Towards Network-Based Education: A Multidimensional Model for Principles of Planning and Evaluation

Seppo Tella & Marja Mononen-Aaltonen
Helsinki

Abstract

This article presents a conceptual multidimensional model intended for designing principles for planning and evaluating network-based education (NBE) as well as teaching materials used in NBE. The model is based on an integrative approach to the teaching–studying–learning paradigm, which we call network-based education. NBE is seen as a comprehensive developmental trend that combines traditional in-class education and different modes of utilising network-based materials, courses and information. It makes full use of telematic and network-based materials without excluding any printed or electronic materials.

The multidimensional model is grounded on the background flows of communication (*viestintä*) and mediation (*välitteisyys*), which are then connected to some key constructs of media education. The construction of the present conceptual model is part of the TriO[1] Project of the Media Education Centre, developed in co-operation with the National Board of Education in 1999–2000.

Keywords: network-based education; teaching materials; media education; didactics; communication; mediation; intermediality; dialogism.

1 Problems Related to Traditional Evaluation Classifications

In the 1980s and 1990s, the most conventional approach to evaluating teaching materials in general, and computer-assisted learning (CAL) materials in particular, consisted of having recourse to extremely detailed and analytic sets of criteria that were expected to reveal the true nature of the materials to be evaluated. These sets of criteria approached the task of planning and evaluation analytically and step by step, generally emphasising the principles of effective screen design

[1] http://www.edu.helsinki.fi/media/trio.index.html

(e.g., Alderson & DeWolf 1984). This kind of evaluation could be called a *technological model of evaluation*, which reflected the instructional designers' ideas of how teaching (or instruction, rather), usually emerging from an objectivist tradition, should be organised and built on "teaching units with thoroughly planned behavioural aims, leading to learning activities and exercises in textbooks which mostly deal with finding the proper information in the textbooks and transfer it on to the exercise books" (Duffy & Jonassen 1992, 7).

At their best, evaluation criteria did include pedagogical viewpoints and reflections on the cognitive level of achievement (e.g., Meisalo & Tella 1988, 175–191; Reeves 1997). One of the crucial problems was, however, that planning and evaluating teaching materials was a process that was kept separate from the very teaching–studying–learning process.

At present, we can identify several other problems that are related to earlier evaluation classifications: they were often out of any real context, they frequently included an enormous number of individual criteria (sometimes more than a hundred), and at their worst they had a mechanistic character ("tick the best option") and harboured an atomistic illusion of covering everything. The lists were based on the faulty idea of one classification being able to present everything in the format of visible and concrete choices on one single level or plane of abstraction.

As technology advanced, and especially now that we are entering the age of network-based education, deploying old-type criteria lists has become even more problematic. For instance, the criteria that were originally designed for the evaluation of relatively simple and linear programs delivered on a computer diskette do not hold for evaluating a teaching program transferred via a CD-ROM. In conjunction with network-based education gaining more and more ground, the situation has obviously become impossible. As a recent example—brave and fairly successful, in fact—of an attempt to master the planning and evaluation of network-based materials we refer to the pages of the Usability Group[1]. They contain different models, sets of criteria and benchmark comparisons focused on various levels of human/machine interface. These pages almost create a microcosmos of their own, with all the materials incorporated into it. This is the Usability Group's strength and danger: in order to cover a sufficiently representative space, the user is compelled to browse through huge masses of text.

Since our thinking does not concur with that behind earlier analytical sets of criteria, we started to consider a different approach, which little by little led

[1] TUG, http://www.usability.com/umi_links.htm.

us to start constructing a multidimensional model which we present in detail in the following.

2 FOUNDATIONS OF MULTIDIMENSIONAL MODELLING

The starting point of our multidimensional model differs from earlier, more linearly based sets of criteria in several respects.

1) We observe and analyse the teaching–studying–learning process, as well as teaching materials, from the perspective of didactics and media education. Thus, we will not separate teaching, studying and learning, or emphasise just one (such as learning) of the three components; rather, it is our firm belief that they belong together and should be discussed as three facets of the same thing. Holistic comprehension of the teaching–studying–learning process is the key to our notion of network-based education (NBE). In fact, we believe that considering an educational rationale should precede any use of technology.
2) Didactic or media-educational issues cannot be solved or evaluated solely by using the same criteria that are used in evaluating the human/machine interface. The interface is the most visible and "tangible" level of our multidimensional model, but other levels also have to be taken into account.
3) Didactic solutions cannot be evaluated exclusively from, say, one learning psychological perspective; in fact, we need a larger framework, which in this context is that of media education. Our perspective could therefore be called integrative, aiming at a global vision, with firm links to the teaching–studying–learning paradigm itself.
4) At this stage of development, a network-based environment is still an unstructured resource with uncharted potential for teaching, studying and learning. What we need is a *minds-on* approach, not only a *hands-on* approach, to talking about planning and evaluating teaching materials.
5) A didactic network-based environment presupposes working on the web and using it as a tool, context and environment for teaching, studying and learning. However—and equally importantly—we still need the "traditional" environment, for instance the kind that we have in school and at home. Network-based education is thus a symbiosis of in-class and virtual or telematic education, combining traditional in-class education and different ways of utilising network-based materials, courses and information. It

makes use of telematic and network-based materials, but does not exclude any printed or electronic materials.

6) We consider network-based education a comprehensive developmental trend, which, in the spirit of rhizomatic multimediation (*moniviestinvälitteisyys*), integrates all materials, whether on the web, telematic or printed.

Our primary objective (Mononen-Aaltonen & Tella 1999; Mononen-Aaltonen & Tella 2000b) was to create, expressed in the terms used by Uljens (1997, 216), a useful public framework in which network-based education (NBE) and teaching materials could be evaluated as an integrated entity:

> "A framework is a general set of ideas which is drawn upon by theorists within a particular discipline … The important thing about frameworks is that they should be regarded as useful or not useful rather than correct or incorrect. The reason for this is that they consist of high-level assumptions which cannot be tested directly at an experimental level." (Uljens 1997, 146)

Our research has now taken us beyond this basic framework and therefore we would like to think that our model is a **conceptual framework**, which Tella (1998, 86–88; based on Frankfort-Nachmias & Nachmias 1992) regards as one of the four levels of theories. According to this classification (Table 1), conceptual frameworks represent broad structures specifying relations. Concepts themselves only become significant once they are related to other concepts; one element of a conceptual framework is defined by others, because they are all interrelated (Seels 1997, 13; Tella 1998, 86).

Table 1. Four Types of Theories (Frankfort-Nachmias & Nachmias 1992; cited in Seels 1997, 14).

	Name	Explanation
(i)	*ad hoc* classificatory systems	arbitrary divisions into categories
(ii)	taxonomies	categories based on empirical observation
(iii)	conceptual frameworks	broad structures specifying relationships
(iv)	theoretical systems	combining taxonomies and conceptual frameworks

The concepts we have selected for inclusion in the multidimensional model create new relations or functions that help us to define what sort of didactic principles are feasible in planning, implementing and evaluating network-based education and the materials used in it. Evaluating these principles is related to their

practicability and usefulness; assessing them must be in proportion to the purposes for which they have been designed. We will divide the conceptual model into several levels, according to how close or how far the relations created by these concepts are from the pragmatical context in which they should be used. For instance, the "lowest" level, Level I (the on-line level of the studying environment), is a very pragmatically-oriented real-time level, while the "highest" level, Level VI (the level of background flows), is the most abstract, even if its impact on all the others is very concrete and even dominant.

It must be taken into account, however, that even if teaching is guided by certain general principles, most of the details depend on the teaching content and on the interest and the questions asked by the learners themselves (Lin et al. 1995, 58). We would like to think that it is a question of the principle of **subsidiarity** applied to network-based environments, because "effective learning environments, whether based on physical presence or virtual togetherness, must be reinvented from location to location, rather than just being brought and then implemented" (Lin et al. 1995, 58; cf. also Brown & Campione 1994). In conclusion, we believe that starting-points that are grounded in a media-educational framework are prerequisites for any analysis of the different contents and structures of different subjects, disciplines and domains of science, as well as of the fundamental question of what sort of problems concern our pupils and students.

3 Background Flows Exemplified by Communication and Mediation

What kind of conceptual framework of media education would be needed to help us to conceptualise network-based education and network-based teaching materials, so that we could develop their planning and, at the same time, construct didactic principles for their evaluation?

In our thinking, this kind of conceptual framework appears to consist of several levels which are based on **communication** (*viestintä*) and **mediation** (*välitteisyys*). These two concepts are the background flows of the highest level, having an impact on all other levels. In this respect, our model is in line with and grounded on Tella's multi-level analysis[1] of media education (1998, 96), and it makes full and integrative use of the foundations of the theory-building associated with it.

In our model, communication and mediation are specified by two other concepts: **dialogism** (*dialogismi, dialoginen viestintä*) and **intermediality** (*in-*

[1] http://www.helsinki.fi/~tella/mep8mkfig3.html

termediaalisuus). Dialogism is the function of communication when analysed from the perspective of media education, while mediation is further specified by intermediality. In other words, communication is empowered—almost dramatically, one could say—by dialogism or dialogic communication (for a more elaborate analysis, see Tella & Mononen-Aaltonen 1998; Tella 1998). Intermediality (to be explained in more detail below) should be understood as the co-impact of several media or means.

