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Developing policies for the utilisation of multi-media in support of vocational education and training

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Introduction

In the light of the economic upheavals and social change of the last twenty-five years and ongoing profound technological and structural changes in labour markets and work processes, qualifications for lifelong learning have become a 'conditio sine qua non' and are regarded as core skills of individuals in order to enable them to have a better chance to develop and maintain their career (European Commission 1993, 1995). This has led to an increasing focus on vocational education and training (VET) in the member states, for school leavers, in the form of initial vocational education and training, for the workforce as continuing education and training, and a focus upon the development of employability for the unemployed and socially marginalised.

At the same time the advent of modern communication technologies and the arrival of the Internet, especially the World Wide We, has been heralded as ushering in a radically revised form of education and training (Timms et al, 1998). The technologies themselves are said to have become more readily available, to have decreased in cost and to have become more transparent to the end user. This paper forms part of a resource pack being produced for CEDEFOP examining the use of information and communication technologies (ICTs) for vocational education and training.

Other parts of the pack consider the implications of the new technologies for pedagogy and models of teaching and learning, as well as reviewing the impact of ongoing institutional changes. It also examines in some depth policy development and evolution within the Member states of the European Union. However, it is our contention that any consideration of the impact of multimedia on education and training must start with the changes taking place in the social and economic structures of the Member States and the resultant new demands this places on education and training. It is argued that many of the developments to implement the new technologies are a response to these pressures.

This paper begins by looking at the changing social and economic context in which requirements for learning are proposed, and goes on to look at the requirements and challenges of these changes, in terms of the content, pedagogy, situation and context of learning. The challenges include the 'what' of learning and also the 'how' and 'why'. The changing nature of late industrial society challenges the very taxonomies of knowledge and the meanings of European society, which can be viewed as dating from the time of the Renaissance (Rauner, 1998). The challenge for vocational education and training is to transcend the requirement to respond to changing economies, and to equip people with the ability to

help to shape the forms of technology and work in the twenty first century. The paper concludes with a brief assessment of the impact of government and European policies for ICTs and VET, and puts forward a tentative proposal for how those policies might be developed.

Economic and Social Challenges

Technological change and increasing internationalisation of economies
There have been dramatic changes in the economies of the industrialised nations of the world in the last quarter of the twentieth century, which have led to new requirements and challenges for vocational education and training. The first major driving force behind economic change has been the rapid implementation of new technologies. This can be seen most strikingly in the emergence of whole new industries engaged in the production and distribution of information. However, this change is not limited to the computer and information technology industries, even more profound is the penetration of the new technologies into almost every area of business and manufacturing activity.

This provides a dual focus and agenda for multi-media and VET – learning about multi-media for work – and using multi-media to facilitate learning. The second key force behind the economic transformation is the growing internationalisation of economies. Many factors have contributed to this, ranging from relatively peaceful international relations since the end of the second world war, to massive technological change in communications and transportation (Cisneros and Weiss, forthcoming) and the development of economic free trade zones. The exposure of many manufacturing industries all over the world to international competition, and the growing globalisation of capital, has resulted in a dramatic increase in the productivity of labour and has led to significant industrial restructuring. This has in turn taken a number of different forms.

Changes in the spatial location of industry

There has been a decline in older extractive and heavy industrial centres and a general trend to relocation in suburban areas and areas with good infrastructure links within individual regions and countries. At the same time there have been movements towards clustering of industries in particular locations. Internationally the transfer and development of new technologies in the 'developing' countries has led to both competition with the old industrialised nations, new world centres of production and a trend towards the movement of low value added production to lower wage economies.

The use of Information and Communication Technologies allow communication, and the sharing of data and knowledge and co-operative work between dispersed sites and countries.

Changes in sectors and industries

The past period has seen dramatic changes in the importance of different sectors and industries in every industrialised country particularly in relation to employment. The agricultural sector has continued its steady decline and there has been a marked decrease in employment in the extractive industries. Most remarkable has been the decline in employment in manufacturing and a corresponding increase in services.

There has been rapid growth in technology based industries such as consumer electronics, computers and semi-conductors. Recently there has been a rapid growth in information based services.

