.'[3] It is not that they make things easier, but rather that they make new things possible. But, just as a carpenter must not only have good tools, he or she must also be skilled in using them. Knowledge workers (teachers, students) must become skilled operators of these tools in order to utilise them properly.

Mindtools are *generalisable* tools which can be used from setting to setting and domain to domain for engaging and facilitating cognitive processing. They are not specific to any one purpose, nor do they reduce information processing. They (see the previous characteristic) make better use of the user's mental efforts in a multitude of domains and situations. They do not make processing easier, but afford or allow it to occur. This also means that users have to think harder since to think more deeply requires more effort.

Mindtools are *critical thinking devices* which help users to think for themselves, make connections between concepts and create new knowledge. This is similar to what Crombag et al (1979) call 'operations on knowledge'.

They are also *intellectual partners*. As a partner in the learning process, they are responsible for that which they can perform best. Computers should calculate, store and retrieve information, while the user of the tool should be responsible for recognising and judging patterns of information and its organisation.

Finally, a mindtool is a *concept*. It is a way of thinking about and using ICT, other technology, the learning environment, or intentional and incidental learning activity/opportunity (constructivist in nature), so that the users of these tools can represent, manipulate, and reflect on what they know instead of reproducing what others tell them.

The distinction between productivity tools and mindtools is analogous to Salomon's (1995) distinction between the two effects of technology. We generalise this idea to the effects obtained *with* something and effects *of* that something.

Effects *with* technology and/or the technology tools used are those changes that take place in learners while they are engaged in working with ICT and/or while they are busy with the technology tools available. An example of effects with technology can be seen as the changed quality of problem analysis and solution, as a result of either working in a group decision room with others or that a specific project is delivered on time because of the use of project-planning software.

Effects *of* technology and/or the technology tools used are those *longer lasting changes* in learners that are a result of working with technology or are the result of having made use of the tools available. An example of the effect of technology could be the skill of asking more exact and explicit questions because of the experiences within the group decision room or the ability to formulate more precisely oneself. An effect of the tools used could be that the person is able to plan and carry out a project more effectively and efficiently (at a later date) due to earlier use of specific project-planning software or the ability to carry out more effective and efficient information search procedures due to having used broad, general search engines. Salomon argues that educational emphasis should be on the attainment of effects *of* technology and not just on the attainment of effects *with*.

Used as productivity tools, we speak of the effects obtained *with* a programme or application. Used as a mindtool, we speak of the effects *of* the programme or application.

Communities of Practice

Communities of practice are groups of people who share similar goals and interests (CoVis).[4] In pursuit of these goals and interests, these people employ common practices, work with the same tools and express themselves in a common language. Through such common activity, they come to hold similar beliefs and value systems.

As teachers, we belong to a community of practice (the community of teachers) and almost always to a sub-community such as the community of science teachers, of elementary school teachers or of teacher educators. As teacher educators we share the goal of helping students learn about the pedagogy of teaching (often within a subject area; the pedagogical content knowledge), we have an interest in preparing our students to be as good as they can be, we use the same or similar techniques in our practice of teaching the new generation of teachers, and we apply scientific knowledge and practice in our teaching. We cover topics and employ teaching techniques that other teacher educators employ and use tools that are available in other classrooms like our own. Finally, we speak with other teachers both in our own school and in other schools about our activities because we share a common language and common beliefs.

According to CoVis (adapted from Lave & Wenger, 1991; Edelson et al, 1996):

> ... part of belonging to a community of practice is being aware of the range of goals and beliefs held, as well as techniques used, by community members at large. Some of these will be part of the practice and belief system of a large number of the community members. Some will belong to a minority or the membership, or 'fringe' groups. Awareness of the community debates and contentions is as important a part of community membership as awareness of what is common to most, or all. It is not unusual in some communities for such debates and contentions to be a key component of what drives community activity and the evolution of that activity over time. (p. 4)

In this, communication and conversation with other members of the community and its sub-communities is of the utmost importance.