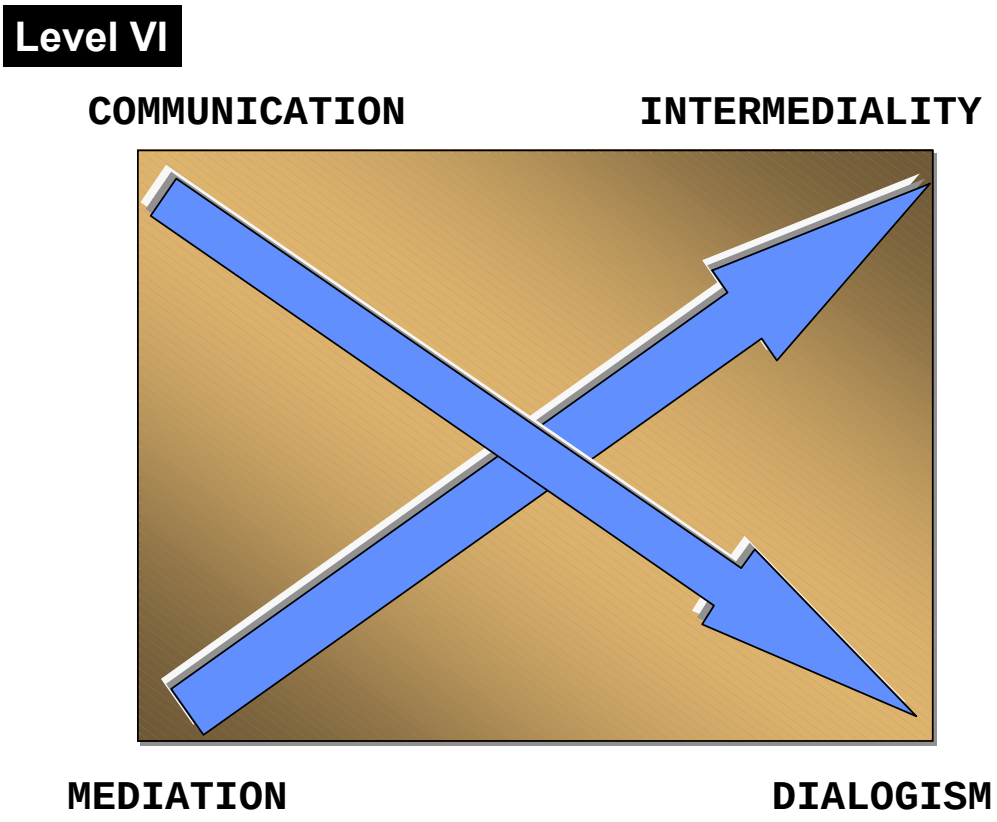

Figure 1. Level VI: The Level of Background Flows.

Communication

From the viewpoint of education and teaching, what really counts is **communication**. According to some reductionist yet apposite definitions, the teacher's main job is to communicate and to organise the pupils' school-going, because without these two functions, she [the teacher] would be useless (Ollivier 1992, 244–245[1]; Tella 1994, 18). In the context of media education, the significance of communication is equally crucial. Therefore we have decided to choose com-

[1] « Un enseignant passe son temps de travail à communiquer. On pourrait même dire que c'est ce qui définit le mieux son emploi. Qu'il fasse cours, qu'il aide des élèves dans un recherche, qu'il annote des copies, qu'il assiste à un conseil de classe, ce qui caractérise son rôle, c'est que faute de communiquer, il est inutile. » (Ollivier 1992, 244) « Quel est le rôle de l'enseignant ? (…) tout simplement, d'organiser l'école. » — (Ollivier 1992, 245)

munication as our first background flow. Communication is not analysed in great detail in this article, as it is a rather well-known concept, though conceptually not always straightforward. Suffice it to say that in media education, important aspects of communication include **computer-mediated human communication** (CMHC,) as well as **direct** and **mediated communication**. The six different dimensions identified by Tella & Mononen-Aaltonen (1998, 70, 90–93) serve well as a starting point for analysing existing educational software from the point of view of the learners' communicational needs:

1. direct vs. mediated addressivity
2. human-to-human (HHC) vs. computer-mediated human communication (CMHC)
3. monophony, stereophony, polyphony
4. primary, secondary or tertiary addressivity
5. synchrony vs. asynchrony
6. unidirectionality, bidirectionality, multidirectionality

Tella & Mononen-Aaltonen (1998, 97) conclude that most of the latest developments in technology, such as the World Wide Web, network-based learning and integrated distributed learning environments, tend to become clustered around multidirectionality, asynchrony, polyphony (multi-voicedness) and mediated secondary- or tertiary-level addressivity, while at the same time computer-mediated human communication (CMHC) is gaining ground at the expense of human-to-human communication (HHC).

Dialogism

By dialogism, we refer to a scientific approach to dialogic communication based mainly on Bakhtin's and Vygotsky's thinking. To us, dialogism is a perspective, a point of view, a standpoint with reference to communication. Like Holquist (1990), we think of it as a pragmatically oriented theory of knowledge that aims to grasp human behaviour through the use humans make of language (Holquist 1990, 14–15). Thus, dialogism is a philosophical school which deals with research on dialogue and the notion of multivocality or polyphony (Mononen-Aaltonen 1998; Tella & Mononen-Aaltonen 1998, 13–14 et passim; Tella 1998). We also believe that Arnett (1992, 6; cf. also Tella 1998, 116) was right in arguing that "[d]ialogic education … assumes that the development of human character and commitment to lifelong learning needs to be part of a *quality education* [italics added]." Indeed, dialogism might be one humanistic way to increase quality in education in general, and in network-based education in particular.

Mediation

Technological advances have promoted the notion of **mediation**, as communication is increasingly taking place in a mediated fashion, namely via technical means or through tools. It is true that mediation has always existed at the level of language, for instance, but the research focus in media education is more precisely on the dimensions that technology and media have enabled, on "technological and technical" mediation, which could be summarised as computer-mediated human communication (CMHC).

Mediation (*välitteisyys*) means a relation between two things or two people (« *la médiation est ce qui permet de créer une relation entre deux choses* »; Quéau 1993, 21). The way people obtain information about the world and they way they handle it is fundamentally mediated. Wertsch, Del Río & Alvarez (1995, 21) argue that "humans have access to the world *only indirectly, or mediately* [emphasis added], rather than directly, or immediately". In the words of Smagorinsky (1995), a person's "mind is unlimited in the sense that its development is inseparable from the tools of mediation" (Smagorinsky 1995, 197). In our thinking, mediation is linked (i) to the evolution of the human mind and of human beings' socio-cultural development and—most importantly for this article—(ii) to the means and media generated by the stupendous progress of information and communication technologies. (For a closer analysis, see Tella & Mononen-Aaltonen 1998.)

Intermediality

The concept of intermediality (*intermediaalisuus*) deals with the abilities each of us brings to network-based education, and with the ways we read and watch network-based materials. In brief, intermediality is related to our cultural awareness and our ways of coping with various culturally-charged situations. As Lehtonen (1998, 182) put it, such materials are not only from one medium. None of us is just a reader of a novel or a TV viewer; rather, when we read or watch, we also use the skills we have adopted as radio listeners, users of computers and telephones, and readers of newspapers.

A near synonym for intermediality is multimediation (*moniviestinvälitteisyys*; Tella 1994, 54–55), which stands for an integrative, polytechnic approach, in which there is no single right way to solve a problem, but different aspects are tackled in a host of different ways. Multimediation does not particularly emphasise the role of the computer; rather, the computer—as any medium in fact—is seen as one of the numerous means and media available. On the other hand, the

use of computers is crucial in lots of applications, because they are, at their best, multifaceted and flexible tools, intellectual partners and creators of new contexts (Tella 1999a). Multimediation also acknowledges the important role and position of printed materials, and books in particular.

Intermediality is one of the key concepts in our model. We have based it on the notion of multimediation as presented earlier by Tella (1994) on the one hand and on Lehtonen (1998) on the other hand and define it as follows: Intermediality (multimediation; co-impact of several media or means) refers to the co- or parallel use of several or many means and media and to their joint impact on the teaching–studying–learning process and the communication process embedded in the former. The focus of intermediality is (i) on the salient features of various means and telematic tools and (ii) on how these features or characteristics are represented in different contexts of action as experiences, sensed and used by human beings.

4 THE INTERACTIONAL TEXTUAL LEVEL OF TECHNOLOGY AND CULTURE

In order to analyse our conceptual model more closely, we must freeze the upper-level background flows for a moment and restrict the area of observation. This way we can conceptualise four new functions of the background flows, which leads us to the concepts of **culture**, **technology, interaction** and **text.** These four concepts are used to define the contents of this level, Level V. Depending on where they are located in the model, they form different relations, which could also embrace the dimension of time. We will analyse this level without its temporal dimension (however, see Tella 2000 on the notion of *achronos* or timeless time). We have labelled this level the interactional textual level of technology and culture.