Changes in products

Changing consumer demand has led to a decline in mass produced products with a rise in demand for customised products with shorter production runs.
This is turn has led to increasing importance for design processes within production. Added to the impact of the introduction of new technologies this has resulted in a drastic reduction in the product life cycle.
Increasing focus upon quality
Consumer demand and heightened international competition have led to the introduction of new forms of quality control. The implementation of new quality systems such as Total Quality Management (TQM), and ISO9000 have resulted in significant changes in the processes of production. These changes have had fundamental implications for the nature of work in the late 20th century.

In 1974 Braverman published his seminal thesis predicting that increasing automation would lead to a general de-skilling of the work. As a general trend this has not happened. Rather there has been a bifurcation in labour markets, with evidence of both de-skilling and up-skilling. Thus while there has been an increase in automation and a strengthening of Taylorism in some production and service processes, in other settings the skills required of workers have been considerably increased. The latter process, influenced by the new management paradigm of the Learning Organisation, has led industrial sociologists to proclaim the advent of a post-Fordist society. This is likely to prove an overstatement too, although in a diametrically opposite direction to Braverman's ideas (Wright and Edwards, 1998).

Whilst it is possible to identify divergent trends between the leading world industrial centres of Japan, the USA and Europe, profitability and competitiveness are increasingly seen as dependent on the skills and knowledge of the workforce (Bewick, 1997).
This is the new paradigm, linked to the rapid implementation of new technologies and new products, which has led to the focus on lifelong learning.

Innovation, competitiveness and social cohesion

In Europe researchers and policy makers alike have increasingly stressed the importance of skills and knowledge to innovation. Product and process innovation are seen as central to the competitiveness of the European economies and to the creation of employment. This is particularly so in the context of the European cultural tradition of social partnership and social inclusion. Such a tradition emphasises not only economic competitiveness but also social cohesion. Regional learning environments comprising learning organisations in enterprises and public bodies are seen as central to both the generation of new enterprises and competitiveness and to the promotion of social inclusion and personal self-fulfilment. The combination of technical and work organisation innovation, and the economic development of regions with concomitant reduction of unemployment and social reform, is known in current debates as the 'Social Organisation of Innovation'. Innovation has traditionally been seen as technologically determined. More latterly researchers have

pointed to the limitations in such a linear and deterministic analysis of the development of innovation and have pointed to the choices in the way technology is developed and implemented (Niewenhuis, forthcoming; MacKenzie, 1996). Thus innovation has a social nature and workers have a key role in the shaping of technology and the organisation of work (Heidegger, 1997).

Politicians and social scientists are seeking a specifically European path for development, which can take up the opportunities of accelerating modernisation while confronting the risks inherent in these opportunities. Two recent European White Papers, Growth, Competitiveness and Employment and Teaching and Learning: Towards a Knowledge based Society, emphasise the centrality of vocational education and training in furthering economic and social competitiveness.
In meeting the challenge of the information society human resources are seen as important as technological development in promoting the social organisation of innovation.

Continuing development of skills and knowledge

Skills and knowledge are also viewed as integral to the promotion and maintenance of individual employability. Thus European policy stresses the importance of individuals taking responsibility not only for the acquisition of initial education and training but also for maintaining that knowledge through their working life. Finally, skills and knowledge are seen as central to the development of social citizenship through informed participation in democratic decision making.

The introduction of new technologies and the increase in scientific knowledge demand continuous learning as a basis for social participation.

New Requirements for Skills and Knowledge

Stronger emphasis upon flexibility, adaptability and mobility
Whilst vocational education and training has found new favour with politicians, policy makers and planners alike, traditional curricula and learning processes are seen as insufficient to meet the need to develop the skills and knowledge required by the new economies. Traditional definitions and explanations of professional competence or expertise have been based on theories of technical rationality - on the basis that learning can be applied in predictable and repeated ways (Edwards, 1993). Vocational education and training curricula and processes have traditionally been based on imparting a fixed body of knowledge and skills required for identified tasks within occupational roles.
With the rapid rate of change in today's industrial society these roles and tasks are no longer fixed and predictable.