According to Barnett (2002), network-based technologies have made an impact on teacher professional development by reducing teacher isolation and supporting sharing, by fostering reflection on practice, by influencing actual practice and through the formation of communities of practice. Electronic networks allow pre-service and novice teachers access to a 'wide range of distributed expertise from more experienced teachers to university faculty' (Johnson, 1997). These networks also help beginning and novice teachers to learn more about technology and how it can be used to support the learning of their own students (Barnett, 2002). Through the development of communities of practice, electronic network-based technologies provide sustained support to these teachers, even after they themselves have become experienced teachers. They do this by allowing teachers to share their teaching experiences and techniques with others and get feedback on it so that they can modify their actions, their methods and their curricula. This type of interaction can, according to Lehman et al (1992) and Schlager et al (1999), play a key role in innovation in education.

In the following section we will present the role of conversation tools in these communities and illustrate how this can be 'learned', based upon examples of good practice in teacher training.

Conversation Tools as Mindtools

In the rest of this article we will highlight a number of programmes in Europe which encourage (aspirant) teachers to embrace ICT and ICT applications such as mindtools for stimulating and maintaining communication. Conversation tools encourage and support discussion and discourse, allowing users to carry on a meaningful conversation and leading to co-construction of knowledge. Conversation tools can be either synchronous (communication at the same time, as in a telephone conversation) or asynchronous (communication at different times, as in email). The first category consists of tools which support real-time communication. With such tools, people can share different types of data with each other, process it and discuss it at the same time. Their computers are connected to each other over a network and the communication middleware affords simultaneous communication. Examples of forms of synchronous communication are Internet relay chat, desktop video conferencing and MUDs (Multi-user Dimension; a text-based virtual environment in which users, in the form of 'avatars' or 'characters', interact in real-time). Asynchronous communication involves delayed communication, where only one person can communicate at any one time. Jonassen (2000) distinguishes three types of asynchronous conferencing, namely one-to-one communication as in email, one-to-many communication as in bulletin boards (special-purpose computer programs that enable individuals to post messages to a bulletin board or read messages and copy them to a computer), and many-to-many communication as in computer conferences (asynchronous discussions, debates, and collaborative efforts among a group of people who share an interest in the topic).

Conversation tools, both asynchronous and synchronous, can be used as tools for supporting communities or networks aimed at the professional development of (aspirant) teachers, as was discussed in the previous sections.

Communities for teacher professional development can differ with respect to a number of variables. The size of a community can differ, the setting where the community operates can vary and also the composition of a community is a factor that typifies a community. Science teachers, for example, making use of mindtools in their lessons in a special-interest discussion group in a newsgroup (let's call the group SciTeacher), can be regarded as a homogenous discourse community. The same topic of 'mindtool use' can also be discussed in a learning community with aspirant science teachers, teacher educators and practising science teachers. In such a community, the group is heterogeneous with respect to both expertise and

domain of specialisation. Heterogeneity is further increased when subject experts are part of a large community of practice where science is the binding factor.

In the remainder of this section we present examples of good practice in teacher education where conversation tools are used as mindtools within communities. Examples of good practice are described from simple to complex with regard to the composition of the community.

The first example of learning to use conversation tools or networking technologies as mindtools for professional development is the use of the asynchronous tool *Yahoo Groups*® in the 1-semester course 'Networks for the Teaching Methodology of Foreign Languages' at the University of Amsterdam Graduate School of Teaching and Learning. This course is a follow-up to lower-level courses on the methodology of foreign language teaching. The target population of the course is aspirant teachers doing their apprenticeship (i.e. student teachers) or in-service teachers studying for a university degree. The course is supported by an electronic discussion forum with facilities for collaborative work (*VAKNETALFA* in *Yahoo Groups*®). Access to this electronic forum is restricted to participants of the course. The participants learn to analyse an existing network, they participate in an existing network and they learn how to set up a network of their own. During the creation of a new network the focus is on how to implement innovative educational policy at the micro level (in the classroom). The students design, develop and implement ICT-rich educational materials and exchange designs and experiences with fellow students. Giving feedback to each other is seen as an important feature in this process. In other words, they form a community of practice.