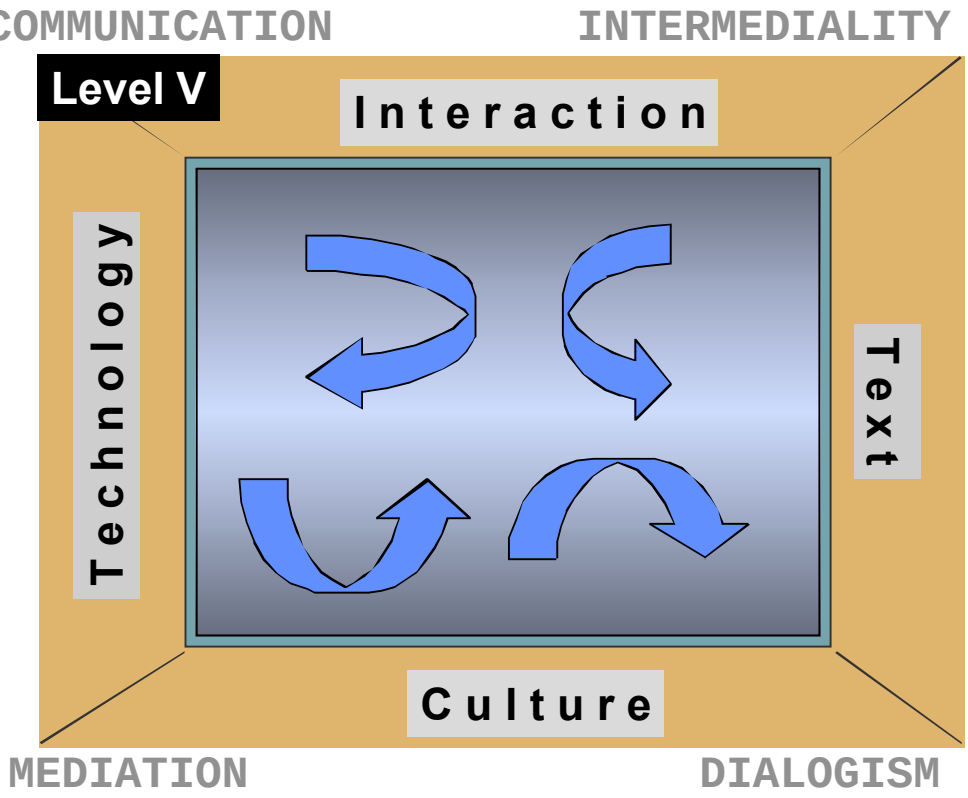

Figure 2. Level V: The Macro Level or the Interactional Textual Level of Technology and Culture.

Mowlana (1997, 240) distinguished two revolutions: that of **communication** (*viestintä*) and that of **communications** (*viestimet*) (cf. also Tella & Mononen-Aaltonen 1998, 6, their visualisation).

In our thinking, these two revolutions justify our choices: the technological revolution of communications refers specifically to the spread of technology (telematic tools, such as e-mail, multimedia conferencing, chat, groupware), to systems innovation and to the speed and quantity of messages. The development of media and means makes us pay more attention to the **text**, because telematic tools underscore the importance of text (especially e-mail and short messages). Thanks to these media, communication has become considerably "textualised" during the past few years.

On the other hand, simultaneous developments in human communication have contributed to a quest for satisfactory human interaction, a quest for dialogue and seeking human dignity through dialogue. Consequently, this kind of communication revolution is bound to underline the importance of **interaction** and **culture** at the same time, and as a result, of intercultural or cross-cultural communication. Cross-cultural communication must be understood and interpreted widely enough to cover the communication encounters of different subcultures (ethnic, religious, social) within one country to an equal degree.

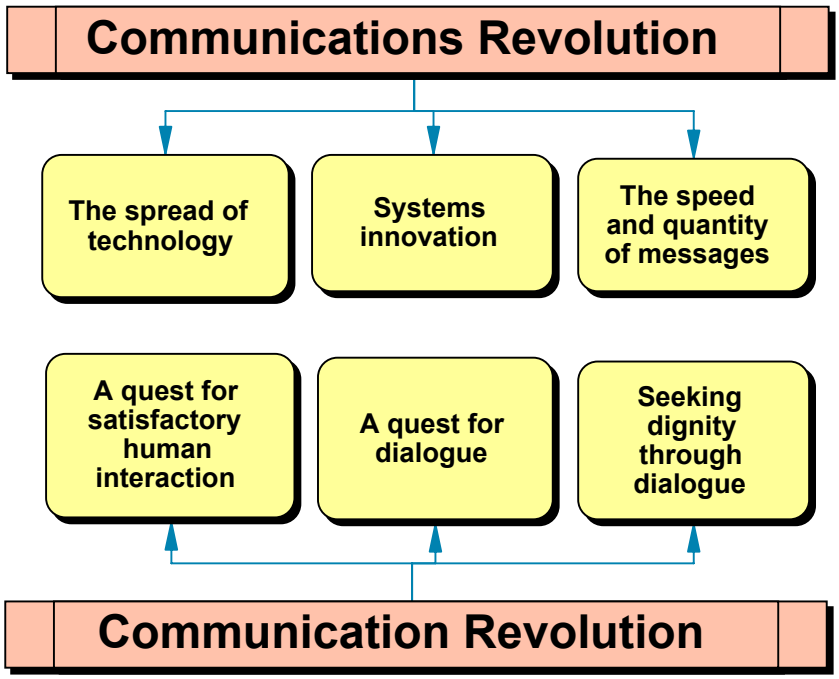

Figure 3. The Difference between the Revolution of Communications and the Revolution of Communication (Mowlana 1997, 234; Tella & Mononen-Aaltonen 1998, 6).

Technology and **culture** are in constant interplay (e.g., Tella 2000), but which came first, technology or culture? Without one, there cannot be the other. It is argued that *the context for human development is always a culture, not any single technology*. Still, it is technology that promotes human beings' development and their culture. Penny (1995, 1), for instance, draws a close parallelism between technology and culture by writing that "[i]t would be difficult to refute the suggestion that technological change has been the major force for cultural change for at least a century".

Culture can also mean something more specific. Oksanen (1999), for instance, speaks of media culture, stating that "a modern media environment is typified by the fact that several media get clustered to form a uniform 'media culture', used by the recipients as a whole and spreading through these means of communication in industrialised countries" ["*Nykyiselle mediaympäristölle on tyypillistä useiden eri medioiden kerääntyminen yhtenäiseksi 'mediakulttuuriksi', jota vastaanottajat käyttävät kokonaisuudessaan, ja joka leviää näiden välineiden kautta teollistuneissa maissa*."] (Oksanen 1999, 27).

Even **text** should be understood very broadly in our conceptual framework. It may convey textual or visual information, but it also embraces a host of different actors, as Lintula (1999) has pointed out:

> "*Opettaja ja oppilaat toimivat ja ovat olemassa tekstinä verkkoympäristössä, samassa alustassa kiinni muiden verkon tekstien rinnalla. Toimijoiden voidaan nähdä pelkisty-*

> *vän tekstiksi. Toimijat 'lukevat toisiaan' ja heidän olemuksensa muodostuu kirjoitetussa ja luetussa tekstissä, vailla sitä sosiaalisten vihjeiden moninaisuutta, joka on läsnä lähitilanteessa*." (Lintula 1999, 241)
>
> "The teacher and the pupils act and exist as texts in a network-based environment, tied to the same platform as other texts of the web. Actors can be seen to be reduced to text. Actors 'read each other' and their figures are formed in texts written and read, without the multiplicity of social cues that are present in face-to-face situations." (Lintula 1999, 241; our translation)

Texts *qua* text may also be seen to associate with different interpretations when information is transferred via the net telematically or electronically, for instance in e-mails, on web pages or through short text messages enabled by mobile telephony. It is also true that the interpretation and analysis of the text itself, and especially its possible *paratext* (such as footnotes or other references in the document to other documents) or *cotext* (e.g., the aspects of the layout of the information included in the text) may radically differ from what we know and are used to in traditional printed teaching materials.

5 HABITAT OR THE LEVEL OF LIVING

Contrasting technology with interaction, interaction with text, text with culture and culture with technology, gives us four new constructs: **virtual togetherness** (cf. Tella 1998, 111–112; Bauman 1995, 44–49; *atopos*, ks. Mononen-Aaltonen 1998), ***genre***, **context** and ***Umwelt***.

If we relate these different constructs to each other, we find new concepts which, though based on the previous conceptual analysis as independent phenomena, now help complement and enrich the global picture. At this level of our model, we are in the Habermasian world of *habitat*, which could also be called the *milieu* of media education. The constructs of this level indicate the new contexts we are facing, together with the new technologies. As Kerr (1996, 143) has argued, sociological phenomena cannot be adequately explained only by looking at individuals. At this very level, we ponder on those conceptual factors that human beings take advantage of when using modern information and communication technologies.