Vocational education and training is now increasingly putting an emphasis upon the flexibility and adaptability of individuals (Nijhof, 1998; Oates, 1998). Workers need to be able to adapt to new skills and processes and to update their knowledge on a regular basis. Skilled work increasingly requires the ability to deal with unpredictable occurrences. Occupational profiles are no longer fixed but mutate and migrate over time (Heidegger and Rauner, 1997). There is a tendency towards far broader occupational profiles than the narrow boundaries of skills and knowledge application based on Taylorist work organisation. New forms of working organisation place a priority on communication skills and on the ability to work in teams.

There are other significant changes in skill requirements. In the past the vast majority of people have lived within five kilometres of their birthplace (Parkes, 1998). Today's society demands increasing mobility, both within countries, and in the European context, between Member States. There is a growing necessity for competence in foreign languages. It is not only the content of skills and knowledge that is changing. The new information and communication technology industries in particular are demanding higher levels of skills and qualification.

Necessity of learning to learn

The pace of change in many aspects of work and the work environment put a premium upon the ability to learn. Learning to learn is seen as fundamental if workers are to be able to adjust to changes in organisational structures, technological innovation and almost constant change to work processes. One key attribute, associated with initial skill development, which needs to be developed, is the ability `to pick up the threads' in future when skills need updating (Brown et al, 1991). That is, young people need to be confident about their ability to learn in future. Learning to learn can thus be seen in terms of the ability to consciously shape and determine ones own vocational and occupational biography. Learning to learn, or self-directed learning, may also be considered as having a social and cultural, as well as an individual, nature. Gerald Straka (1997, p.4) proposes that self-directed learning is "the key qualification for mastering global competition and constructing a humane society at a European level".
Multi-media and information technologies not only offer access to information and knowledge but also will change the way in which people learn to learn.

Social shaping as a goal

There is a growing critique of the European vocational education and training agenda as being economistic in viewing qualifications as necessary for adaptation to technological and economic demand (Attwell & Hughes, forthcoming). Gerald Heidegger (1997) argues it is not enough for skilled workers to be able to respond to the changing requirements of our society. Instead they need the skills and knowledge to be able themselves to shape the application of technology and the social form of work. Instead Heidegger believes there is a dialectical relationship between education, technology and work. Felix Rauner (1998) also points to the inadequacy of existing taxonomies of knowledge, seeing the need to overcome the duality between academic knowledge (brain work) and vocational skill (hand work) which he traces back to the Renaissance. In the 21st century work related knowledge will become central to both profitability and social community.

The importance of work-related knowledge

The cognitive side of occupational competence is key to the development of context-related expertise: with work-related knowledge providing the link between knowledge, which is not context related, and experience at work, which may not necessarily be used in a generalisable way. This implies both the need for active reflection upon experience and a shift from information to knowledge: expertise cannot be developed through simple although extended information acquisitions, but only through continuous and subtle cognitive experiences related to putting knowledge into action, co-developing personal and professional knowledge, and

integrating individual knowledge into the larger dimensions of knowledge held by groups and whole organisations.
Multi-media and ICT based systems can be utilised to develop cognitive apprenticeship and build on personal and professional knowledge and expertise within communities of practice and within organisations.

In another part of the CEDEFOP Resource Pack we undertake an in-depth analysis of the nature and impact of policies and measures to promote ICTs and multi-media for VET (Attwell, forthcoming). We point to the difficulty of such an undertaking. On the one hand, there is no shortage of texts. Almost every European government has recently issued updated policies in this field, the ground is littered with directives of intent, and there are large numbers of Non-Governmental Organisations or state supported agencies purporting to support developments in the field. However, many of these statements exist at a rather vague level of generality, and the terminology (especially in translation!) is often confused. We are entering the information society, so runs the argument, where knowledge and access to knowledge will be the key to economic competitiveness and growth. Changing technologies will require continuous and higher levels of learning. The introduction and use of ICTs can provide us all with access to the information age and ICT based learning can transform our education and training systems. Beyond such levels of often articulate and impassioned argumentation lie various plans of interventions and development targets. Whether such targets represent a policy, still less a strategy is harder to discern.