In 'eL3' teachers learn how to work on ICT applications for their specific school subject.[5] eL3 is a project for teacher educators and their students in 16 school subjects. It aims to teach teachers to make use of ICT in their lessons. The guiding principle is subject orientation, so that teachers (of all school types) can jointly learn to work on ICT applications for their specific school subject. Basic ICT skills, ICT and media pedagogies, and themes such as the design and development of new interactive teaching and learning material or evaluation of eLearning and eTeaching are at the core of eL3. A variety of conversation tools is used for critical thinking and meaningful learning. The learning platforms for the courses (in Erlangen that is *ILIAS*®, in Oldenburg *eLearning Suite*®) support asynchronous, group-oriented email and bulletin board forum messaging (including attachments) as well as synchronous chats. The course material is designed with a focus on small-group (approximately five participants), collaborative learning situations to ensure participation in discussion by all participants. The embedded student tasks have been designed to be solved collaboratively. Learners work between 50 and 60 hours in a 'blended' learning environment, often starting with a 'real' meeting of all the participants from one region with their lecturer and the tutors and then

continuing using conversation tools for student-student and student-tutor interaction.

A somewhat more complex learning community using conversation tools to facilitate meaningful learning can be found in 'eScience'.[6] This is a training programme for primary school student teachers (teaching children between the ages of 4 to 12 years) learning to teach science using ICT (e.g. using web pages, discussion lists, etc.) and is part of a 5-year teacher training programme. The three main web-based components of eScience are: learning material for pupils at primary schools, pedagogic (web-based) learning material for student teachers, and a content area package in physics and chemistry. All three web-based materials interact in terms of design and layout, structure, and usability/functionality aspects. The student teachers work in groups of three. The groups make use of asynchronous and synchronous (*WebCT*®) communication/discussion forums to discuss content and didactics or pedagogy.

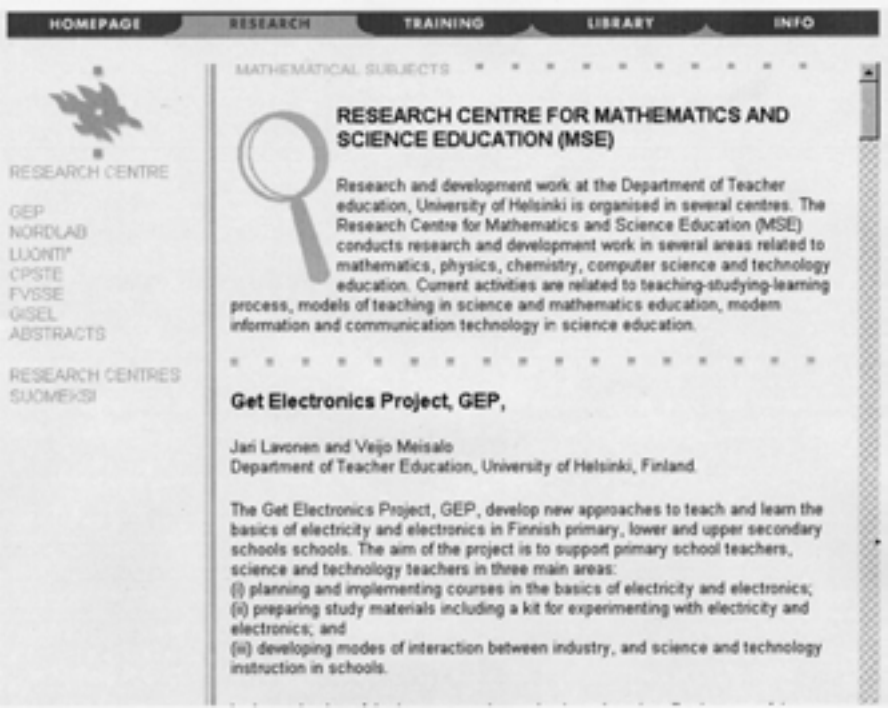

Figure 1. 'eScience', Finland.