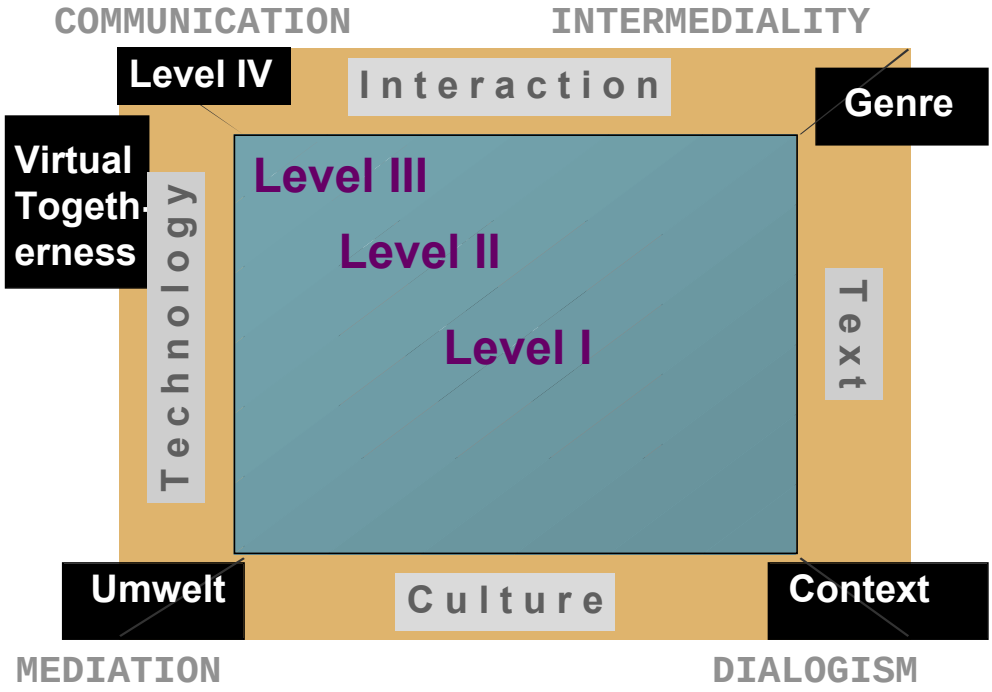

Figure 4. Level IV: Habitat or the Level of Living.

Virtual Togetherness

Technology can modify our conceptions of interaction in a way that absence may start to look or feel like presence, thanks to the immersive influence of modern information and communication technologies. This 'virtual' presence is referred to as virtual togetherness in this article (Tella 1998, 111–113). The notion of virtual togetherness has been derived from Bauman's (1995) concept of togetherness, the categories of which include mobile, stationary, tempered, manifest, postulated and meta-togetherness.

As a Baumanian metaphor, *mobile togetherness* deals with human encounters in a busy street or in a shopping centre, for instance; people are aside each other, but usually they attempt not to be with each other. *Stationary togetherness* is linked to spaces such as a railway carriage, an aircraft cabin or a waiting room. Bauman regards this kind of togetherness as "totally fortuitous, accidental and redundant" (Bauman 1995, 45). *Tempered togetherness*, manifesting itself in an office building or on a factory floor, is more purposeful, but the "continuity which the office-type togetherness can hardly do without tends also to transform the matrix intended for structured encounters only into a matrix for unintended, spontaneously and 'rhyzomically' growing solidarities" (Bauman 1995, 46). *Manifest togetherness* is illustrated by a protest march, which embraces the idea of being together in large numbers for a particular reason and wanting to be seen and heard. *Postulated togetherness*, on the other hand, consists of the

brotherhoods and sisterhoods of nations, races, classes, genders and other communities. *Meta-togetherness* is a scene for encounters, such as a pub, a holiday beach, a dance-hall, a land of endless experiments, of trials and errors. (Bauman 1995, 44–49; also Tella 1998, 111–112)

In our model, **virtual togetherness**, based on Tella's initial interpretation (1998, 112), refers to the shared feeling of belonging to the same virtual community and being able to fully capitalise on its resources. It is related to Ascott's *telenoia* (1993; Huhtamo 1995, 177), which means "networked consciousness". This interactive awareness is often referred to as virtual communities generated by telematic environments (Tella 1999b, 210). Other terms are also used in the literature to refer to similar phenomena. For instance, Mononen-Aaltonen (1998, 185; 1999, 227) promotes the notion of *atopos* (a place that is not present; a place absent; cf. Heidegger 1950/1975, 41; Derrida 1993/1994, 23–24). Tiffin & Rajasingham (1995, 139) talk about *telepresence*, Balle (1991) about *remote presence*, Terashima about *telesensation* (1993, 455). We prefer Bauman's terminology, because it embraces a whole spectrum of different manifestations of togetherness, among which our virtual togetherness is a technologically justifiable new component.

Genre

The function of interaction and text is *genre*, a special and systematic group of expectations and hypotheses or, to put it differently, a kind of a *mode d'emploi*—a product specification or a name tag, which we use to label network-based education and materials (defining *genre*, cf. e.g., Lehtonen 1998, 184–185). We believe, at least for the time being, that network-based education (teaching, studying and learning), including network-based teaching materials, form a literary *genre* of their own, whose salient features we would like to trace later on.

Context

The function of text and culture is context, which we, like Lehtonen (1998, 165), regard as those cultural resources or facilities which people working in network-based environments access. Some questions that should then be asked include the following:

- What do we expect people working in network-based environments to know or to master?
- What sort of co-texts (*kanssa-tekstejä*) do they bring with them to the interaction?

- What kind of skills or competences do they need to interpret and understand their own co-texts and those of others?

These skills are represented in texts that participants bring with them to that *milieu* of media education in which the teaching–studying–learning process is being carried out and observed. At the same time, texts are in a dialogic relation to culture. When creating contexts, the participants use the tools that technology gives to them. It is the concept of intermediality that brings up questions of different tools and media, but also at the same time of the users' skills and preconceptions.

Mononen-Aaltonen & Tella (2000a) have argued that technology, too, may be regarded as context, representing and simulating meaningful real-world problems, situations, beliefs, perspectives, arguments and stories of others. Therefore technology as context supports discourse among knowledge-building communities of learners (Jonassen 1995, 62), and can be seen as supportive of our argument of a dialogue being the learning environment.

Umwelt

Technology creates a new kind of ecological culture that focuses on the habits of human beings, especially on their relation to their environment. This culture, however, is not uniform, as different users of technology may find and utilise different sides of it. As an example, in a traditional classroom the teaching and learning culture is the same for everybody; in our present example, and when seen through the concept of *habitat*, the whole setting is different.

Together, culture and technology create a certain environment in which both teachers and students act and interact. In addition to this physical environment, the notions of mediation, communication, dialogism and intermediality, when contrasted with culture and technology, help to create the concept of *Umwelt*, which von Uexküll (von Uexküll & Kriszat 1958) uses to refer to the different understandings and uses of the same environment for different purposes. *Umwelt* manifests itself in the form of divergent action or living environment, depending on what is meaningful and relevant from the perspective of one's own action, objectives, purposes and aims. As a concrete example, von Uexküll mentions an ordinary room as the action and living environment for a human being, a dog and a fly (von Uexküll & Kriszat 1958, 94–101).

The notion of *Umwelt* is associated with the discussion of how to define and understand different environments (teaching, studying, learning, action[al], educational and virtual). Kynäslahti (1999) put this very aptly: "We should understand better than we now do what kind of environments information and

communication technologies really create, where they are, why they exist and whom or what they consist of" ["*meidän tulisi paremmin ymmärtää, mitä tieto- ja viestintätekniikan avulla luodut ympäristöt oikein ovat, missä ne ovat, miksi ne ovat ja keistä tai mistä ne koostuvat*"] Kynäslahti 1999, 263).

6 THE LEARNING ENVIRONMENT

We have labelled Level III the learning environment. There are multiple views of a learning environment, each eliciting in our minds different images about teaching, learning and studying. Mononen-Aaltonen (1998) noted that these are often divided into three categories: learning environments as (i) ecosystems, (ii) places and (iii) space. As a novel way of seeing a learning environment, Tella & Mononen-Aaltonen (1998) suggested that it should be defined as dialogue in the Bakhtinian and Vygotskian sense. In this article, we will not enlarge on our earlier discussion regarding the conceptual differences between teaching, studying and learning environments; we rather argue that the learning environment in our model consists of certain phenomena that are linked to it, viz. the **technological tools, intellectual tools** and **means of expression** (*tekniset, älylliset ja ilmaisuvälineet*), **cultural artefacts** (*kulttuuriset artefaktit*) and **metaskills** (*metataidot*) that combine all of them.