Furthermore, terminology is often used interchangeably, with references to multi-media, ICTs, computer-assisted learning, open and distance learning and, more recently, virtual learning environments. A second difficulty is that policies for ICTs in VET are often reflected in more general VET policy developments. For instance, quite logically policy developments seeking to stimulate continuing learning in Small and Medium Enterprises may promote the dissemination of computer based learning as a strategy for attaining that goal. Thus, it is hard to assess the overall coherence of ICT policy and to judge its impact at systemic level. Similarly, policies to stimulate or regulate developments in ICT may be embedded in more general economic and social policies. This, of course, relates to the nature of VET itself. Unlike the highly regulated school system, or the distinctly defined university sector, VET is a highly heterogeneous and fragmented area of education with different public and private sector providers.

A further problem in assessing the impact of ICTs on VET from a policy consideration lies precisely in the lack of documentary sources. Whilst there may be many policy statements there have been few attempts to undertake systematic surveys or comprehensive evaluations of diffusion and impact. Such studies stand out – notably the various reports undertaken for the European Union under the Delta programme (even though these focused on Open and Distance Learning) and the recent work for DGXXII on multi-media carried out by the MESO consortium and co-ordinated by SCIENTER in Italy. Even so these tend to concentrate on the economics of policy interventions and on the development of markets for multi-media based learning.

Policy Measures

In this section, we will attempt to describe some of the policy measures being taken by governments and government agencies to implement policies

on ICTs and VET. Before so doing a number of provisos need to be made. The first is that the structures for implementing measures vary across Europe – for instance in Germany and Spain the regional governments have considerable autonomy in developing and implementing policy in this area whilst in the UK it has become common to devolve policy implementation to quasi autonomous non-governmental agencies (QUANGOs). Secondly there are obviously other areas of policy making such as telecommunications which have effects on VET, just as there are areas of education policy which will have effects on ICT development. In this section we will choose to focus on direct measures which impact on ICT and education and training. It is regretted that many of the examples are presently drawn form the UK – but it is hoped to add further examples from other European countries in the near future.

Pilot Programmes

By far the most popular and common measure by which policies are implemented is by the development and funding of pilot programmes. The EC itself runs pilot programmes in the ICT and education field including Socrates, Leonardo da Vinci and through the Multi Media Task Force. National Governments also have initiated such programmes – in Greece the government is directly sponsoring some 15 pilot projects in this field. Pilot projects are by their nature time and funding limited – imposing restrictions of scale and scope. This can be a problem in evaluating longer-term impacts of development. Furthermore, critics have doubted the sustainability of pilot projects when initial seed-corn funding ceases. Pilot projects are intended to develop effective and appropriate practice – and to serve as a test laboratory for new technologies and pedagogies. There effect may be diluted by the lack of effective evaluation (Stern, 1997) and the lack of thorough dissemination. One important question presently being examined by the TSER IVETTE project is the extent to which pilot actions in the field of ICT leads to on-going institutional change.

The establishment of new institutions

There have been a number of initiatives by governments to establish new ICT based intitutions or to 'dualise' existing provision. The UK offers one of the best examples – having as far back as the 1960s set up the pioneering Open University which used television as a main means of teaching. This initiative has been replicated in most European countries, with co-ordination being provided by the European Open University, based in Maastricht. In the 1980s, considerable investment was made in the Open College (or Open Tech) which was intended to develop as a parallel organisation for vocational education and training. Interestingly this initiative was a failure – possibly due to the limited quality of learning materials, and possibly due to the different social backgrounds, experience and expectations of potential learners and the need for higher levels of learning support. Whilst, disappointingly, there appears to have been no full blown investigation of why the Open College failed, it is interesting to speculate on whether different 'knowledge areas' lend themselves in different ways to the use of ICTs (for example is it possible to teach bricklaying or catering through ICTs in the same way we can teach history or physics?). Now with EC Objective 4 ADAPT funding the UK government is trying to launch a University for Industry, once more centred on occupational knowledge, but at higher levels of learning and through a private sector / public sector partnership.