Conversation tools in the previous three examples are used within or between (groups) of students in a particular study or subject matter area. These conversation tools, thus, are used to facilitate small learning communities. Conversation tools can also be used to assist larger, more

heterogeneous communities. Although not implemented in full yet, the 'ICT-E-NET' can be regarded as an innovative initiative to bring together different groups in a specific domain.[7] ICT-E-NET is a platform where primary school teachers, primary education students and college tutors can learn from each other with respect to the integration of innovative ICT use in primary education. Here, good ICT practice, (background) information about ICT projects, ideas, reflections and thoughts are shared among the community members.

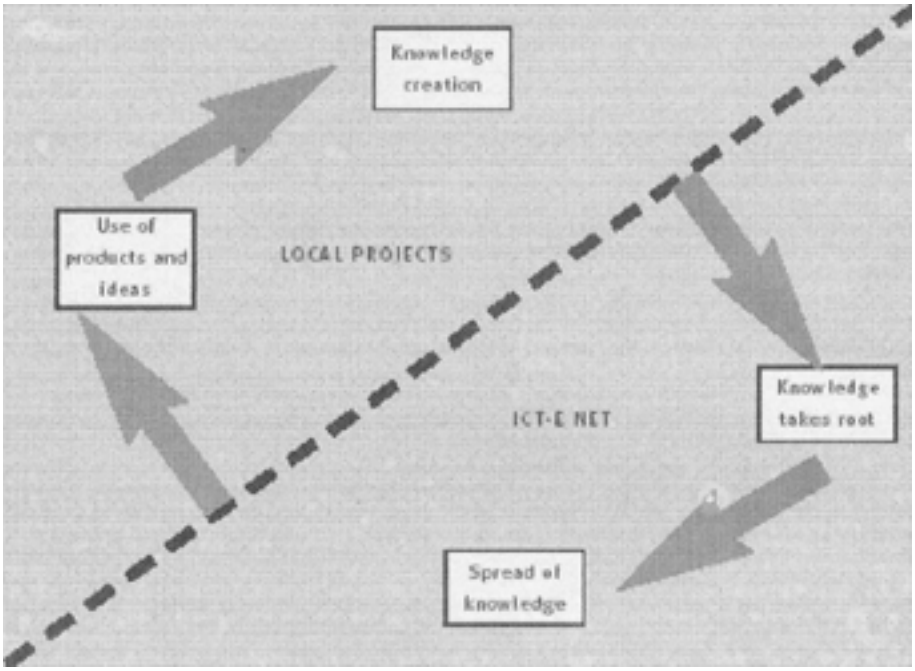

Figure 2. ICT-E-NET, Netherlands.

Conversation tools are used to reflect on products and ideas and to discuss them with each other. Table I shows the four different 'spaces' and the contents of those spaces within ICT-E-NET.

In 'La Main à la pâte', a community of practice for science teachers is formed throughout France.[8] This programme, winner of the 2001 eSchola prize for the best initiative for teachers, promotes innovation in the teaching of science in primary schools by encouraging teachers to place children in a position where they can experiment, observe, query and reason, and thereby opening them up to the beauty of the world round about them and its intelligibility.

Publication space o Example products: lesson plans, worksheets, tests, software o Guidelines for introduction of the example products: essential aspects of the implementation process, guidelines, possible pitfalls, tips o Descriptions of the ways in which the example products contribute to the attainment of targets of primary education o Educational challenges and assignments for teacher education students o Information about the use of ICT in education: references to other websites and a survey of interesting links
Reflection space o Project descriptions and portraits of the schools involved; schools' experiences with implementation of the ICT-E Project o Teacher training students' experiences with ICT-E projects in the project schools o Opportunity for project schools and primary education students to share their experiences
Discussion space o General platform for discussion about innovative ICT applications in education o Chance to pose questions to experts o Survey of Frequently Asked Questions and answers
Construction space o Tools, guidelines and tips for developing new example products

Table I. Parts of the ICT-E-NET.