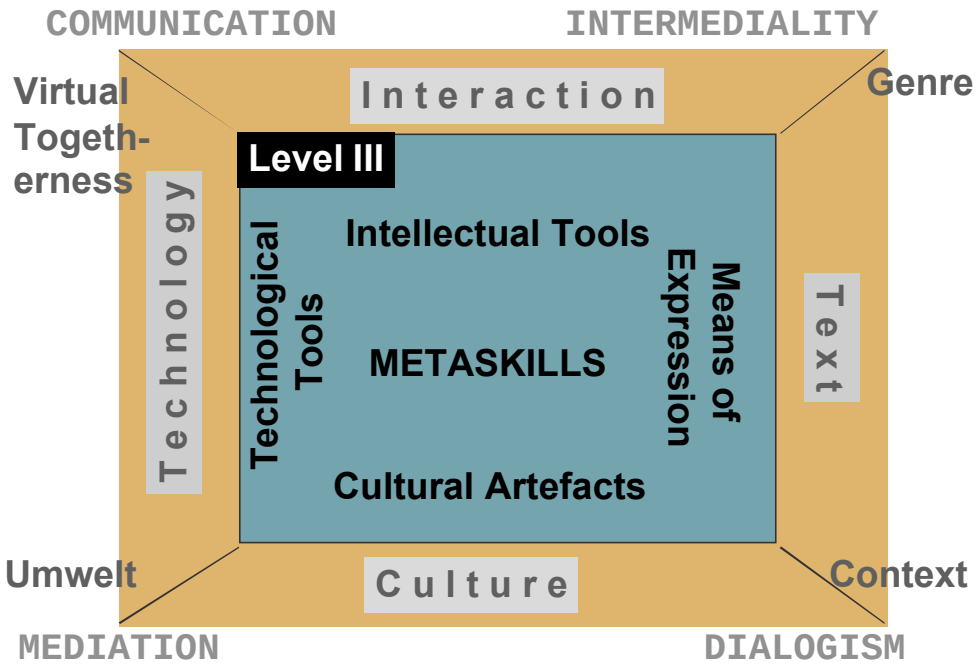

Figure 5. Level III: The Learning Environment.

Our thinking is grounded on what Mononen-Aaltonen (1999, 225) pointed out about Kozulin's thinking (1996; 1998) and which was originally presented as criticism by Vygotsky as early as 1925: **the one and same concept cannot be at the same time the explaining principle and the focus of concrete research: the concept of learning cannot be explained by explaining learning**. This is why we will explicate the essence of a learning environment using concepts other than with those arising from learning itself. It is also why we feel rather sceptical about the way the term 'learning environment' is used at present by learning psychologists and most instructional designers (cf. also our argumentation in Mononen-Aaltonen 1998; Tella & Mononen-Aaltonen 1998, 99–103). In the light of the above, we also find it easy to understand why Kiviniemi (2000, 52) criticises the fact that "web presentations and finalised materials that are externally brilliant are not yet and as such any real guarantee to effective learning".

In contrast to our analyses of the upper levels, we will adopt **a double-bind approach** in our interpretations of the concepts on this level. For example, technological tools are not only the function of technology and interaction; rather, we think that they could also be seen as functions of culture and technology. This, we believe, will give more depth to our interpretations, and corresponds better to the "conceptual information density" of the concepts that influence each other and which accumulate at the same time.

Our learning-environment level contains different tools. They may be very concrete, as **technological tools** and **means of expression** often are. However, they may also be cultural products or **cultural artefacts** that are deeply rooted in our cultural backgrounds. We have discussed this earlier under the name of *mediational means* (cf. Tella & Mononen-Aaltonen 1998, 112). In that context, we also pointed out that the concept of *mediational means* also embraces other than clearly concrete means, such as speech patterns and communication styles (cf. Tella & Mononen-Aaltonen's example of TV news, 1998, 117–188).

On the other hand, in order to be able to behave sensibly in interactional situations, we also need **intellectual tools**, such as the ability to think critically, to reason, to draw conclusions, as well as to instil motivation for lifelong learning and self-directedness. It is equally important to ponder upon, as Vahtivuori, Wager & Passi (1999, 70) do, how features of communal learning, such as the student's self-regulatory skills, the distributed character of cognitive action and the significance of shared expertise ("*opiskelijan itsesäätelytaidot, kognitiivisen toiminnan hajautunut luonne ja jaetun asiantuntijuuden merkitys*") may be taken into consideration. The same problems worry Mannisenmäki (2000, 118), among others, who mentions shared discussion space, projects, exercises and

process-oriented writing as prerequisites for communalism (*yhteisöllisyys*) on the web.

At the same time, we are moving on to some kind of **metaskills** level, where different kinds of tools merge into a set of concrete and mental equipment, which an individual uses to structure those modes of living that Level IV (*habitat* or the level of living) provides him or her with.

Having a fair command of tools, means and media consequently comprises *technique* in the sense of its Greek etymology (*tekhne* = skill). Having the necessary skills helps the individual to create a learning environment in which the social and individual aspects merge, and in which individualism and communalism are immediately enabled. — During the course of the TriO project, the issue of how well technology should be mastered by teachers (and by pupils) raised a lot of discussion. After frequent frustration with different IDLEs (groupware tools), a lot of pessimistic opinions were expressed: is it educationally worth testing technological platforms that are still under preparation and technically unstable, and which apparently do not show any educational rationale behind their design interface? The Vesala Comprehensive School teachers posed the question of whether the use of a new groupware tool measures our professional competence, and whether it is pedagogically relevant to expect that the teacher has to sit at the computer for hours on end in order to have a sufficiently fair command of the tool to be introduced into classroom use. These are relevant questions to be asked by teachers and by teacher educators. They also reflect international research findings which suggest that "[t]echnology is welcomed and used by teachers under certain conditions. One is that they are comfortable with the technology by virtue of training or use of media at home" (Molenda & Sullivan 2000, 10).

We find it important to encourage teachers and learners to think of the technological tools at their disposal and to reflect on their competence in using them in the teaching–studying–learning process, i.e., as part of their educational rationale. As an example, we present a tentative and preliminary categorisation of certain technological tools (Table 2). Our classification was inspired by the work done by LeBaron & Bragg (1993) but, naturally enough, it has been revised and updated. The categorisation (Basic –6 … Basic +5) is indicative of a certain level of expertise, but it also shows the extent of the use of the tools and applications mentioned. The Basic level is to be understood as our idea (our "guestimation") of the basic level of competence that all teachers should have, viz. they should know how to use e-mail and e-mail attachments, they should have a basic understanding of common multimedia and hypermedia applications, together with CD-ROMs (or CD-Is in certain countries), and be

familiar with the WWW and the Internet. This level gives no specific indication of the degree of expertise, for instance with reference to different levels of Internet usage (receptive, productive). The levels on the negative side (such as Basic –6) refer to some of the earlier technologies, the current use of which does not require any particular action as far as teacher education or training is concerned.

Table 2. A Tentative Categorisation of Technological Tools, with Special Emphasis on Open and Distance Learning.

TRADITIONAL SITE-BASED INSTRUCTION			BASIC –6
SITE-BASED INSTRUCTION USING EDUCATIONAL TECHNOLOGY			BASIC –5
CONVENTIONAL TELEVISION	CONVENTIONAL AUDIO		BASIC –4
EDUCATIONAL VIDEO			BASIC –3
FAX, AUDIO CONFERENCING, [AUDIOGRAPHICS]			BASIC –2
COMPUTER CONFERENCING	[GOPHERS] IRC, COMPUTER FILE EXCHANGE	MAILING LISTS, LIST SERVERS, NEWSGROUPS	BASIC –1
MULTIMEDIA, HYPERMEDIA, CD-ROM, CD-I	**INTERNET, WORLD WIDE WEB (HTML->VRML)**	**E-MAIL + ATTACHMENTS (8-BIT COMPATIBLE)**	**BASIC**
MICRO-WORLDS (MUDS, MUSES, MOOS, VEES)	VIDEO-CONFERENCING	INTRANET + SMART EXTRANET	BASIC +1
APPLICATIONS OF HUMAN LANGUAGE TECHNOLOGY (GRAMMAR CHECKERS, SUMMARISING, COGNITIVE TOOLS)			
	COMPACT VIDEO-CONFERENCING (NETMEETING)	DESKTOP VIDEO-CONFERENCING, REALAUDIO, NETPHONE	BASIC +2
MOBILE TELEPHONY/WAP/VIDEOPHONY + DIGITAL NOMADISM PERSONAL COMMUNICATORS (INTEGRATED E-MAIL, FAX, INTERNET, SMART MESSAGING SERVICES, ELECTRONIC CALENDAR, CONVERTERS NOTEBOOK, CALCULATORS, CLOCKS)			BASIC +3

Table 2 continues

NETWORK-BASED EDUCATION (GROUPWARE, IDLES, ONLINE COURSES, SHARED WHITEBOARDS, APPLICATION PROGRAMS; AUTHORING TOOLS, STREAMING VIDEO & AUDIO)	BASIC +4
SATELLITES, GLOBAL -> UBIQUITOUS COMPUTING, VIRTUAL REALITY, PAN TECHNOLOGY	BASIC +5

Based on Tella (1997, 18–19), though heavily updated. Originally based on the idea of LeBaron & Bragg 1993.