The EUROSPACE project has advocated the policy of 'dualising' institutions – of providing parallel programmes of traditional teaching and learning along with flexible and distance learning utilising ICTs. Whilst effectively many institutions do offer distance learning as a complement to some of their traditional programmes this is not usually as yet a policy or strategic intent. Whilst there is much on-going debate on the future institutional development of the university sector this debate has not yet happened for schools and for vocational education and training organisations.

The Provision of Hardware and Software

A major issue for colleges and other organisations providing Vocational Education and Training is the cost of hardware and software for education. Some governments have provided support either through direct funding to institutions or through subsidising the market for software production. The UK has launched a major programme to ensure that all school students (and teachers) have access to computers. Software production is more complicated, especially given that apart from in the UK, Spain, France and Germany, the markets are generally considered too small to provide a range of multimedia titles in indigenous language versions. In Wales, the government has provided direct support for the setting up of a software production facility in the minority Welsh language (ACAC). More common is the encouragement and support of private / public consortia of educational organisations together with private software houses. There are also examples of public sector consortia bringing together different institutions to share the cost of software production. At a European level, many of the Socrates and Leonardo pilot projects in this area have sought to bring develop new software through multi-national consortia, although different languages and the differences in curricula remain a constraint.

The Provision of Guidelines and Advice

Many governments and agencies which support vocational education and training are providing guidelines and advice for managers and teachers in how to utilise ICTs for education and training. An example, drawn from the UK National Grid server is provided here. Further help may be provided through the use of consultants to advice Vet institutions on how to implement ICTs.

The Development of New Qualifications

The rapid rate of technological development and change is leading to new demands for competence and qualification to deal with skills shortages. There is a presently a shortage of software programmers in most European countries and considerable demand for Web Site Developers. Qualification agencies are developing and piloting new qualifications to meet this need – both at initial level and for continuing education and training. One of the most ambitious is the recent German qualifications for Information and Communication technologies. It is interesting that whilst most countries have chosen to train software engineers through universities the Germans have produced qualification routes within the vocational Dual System. It is also noteworthy that Germany has had to streamline procedures for developing new qualifications to meet the deadlines imposed by demand. The development of processes for modernising curricula and qualifications to respond to pre-empt new work demands is a major issue for VET, as of course is the on-going debate as to the structure

and contents of qualifications to enable workers to meet with and shape new technologies and work organisations.

Supporting new ways of Learning

Supporting new ways of learning can take different forms. It can be as simple as providing students with free programmes in open and distance learning, or subsidised programmes. Equally it can be through differentiated funding for institutions providing premium payments for ICT based provision. Through use of funding measures, governments can effectively provide a steer to encourage the development and implementation of new ways of learning.

Support for Research

Most national governments, as well as the EC itself through DGXII and DGXIII are providing support for programmes of research into ICT and education. However, the provisos raised earlier have to be restated. There is still very limited research into the use of ICT for vocational education and training, and for that matter only limited research into the use of ICTs in schools, especially at a primary level. Much of the research has tended to focus on the possibilities of particular technologies, rather than on the development of the use of ICTs to support new learning paradigms and to support the development of new knowledge. Often research in concentrated in specialist IT related disciplines – and given that VET research itself is a weak area, little attention has been paid to this sphere. There still lacks thorough evaluation of the impact of policies in this area. Dissemination and dialogue regarding research outcomes is still patchy, although at least at an HE level, there are a number of excellent Listservers, and a growing number of electronic journals, with much of relevance to education and training.

Changes in regulations for programmes and assessment

It is difficult to generalise but this is one of the most important measures to stimulate activity in ICTs for VET. In many countries regulations regarding participation, assessment and qualification have been framed around traditional didactic programme provision. If the use of ICT is to become part of mainstream education and training provision then governments and national curriculum agencies and authorities will have to develop new forms of regulation which can value and assess different forms and processes of learning. Often this will entail social dialogue and change – and will force a review of the social meanings of education. For example, apprenticeship models assume a process of mastery through mentorship and legitimate peripheral participation. The individualised nature of many ICT based learning programmes may inhibit the development of work process knowledge and expertise. There is the need for further consideration of this important policy area.