Initiated in 1996 by Georges Charpak, Nobel prize winner for physics in 1992, La Main à la pâte is managed by the French Academy of Science. It is based on teachers networking their skills to create effective synergy with external actors, inspectors and educational advisers, College of Education training staff (from the IUFM – Institut Universitaire de Formation des Maîtres), teaching specialists in science and other subjects, scientists, researchers, engineers, students from science universities or from the national colleges (grandes écoles), and parents. In April 1998, an Internet site was opened offering teachers an information section on the structure and history of the project, a resource section containing class activities, scientific documents, and educational documents, and an exchange section

with access to training and scientist networks, to (sub)sites of the La Main à la pâte network, and to archives of a distribution list.

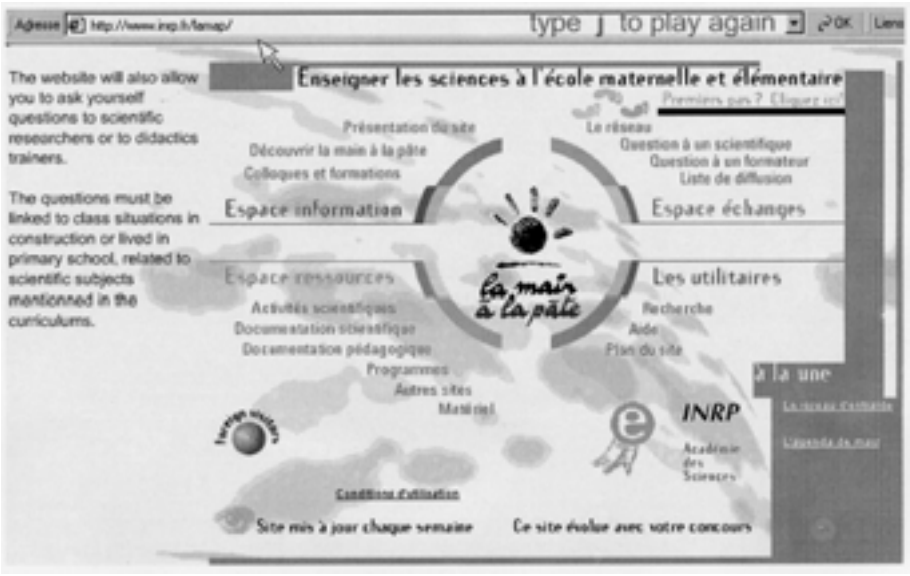

Figure 3. La Main à la pâte, France.

The networks are set up to foster exchange and cooperation between the different actors involved in the teaching of science, dialogue among teachers, and teacher-teacher assistance. Two important networks within the exchange section are the scientific consultant network and the teaching specialist network. Dialogue within these networks is achieved through asynchronous, built-in conversation tools with the results classified by both topic and resource form. The scientific consultant network is a constantly expanding network made up of researchers and engineers who are willing to help teachers (i.e. act as a resource or sounding-board). They, in their own area of competence, reply to science-related queries by teachers preparing or implementing an activity. Replies are generally received within 48 hours. The teaching specialist network is made up of trainers and researchers skilled in the teaching of an academic subject (i.e. the pedagogical content knowledge of a certain area). These community members aid teachers to solve those problems encountered when preparing or conducting science activities.

Finally, Sipoo Institute can be called a virtual institute or project.[9] It started in 2000 and will continue at least until 2005. It is funded by the National Board of Education of Finland and the municipality of Sipoo. The main idea of the project is that all of the schools in Sipoo gain access to pedagogical, financial and technical support for innovating and improving

their education. Members of this community are teachers at the schools in the municipality of Sipoo (30 of the 110 teachers working there take part in this project), student teachers at different universities, faculty at those universities, parents, community members. Examples are: The National Board of Education, Campus Internetix, Virtual School, The University of Helsinki Department of Education, and Keuda Vocational Education.

Figure 4. Sipoo Institute, Finland.