There are several ways in which Table 2 could be used. For instance, a group of teachers could be asked first to familiarise themselves with the classification, then to evaluate their own personal position *vis-à-vis* the different levels. They would thus have a provisional idea of what their own competences are. Second, they could think of a number of colleagues and try to locate them on the table. The same goes for their respective institutions. It is obvious that people may have a deeper understanding of and a lot of experience in the use of certain tools, applications or media, while they might feel disadvantaged in relation to others.

It is important to note that the classification is not absolute; rather, it reflects, to some extent, the chronological development of certain tools and means in open and distance learning. In addition, it is a "conversation piece", as most people spontaneously start analysing the classification itself, and they find more tools or media to be added to it, or they simply want to change some tools from one level to another.

A fruitful discussion might follow if these technological tools are associated conceptually with some intellectual tools. It might also be worth reflecting whether some (or perhaps all) of these tools have already established themselves as cultural artefacts. Again, one more line of discussion could be to combine different means of expression with the technological tools. The most important issue, however, would be to focus on what educational problems could be solved by using this or that tool or application; in other words, why would it be educationally valuable and meaningful to use technology?

7 THE ACTION OR TEACHING ENVIRONMENT

Level II represents the action level and the teaching level. It also represents the *pedagogical meeting*, in the words of Uljens (1997).

The central concepts of this level include **actionality** (*toiminnallisuus*), which we use to refer to the pedagogical meeting made possible by information and communication technologies. It consists of *transactionality* and *interactionality*. According to DeVito (1997), communication is always a transaction and its transactional character implies that each person can be seen as both sender and recipient, and therefore communication is an ever-changing process, an ongoing activity, inevitable, irreversible and unrepeatable (DeVito 1997, 28–29). Following Vygotsky, Bruner (1985, 25) goes even further and equates social transactions with the fundamental vehicles of education. Interactionality, on the other hand, is interpreted by Tella & Mononen-Aaltonen (1998, 92) to refer to the interactional character of not only communication as such, but also regarding the majority of the "new media" tools now available for the teaching profession. In network-based education, teachers and learners interact with various educational software via their instructional interface, but also, and increasingly, with other people logged on to the network, underlining the human element in computer-mediated communication.

Action should not be confused with external activity, which used to be rooted in the behaviourist/objectivist theory of learning. Rather, action and actionality should always afford enough time for learners to think about things, to solve problems in dyads, in small groups or on their own (a more constructivist approach). This might also imply that feedback is not given as quickly as possible (the behaviourist approach); rather, learners should be given time to reflect upon their own performance, and even to consult each other before asking the teacher.

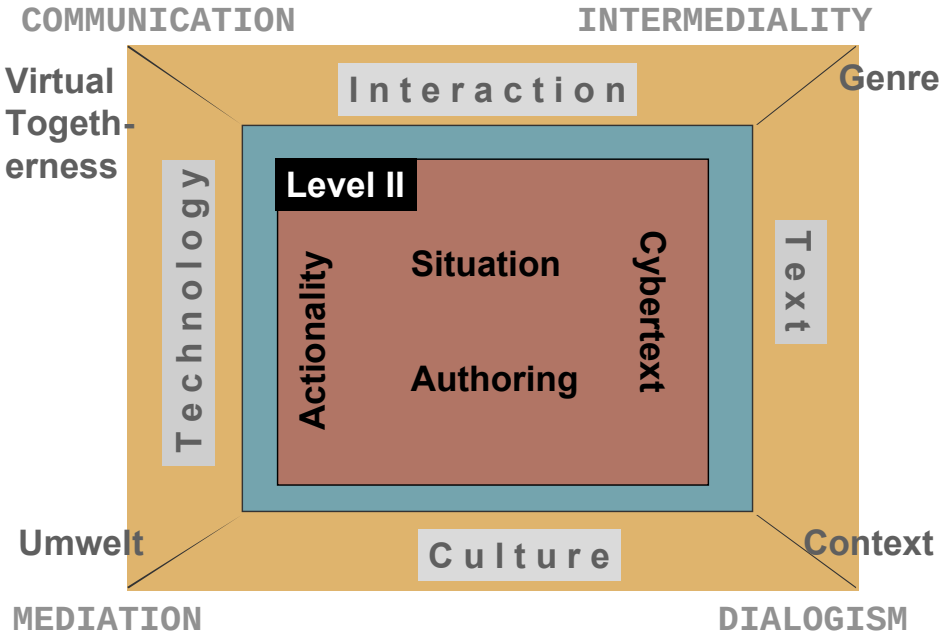

Figure 6. Level II: the Action or Teaching Environment.

Action, the key component in actionality, and teaching are interlocked in the second central concept of this level, viz. **situation**. We structure the notion of situation according to Brown & Fraser's (1979) classification. A situation consists of a scene and its participants.

The scene is further divided into the setting and the communication purpose. Persons participating in the situation are regarded either as individuals or as members of various social categories, while the other important dimension deals with relations between the individuals. These relations are of crucial importance, since they help manifest various other factors embedded in the situation, such as the use of power and distributed expertise (cf. Level I: voice and power).

In school contexts, the scene has traditionally been the classroom proper or the school as a physical setting. Network-based learning environments expand this kind of scene radically, bringing with them different kinds of challenges for the participants and their relations towards each other and towards the surrounding community. What counts in this respect is the conscious effort by producers of teaching materials to take this expanded setting sufficiently into account. It might not be feasible just to expand the activities now meant for use in traditional classrooms; rather, more innovative and genuinely authentic assignments and approaches to reflect this enlarged setting should be planned.

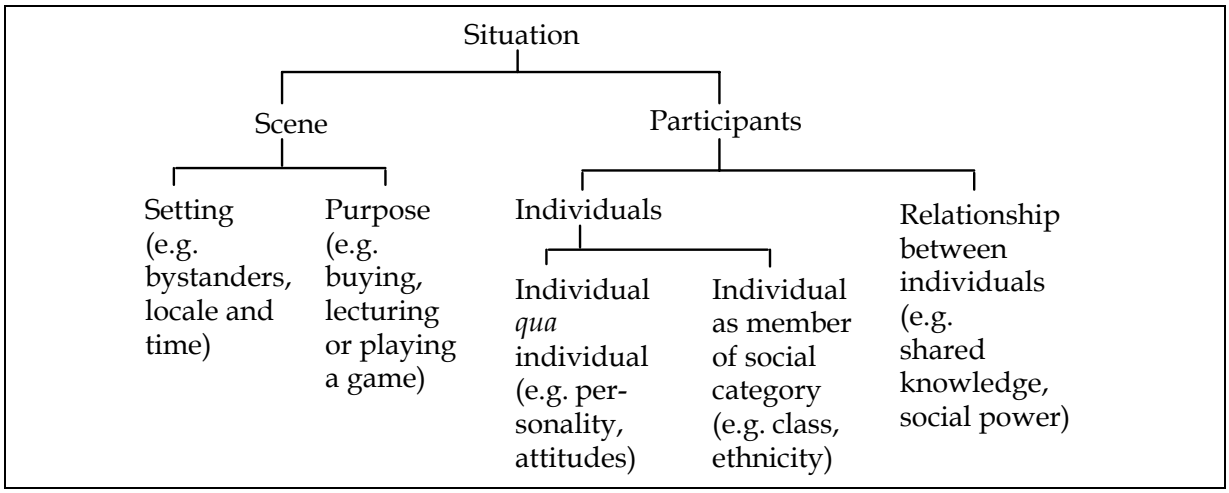

Figure 7. Situational Factors (Brown & Fraser 1979).

In another context, Mononen-Aaltonen & Tella (2000a) have argued that IDLEs (Integrated Distributed Learning Environments, such as WebCT, Blackboard, FLE, TELSI, LearningSpace, Mauri) can create the "centre stage", the forum or educational context, on which all actors—both teachers and students—can interact.

When linking theory and practice, we must remember to be realistic. Most teaching and learning still take place in ordinary classrooms, without even much access to the Internet. One of the TriO teachers describes their situation very aptly and colourfully:

> "*Olisi suotavaa, että lähellä olisi erillisiä piennäyttämöitä, joilla pienryhmät voisivat työskennellä rauhassa ja keskittyneesti (radioäänitykset, kuvaukset, editointi jne.). Nykyisellään vieressä on yksi koppi ja joskus entinen keittiö laajennettuna siivouskomerolla. Olosuhteet näissä eriöissä ovat niin alkeelliset, että sävyttävät oppilastöitä dyykkaritasolle. Mutta mediamaailmathan syleilevät katuojia ja viemäreitäkin.*" (Teacher B, Pohjois-Helsingin yläaste, May 5, 2000, an e-mail message)
>
> "It would be good if there were separate ministages close by [= close to the classroom itself, the 'main stage'], on which small groups could work and concentrate in peace and quiet (radio recordings, videotaping, editing). What we now have to hand is one cupboard and sometimes a former kitchen cum cleaning closet. Conditions in these cubicles are so primitive that they bring the pupils' work down to something close to zero value. But we know that media worlds embrace gutters and sewers too." (Teacher B, Pohjois-Helsinki Comprehensive School, May 5, 2000, an e-mail message; our translation)

This realistic view of everyday working conditions is a relevant reminder to those planning and implementing network-based education that it is rarely possible to work under ideal circumstances. Rather, as has been done in the TriO

project of the Media Education Centre and the National Board of Education, it has to be admitted from the outset that **accessing the Internet and the WWW varies considerably, and that it is pedagogically sound and didactically necessary to think of noticeably diverging solutions**. At the one end of this continuum, the circumstances closely resemble those in traditional classrooms with little if any access to new technology. A lot can be done even then. The most typical situation is characterised by a teaching and learning environment in which some telematic tools and applications are used and experimented with, in conjunction with other educational means, such as books, records, diskettes, CD-ROMs and tapes.