Promoting Access

There is growing concern that the introduction of ICTs is leading to increased social exclusion, either because of lack of knowledge of how to use ICTs or because lack of access to hardware. A further issue is the lack of software in minority languages or in languages without sufficient market potential for software producers. A whole host of different measures are being undertaken to deal with this question, ranging from

the development of drop in centres or publicly funded cyber cafes to the provision of computers and open learning facilities in libraries.
One interesting development in the UK is the production of a TV series designed to introduce ICTs linked to short introductory courses in colleges and drop in centres.
The EC itself has launched a number of measures designed to develop IT democracy and to promote the use of ICTs by minority groups. This area is likely to be the focus of more attention in the forthcoming period.

Assessing the Impact of Policies to promote ICTs and VET

As we have said earlier it is very difficult to make any overall assessment of the impact of policy developments in ICTs and VET. Certainly we would view developments as being at a very early stage, compared with the impact of computers and telecommunications in other areas of society. Given the Finnish have a penchant for developing and using the new technologies their comprehensive evaluation of the impact of policies in this area can only overstate the level of development. Writing in the English language journal Lline, Matti Sinko concludes that "if we expect implementing ICT to bring about profound pedagogic change, then we are still struggling in the wide chasm between early adopters and an early majority, a chasm which is always the most difficult of the discontinuities on the innovation adoption curve to overcome."
His conclusion is worth quoting at some length:

"The vision of the information society can be interpreted differently from different viewpoints. The rationalistic and economic viewpoint highlights the opportunity to produce education more cost-efficiently through ICT. The working life's viewpoint stresses the need to learn competences for future working life. The learner's point of view sees the possibility to learn more independently and more flexibly from the restrictions of time and space.

The assessment project shows that the rationalistic and economic tendency may be the driving force in the educational use of ITC. There is the clear danger that the early majority of educational institutions will adopt only the technology, and reproduce their existing practices in a new framework. The competences for working life will be produced elsewhere, and learners will pursue their interests in other contexts. Meaningful learning is located outside the education system".

It is this challenge that policy development must answer.

Different types of knowledge

When thinking about knowledge development in a richer way, it may be useful to distinguish between different types of knowledge. Lundvall and Johnson (1994) identify four different kinds of knowledge, each requiring different types of mastery: know-what, know-why, know-how, and know-who.
Know-what refers to knowledge about 'facts': it can be considered as equivalent to what is normally called information and related to the knowledge 'corpus' that each category of experts must possess.
Know-why refers to scientific knowledge, influencing technological development and the pace and characteristics of its applications in industries of every kind.

Also in this case, knowledge production and reproduction take place within organised processes, such as university teaching, scientific research, specialised personnel recruiting, and so on.
Know-how refers to the capability to operate skilfully in different contexts (e.g. judging the market prospects for a new product, operating a machine tool, etc.).

Know-how is typically developed at the individual level. However, its importance is evident also if one considers the degree of co-operation taking place within organisations and even at the inter-organisational level. For instance, the formation of industrial networks is largely due to the need for firms to be able to share and combine elements of know-how.

Know-who is another kind of knowledge which is becoming increasingly important, referring to a mix of different kinds of skills, in particular the social skills, allowing the access and use of knowledge possessed by someone else, often through a combination of professional and personal networks (Eraut et al, 1998).

Vickstroem and Normann (1994) argue a similar line in their attempt to develop a new perspective of corporate transformation. They distinguish between information, skill (or know-how), explanation, and understanding. Information is knowledge of an objective kind whose importance is mainly related to its 'factual' nature but is not limited to that. For instance, the addition of new information about a certain topic can modify the pattern in which this topic was conceived letting a new intellectual structure emerge. Skill or know-how, unlike information, is embedded in individuals, as they are able to behave purposively in a particular situation in order to achieve a certain result. Explanation refers to scientific knowledge, it is not person-based and can be found in articles, textbooks, and so on. Explanatory knowledge very often provides the basis for problem-solving activities. Understanding is the most profound form of knowledge, arising when principles and connections are recognised.

Understanding is thus embedded in individuals and is central to the creation of new knowledge.