These people all work together in a community of practice on projects such as learning logbooks and portfolios for the guidance of the process and assessment on the Web, home pages and web magazines for spreading information on the Web, gathering and handling information for attaining cognitive web skills, cooperative project learning on the Web, and technical solutions/applications supporting web learning. The main purpose of Sipoo Institute is to develop, with teachers, web learning in a wide and balanced way in order to find out how the World Wide Web can be best used in

classrooms. The main idea, thus, is not to develop learning material but to develop tools and methods to be used in as many subjects as possible.

Teachers within Sipoo school district have a large selection of ICT training resources which are used, primarily, after working hours in the afternoons and evenings. All of the applications, resource and communication tools, and groupware tools previously mentioned in this article are a part of the training and working space of all teachers.

Even mobile learning has, to some extent, been introduced. SMS (short message service), integrated in the web-based learning environment, offers students quick information from schools/teachers/courses etc. directly to their cell phones.

Conclusion

The goal of teacher education is not, or at least should not be, to give a new generation of teachers subject matter knowledge, pedagogical content knowledge and the current set of teaching tools for them to use for the rest of their careers. The primary goal of teacher education should be, at the least, the transmission of those competencies which allow candidates to become teachers who are reflective of the decisions that they make and who are able to interact with their ever-changing environments in a meaningful and responsive way. This means that they need to become competent lifelong learners within their field(s) of expertise. And their fields are diverse. They have and need to keep current their knowledge and skills within their area of teaching (language, science, history) as well as with respect to the groups or age levels that they work with (elementary, secondary, vocational, remedial). They must keep abreast of the newest, or recurring, perspectives and techniques with respect to pedagogy (at the moment, competence-based learning, constructivism, working in teams, discovery learning) and pedagogical content knowledge and skills (case-based learning in economics, project-centred learning in engineering). They must also move with the times with respect to the tools of teaching (computer-supported collaborative learning, project environments) and the tools of society (computers, the Internet). It is not possible for teachers to do this in traditional teaching and training situations. Things are moving and changing too quickly, and life is becoming so much more complex, that the courses cannot be designed quickly enough and in enough numbers to meet the need. Teachers do not have the time or opportunity to follow all of these courses.

Teacher training institutions are just beginning to make use of ICT as a mindtool in general and as a conversation tool specifically. There are examples of good practice, but they are sparse and in the early stages of development and use. Teacher education is still busy transferring instrumental skills and teaching students how to make use of teacher productivity tools. ICT as a mindtool can be the key that we need to unlock the future.

The solution is *not* continuing education at universities and teacher colleges, but rather continuous (and ubiquitous) learning in communities of practice, communities of interest and communities of expertise in schools, teacher training institutions, and society in general.

Notes

[1] Professor Reinout Vriesendorp, Chair of the Examination Commission of the Law Faculty at Tilburg University, is of the opinion that plagiarism by students should have criminal law repercussions (http://cwis.kub.nl/~univers/nieuws/0003/08/fraude.html).

[2] http://www.technorealism.org

[3] Inspired by Douglas Adams' book *The Hitchhiker's Guide to the Galaxy*: http://www.bbc.co.uk/dna/h2g2/alabaster/A585281

[4] CoVis (Communities of Practice) http://www.covis.nwu.edu/info/philosophy/ communities-of-practice.html#definition

[5] eL3: eLearning and eTeaching in Initial and Further Teacher Education (http://www.eL3.de), Friedrich-Alexander University, Erlangen-Nuremberg and Carl von Ossietzky University, Oldenburg, Germany.

[6] eScience (http://www.malux.edu.helsinki.fi/malu/koulutus/escience/index.htm). Department of Teacher Education at the University of Helsinki in collaboration with the City of Helsinki and the Federation of Finnish Electrical and Electronics Industry.

[7] ICT-E-NET (http://www.nldata.nl/ict-e/English/files/Brochure_ICT-E_EN.pdf). Ichthus University Rotterdam, School of Education, the Netherlands.

[8] La Main à la pâte (http://www.inrp.fr/lamap/reseau/interna/site_en/). Institut National de Recherche Pédagogique, France.

[9] Sipoo Institute (http://sipooinstituutti.net/english/). National Board of Education and Sipoo municipality, Finland.

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