From the point of view of didactics and media education, these kinds of situation, varying from one extreme to the other, cannot be dealt with by using inflexible or ready-made solutions. **Both teachers and pupils need to be flexible and willing to change their attitudes and approaches to teaching, studying and learning, and ready to start something new.** Mononen-Aaltonen & Tella (2000a) describe this as a **dual stance** that both teachers and students have to adopt:

> "Admittedly, the teacher will change from a 'sage on the stage' to a 'guide on the side'. In an NBL environment, and in our conception of a dialogue, this is not quite enough: the real question is the dual stance (Willis 1995, 14–15) of the learner and the teacher, in which the teacher is still on the centre stage as an actor and as a moderator of all activities but at the same time (s)he will be on the side, observing the teaching–learning process with an attentive eye, reviewing the whole situation. The teacher, then, is both an actor and a critic. And so is the student: playing his or her part but also analyzing his or her own studying process at the metacognitive level. The teacher can easily contribute to this process by giving cognitive support, such as scaffolding. Tella (1999b, 213) has argued that media educators will need a 'media educational' eye in the spirit of Bourdieu's reflexive sociology (Bourdieu & Wacquant, 1992, 248). The question, then, is not only of reciprocity and addressivity between the different actors but also of the changes of the changing roles. One way to express this change is to describe the teacher as the student's cognitive coach and as a motivating and emotional counselor. These will also help her to act as an interpreter of the student's relations with the world. This kind of 'eye' is needed when we think of a dialogue as the metaphor of an NBL environment, which contextualises the process of individual empowerment and raises the awareness of individual actors." (Mononen-Aaltonen & Tella 2000a)

The need for continual change has been one major reason why we have constructed our multidimensional model using the constructs that we are presenting in this article. The constructs have to be abstract enough to tolerate new developments and different approaches when the aim is to implement modern infor-

mation and communication technologies in the teaching–studying–learning paradigm.

Authoring refers to how an individual *qua* individual or as a member of a group is able to represent himself or herself actionally (in action), or how (s)he is able and willing to react to teaching.

This action may come out as **cybertext**, in which an individual writes his or her own paths, his or her own "narration", whose traces can then be spotted and acted upon by others. We have adopted the notion of cybertext from the Norwegian researcher E. Aarseth, who launched it in 1997:

> "Cybertext … is not a 'new,' 'revolutionary' form of text, with capabilities only made possible through the invention of the digital computer. Neither is it a radical break with old-fashioned textuality, although it would be easy to make it appear so. Cybertext is a *perspective* on all forms of textuality, a way to expand the scope of literary studies to include phenomena that today are perceived as outside of, or marginalized by, the field of literature—or even in opposition to it…" (Aarseth 1997, 18)

In Aarseth's theory, two features caught our attention when we were developing our multidimensional model. First, Aarseth (1997, 15) points out **the dual ontology of everyday textuality**, viz. the opposition between screen and paper, which, however, has to be defined in a novel way now that a text can certainly be more than just textual or text-based information. In fact, in our interpretation too, a text is much more, including graphics, sounds and various combinations of text and graphical presentation.

Second, we are interested in Aarseth's (1997) way of enlarging the concept of hypertext to **cybertext** (Figure 8) that makes the role of the user more dynamic while enabling him or her to act textonically and configuratively towards the text itself. What this might mean in practical terms is that the user (of a computer program, for instance) is able to interact with the program in a more versatile manner than before. Aarseth argues that the user can add new paths or find new materialisations of the same text if seen through a textonic filter. Perfect examples might be web-based games, such as MUDs and MOOs (cf. e.g., Tella & Mononen-Aaltonen 1998, 109–110), but we feel that this principle could also be adapted for use in planning next-generation web-based teaching materials.

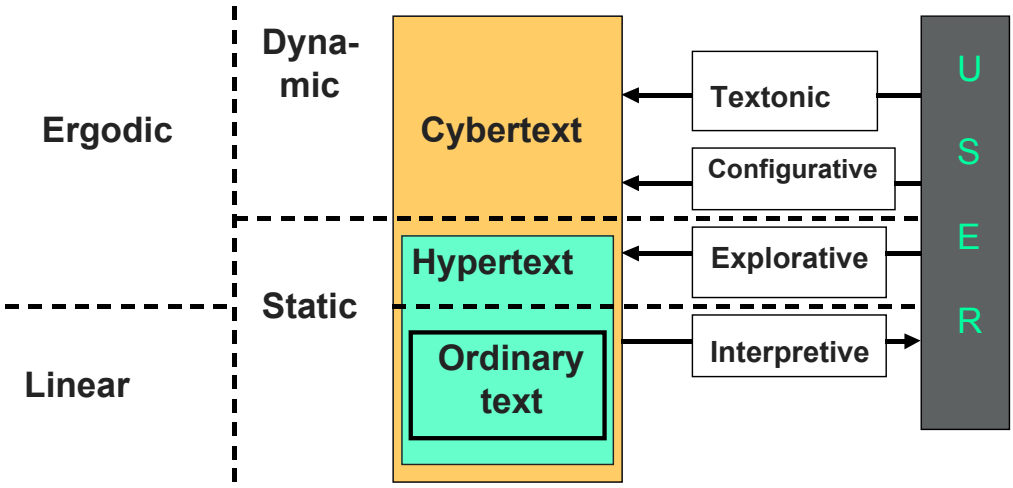

Figure 8. User Functions and Their Relation to Other Concepts (Aarseth 1997, 64).

Aarseth (1997) describes the difference between using an ordinary text and a cybertext in a very vivid way:

> "A reader, however strongly engaged in the unfolding of a narrative, is powerless. Like a spectator at a soccer game, he may speculate, conjecture, extrapolate, even shout abuse, but he is not a player. Like a passenger on a train … he is not free to move the tracks in a different direction. He cannot have the player's pleasure of influence. … The reader's pleasure is the pleasure of the voyeur. Safe, but impotent. …
>
> The cybertext reader *is* a player, a gambler; the cybertext *is* a game-world or world-game; it *is* possible to explore, get lost, and discover secret paths in these texts, not metaphorically, but through the topological structures of the textual machinery. This is not a difference between games and literature but rather between games and narratives." (Aarseth 1997, 4–5)

Aarseth's (1997) cybertext leads us to think of an active or proactive user of computer programs and computer software. If action is thought of as didactic action in this context, then it is justified to adopt the notion of *situated didactic experience*, in which action is situated in a didactically appropriate and apposite process of teaching, studying and learning. In this way, cybertextuality and didactics are linked together.

Action is often related to doing something concrete. When the principle of situated didactic experience is adapted for Finnish comprehensive schools, for instance, it is highly important to emphasise the concrete "actional" side of the teaching–studying–learning paradigm, as younger pupils are not necessarily ready for purely theoretical work. We see strong links between some of the ideas in our model when they are implemented in the real-life working contexts of the Finnish school system.

It must be borne in mind, however, that not all teenagers or youngsters are eager to have their texts and writings published via the net or via a groupware tool. There should be proper investigation into whether the increased potential generated by cybertextuality is likely to meet with "grassroots-level" action and expectations, or whether there are psychological and personal handicaps that are likely to reduce the empowering impact the web might otherwise have.

Writing is intimately associated with reflection. Therefore, at this level, we have a continuous cycle of action which is halted or slowed down by reflection which, again, is due to change into action. When this cycle of action–reflection–action takes place in a virtual space, in "virtual togetherness", and the action is focused on meaningful or purposive educational objectives, then we could call it **mediated pedagogical meeting**.

8 THE ON-LINE LEVEL OF THE STUDYING ENVIRONMENT

In our model, Level I represents the real-time and on-line learning or communication process. We will structure it according to the following logic.