Each kind of knowledge is characterised by different channels through which learning takes place. The easiest cases are those of know-what and know-why, that can be obtained through the typical channels of knowledge acquisition (reading books, attending lectures, accessing data bases), while the other two categories are rooted primarily in practical experience and are more problematic insofar as they require the availability of informal social channels. They are also the types of knowledge upon which dynamic organisations depend and companies are particularly interested in whether new recruits will be able to contribute to the creation and development of such forms of knowledge.

Apprenticeship and other forms of VET that involve on the job learning are fundamental channels for acquiring know-how knowledge. They represent the most important way for skilling newcomers in an organisation, but these protracted processes of learning by doing are also frequently the responsibility of those who are considered the experts in an organisation, capable of above-average performance. Simulations are sometimes used as shortcuts for reproducing the many aspects of the know-how acquisition available in real situations. Know-

who too - as Lundvall and Johnson (1994) point out - is socially embedded knowledge that cannot easily be transferred through formal channels of communication.

Know-who is learned in social practices and through participation in particular networks (like those taking place in the professional communities giving the participants access to information bartering with professional colleagues), although some of it can be learned in specialised educational environments.

Tacit knowledge and its application

Work-related knowledge is to some extent quite difficult to pin down for two reasons. First, it contains a tacit dimension and, second, it is bound up with particular social contexts: that is, work-related knowledge is applied within particular communities of practice, whose members develop ideas about how knowledge should be acquired, applied and shared. The tacit dimension of knowledge was originally proposed by Michael Polanyi (1962). The basic idea is that "we can know more than we can tell." That is, there is a level of knowledge that cannot always be put into words and linearly explained. In this dimension, in which the concepts of know-how, skill, competence, and expertise are rooted, knowledge is a practical and theoretical ensemble, whose development and mastery take place through procedures that cannot be identified in linear terms. In fact, the results of cognitive processes are often obtained only by successive approximations. The acquisition of specific elements of knowledge that we possess, but are unable to express, comes about, in many cases, by focusing our attention on further elements and by successive feed-back on what we have previously learned. The discovery (or acquisition) of knowledge is facilitated by anticipating the implications that are yet to be determined. In this way, knowledge accumulated in a cognitive system, although not expressed, makes up an implicit framework orientating the ways in which successively other elements enter the system. This is the reason why individual skills are usually tacit: "the aim of a skilful performance is achieved by the observation of a set of rules which are not known as such by the person following them" (Polanyi 1962, p.49).

The social nature of work-related knowledge has been underlined by drawing attention to the social context in which knowledge is acquired, developed and applied. The most relevant part of knowledge is seen as interpretation of experience, based on idiosyncratic frameworks that at the same time favour and limit the individual process of sense-making (Resnick, 1991). Situated cognition, the situation in which cognitive acts take place, is the driving idea of this approach, recognising that individuals are very sensitive to their cultural context. The latter provides a complex fabric of references (exchange of information, co-operation, etc.) that in the long run give shape to individual knowledge and determine a social construction of knowledge. Understood this way, the context creates a dynamic equilibrium between the know-what of theory, and the know-how of practice.

It is through the tight inter-dependence, or co-production of theoretical knowledge and practical knowledge (Brown et al, 1989), that competencies can be developed and maintained.

The social nature of work-related knowledge is also stressed in the cultural-anthropological perspective. For instance, Orr (1993) analysing

the working behaviour of work groups for repairing photocopiers, shows that these technicians develop their knowledge over time through problem-solving and continuous interaction. The defects of the machines they have to cope with are often very different to the ones reported in the standard operational manuals. Therefore, problem-solving and problem-setting happen collectively on the basis of previous experiences of each member of the group and on the basis of various types of communication, even the informal chatting around the coffee-machine. This way, knowledge is continuously created and maintained within a specific community of practice, having its own language and myths (partly through the handing down of war stories, reporting the main events of machine repairing and client dealing).

Recently ideas about the application of tacit knowledge in particular social contexts have been developed further in considering moves to create 'knowledge-creating companies' (Nonaka & Takeuchi, 1995). The model is based on the assumption that knowledge in organisations, especially in the most innovative enterprises, is created through the interaction between tacit and explicit knowledge, continuously 'converting' one into the other one. The model postulated four different modes of knowledge conversion called socialisation (from tacit knowledge to tacit knowledge), externalisation (from tacit knowledge to explicit knowledge), combination (from explicit knowledge to explicit knowledge), and internalisation (from explicit knowledge to tacit knowledge). Socialisation is a process of sharing experiences and thereby creating tacit knowledge, such as shared mental models about the application of technical skills. This occurs in the particular case of on the job learning during apprenticeship, in which tacit knowledge directly derives from the master - not through language but through observation, imitation, and practice - and is converted into the tacit knowledge of the apprentice. It is a process that cannot be abstracted from associated emotions and from the specific contexts in which shared experiences are embedded. Externalisation is a process of articulating tacit knowledge into explicit concepts. It is generally based on metaphors, analogies, hypotheses, images or models from which new ideas and products can be generated through interaction between individuals who want to reach the same outcome.

Combination is a process of systematising concepts into a knowledge system, through combining different bodies of explicit knowledge. The media for this purpose can be very different (documents, meetings, telephone conversations, computerised databases, and so on). Reconfiguration of existing information through sorting, adding, combining, and categorising explicit knowledge can lead to new knowledge. Internalisation is the process of embodying explicit knowledge into tacit knowledge. It is closely related to learning by doing: that is, the sum of experiences gained by individuals through socialisation, externalisation, and combination can become individuals' tacit knowledge bases in the form of shared mental models or technical know-how. But internalisation can be also reached through other forms: for instance reading or listening to success stories can induce new levels of tacit knowledge in the members of the same organisation and the establishment of new shared mental models within the organisational culture.

The four modes of knowledge conversion are structurally interconnected. Different events of organisational life can be viewed from a perspective of incorporating each of these modes in the processes of knowledge creation. Of course an organisation cannot create knowledge by itself but

can only mobilise tacit knowledge created and accumulated at the individual level. Tacit knowledge of individuals is the basis of organisational knowledge creation 'organisationally' amplified through the four modes of knowledge conversion. Nonaka and Takeuchi (1995) define this process as the 'knowledge spiral' in which the interaction between tacit and explicit knowledge will become larger in scale as the relationships among the four modes are continuously increased and managed.

In this perspective, organisational knowledge creation, which could be considered a subtler way of viewing organisational learning, is a spiral process, starting at the individual level and moving up through expanding 'communities of interaction', that crosses sectional, departmental, divisional, and organisational boundaries in the organisation. Overall then, work-related knowledge appears as a very complex and multifaceted issue, involving several different and sometimes contradictory dimensions, which can be synthesised in the relationships between explicit and tacit knowledge. Organisations, with business processes highly dependent upon the continuing development of work-related knowledge, are therefore particularly interested in whether new recruits will be able to make substantive contributions to the creation and development of work-related knowledge.
This perspective has clear implications for the relationships and interaction between initial education, work, continuing vocational training and lifelong learning and the role of multi-media and ICTs for VET.

Concluding Remarks: Developing and Implementing Policies for the Use of Multi-Media and Information and Communication Technologies in Vocational Education and Training

One of the aims of the CEDEFOP project is to develop a series of recommendations for policy makers and planners on future policies and measures for promoting multimedia and ICTs for VET. Our studies are still in their initial phase. However, we would tentatively put forward the following as a basis for discussion (here once more we must acknowledge indebtedness to the work of the Finnish evaluation):

There is the need for direct support for the introduction of ICTs in VET. Sustainable cost levels have not yet been reached. This is particularly so in minority languages and in the smaller European economies.
Although often modern hardware is not sufficiently available for use in VET institutions and organisations. There is the need to provide direct support for hardware acquisition and to form partnerships with hardware suppliers and VET organisations to ensure hardware can be supplied at a competitive rate.

There is a shortage of high quality, digital learning materials (especially in minority languages). The support and development of local, regional, national and trans-national consortia can help overcome this problem.

Teacher training needs to be increased and better focused. The lack of teachers at ease with new technologies and new pedagogies remains a barrier to the better utilisation of multi-media and ICTs.
There needs to be increased support for research and development into high-level learning environments – particularly for vocational education and training.

The dissemination of good practices needs to be improved.
The paramount and constantly growing issue of equality needs to be addressed.

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