The notion of situation, belonging to Level II (the action or teaching environment), is manifested at this level as **virtuality** (*virtualiteetti*), or as a **virtual scene**, in which **dialogue** is the concrete representation of communication. Our notion of dialogue embraces three interpretations: dialogue is (i) the basis of *all* human-to-human communication and interaction. At the same time, it is (ii) the key concept of the teaching–studying–learning process, and has (iii) an intimate relation to indivisible origins of thinking. Dialogue comes true through language; thinking, *ab initio*, has been, is, and will always be dialogic (Tella & Mononen-Aaltonen 1998, 66). In this sense, our notion of dialogue is conceptually close to the **cultural democracy approach**, which envisions an unoppressive, equal and culturally diverse society by redesigning classrooms and schools. Appelbaum & Enomoto (1995; Tella 1999a) contend that technology helps us to create an "ideal public sphere" in the spirit of Habermas (1974), in which undominated dialogue could possibly construct a model of social interaction within an unoppressed and equal society: "… the contextualization of this individual empowerment within the artificial model of a pluralist society would foster a comprehension of individual participation in social change" (Appelbaum & Enomoto 1995, 51; Tella 1999a).

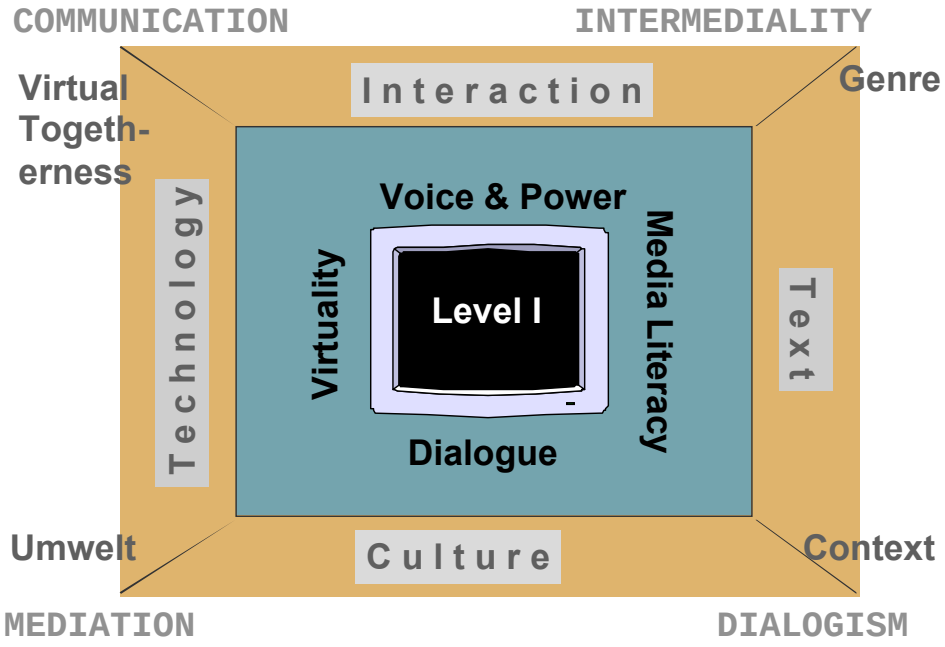

Figure 9. Level I: The On-Line Level of the Studying Environment.

It is in this dialogue that one or more voices can be heard, so that **voicedness** (cf. Tella & Mononen-Aaltonen 1998, 76–82) bears the connotations of power and the use or abdication of power. This notion of multi-voicedness (or multivocality) is extremely important in education, in which more voices are to be heard in addition to that of the teacher, which, for centuries, was the most dominating voice. In network-based education, this aspect is more important than ever. Moreover, because studying or communication manifests itself in environments that we describe as intermedial and multimedia-mediated, skill and competence are also needed to enable us to fully grasp the potential of multi-voicedness and to take advantage of it.

One of the TriO teachers describes how she sees the pupils' voices in a learning situation:

> "*Esityksessä kuuluu paljon erilaisia ääniä; joukossa opettajan. Valtataistelu käydään oppijaryhmän sisällä ja opetussuunnitelman toteuttajan ja koko ryhmän välillä. Arvaan, että pienryhmässä todellista valtaa pitää se oppilas, jolla on parhaat sekä tekniset että sosiaaliset taidot. Mitä tehokkaampi työnjako ryhmässä on, sitä demokraattisempi se on: jokaisen panosta tarvitaan, jokainen voi esiintyä asiantuntijana (mikäli siis edes tekee jotain).*" (Teacher B, Pohjois-Helsingin yläaste, May 5, 2000, an e-mail message)
>
> "In a presentation, a lot of different voices are heard, including that of the teacher. The power struggle is conducted within the group of pupils and between the implementer of the curriculum and the whole group. I guess that in a small group the real power is held by the pupil who has the best technical and social skills. The more effective the division of labour in the group is, the more democratic it is: everybody's input is needed; every-

> body can act as an expert (if they do anything at all).” (Teacher B, Pohjois-Helsinki Comprehensive School, May 5, 2000, an e-mail message; our translation)

The uses of power manifest themselves in a number of forms in the classroom. A typical way of balancing power between the teacher and the pupils is described by one of the TriO project teachers like this:

> ”*Opettaja väistyy alkuohjeiden jälkeen taustalle ja kiertää katselemassa, miten työskentely sujuu. Oppilaat ottavat melko pian koneen omakseen ja neuvovat toisiaan. Neuvominen on luontevaa, koska välillä täytyy antaa toiselle mahdollisuus kirjoittaa koneella. Keskustelufoorumilla oppilaat ja opettaja kohtaavat tasavertaisina. Opettajalla on edelleen valmiiden töiden ja suoritusten (keskustelufoorumille ’osallistumispakko’) arvosteluvalta! Toisten mielipiteitä kommentoidessaan oppilailla on toisaalta valtaa – myös opettajan kanssa voi olla eri mieltä!*” (Teacher A, Pohjois-Helsingin yläaste, May 5, 2000, an e-mail message)
>
> “After the initial instructions, the teacher moves back and walks around, watching how everything works. The pupils soon learn how to use the computer and they help each other. It is natural for the pupils to advise each other while taking turns using the computer. In a conversation forum [= groupware], the pupils and the teacher meet on equal terms. The teacher still has the final word as far as assessing finished products and achievements are concerned (in the conversation forum, this refers to the ‘obligation to participate’)! On the other hand, while commenting on others’ opinions, pupils exercise some power—they can also disagree with the teacher!” (Teacher A, Pohjois-Helsinki Comprehensive School, May 5, 2000, an e-mail message; our translation)

This description reveals a typical and often fully functional setting: the teacher delegates some of his or her power to the pupils, as situations vary at different stages of the work process and when using different telematic tools. It is our understanding that a new network-based working environment is most likely to encourage this kind of teacher behaviour. The teacher does not abdicate his or her power, but rather part of it is delegated to the learners, who, at the same time, are exercising some autonomy and initiative-taking.

One of the classifications of the uses of power in classrooms is presented by Underhill (1989):

- Authoritative power, exercised for and on behalf of the learner by others (usually by the teacher). The use of this kind of power is conceptually contradictory, because the teacher often uses—at least he is supposed to use—the power in order to help the learner to become more autonomous;

- Autonomous power, exercised by the learner himself, whose autonomy the teacher attempts to facilitate and support by yielding some of his own power to the learner;
- Authoritarian power, a degenerate version of authoritative power, exercised by the teacher, consciously or unconsciously, over the learner without paying enough attention to his interests. The learner is taken for an object, rather than for an autonomous and reflective subject;
- Abdicated power, a degenerate version of autonomous power, exercised by the learner to whom it has been given inappropriately by the teacher who is unable or unwilling to exercise it himself. The teacher attempts to yield some of his authority to the learner, who is not able or capable of assuming the responsibility of his own deeds. (Underhill 1989, 254)

Even if this classification is intended to be used in an ordinary classroom, we find that it has relevance in a network-based learning environment. It is also only fair to remember that, according to van Manen (1990, 153), the opposite of oppressive authority is not necessarily democracy, but rather pedagogy, i.e., a working relationship between teacher and learner can be built on relations facilitating learning from and with someone who can deepen the learner's action-sensitive understanding. If, so far, the teacher has mostly been the "knowing" person, it is now time to see the web as an exceedingly "knowing" partner in the teaching–studying–learning process.

Underhill (1989) concludes that as far as the first two uses of power (authoritative and autonomous) are concerned, the sound balance constitutes a competent and legitimate dimension of power. Learners, naturally, are different in that some of them are more capable of working on their own, while others profit more from the teacher structuring the learning task for them. In network-based education, teachers' behaviour is expected to support learners' self-directed, autonomous learning. It will be—and already is—a great challenge, as the presence of the web makes the situation much more complex than it used to be. Many teachers will do their best to incorporate this new element into their teaching practices. Are all teachers willing to move in that direction? Referring to the reasons why computers were not being used optimally in public schools, Dalton claimed as early as 1989 (Dalton 1989, 22–23) that "most teachers simply enjoy being on center stage, being a celebrity within their classrooms and schools". However, the division of power ought to change, as first computer-assisted learning (CAL), then computer-mediated communication (CMC), and now network-based education (NBE) require more autonomy on the part of the learners in order to be beneficial and conducive to learning.

Power and responsibility are also interrelated. In network-based education, teachers might feel ill at ease and think that their traditional position is at risk. They might then stick to the teaching practices and settings that they know they master well. A feeling of insecurity may be brought about by inadequate computing skills, by unfounded fears of new technology, by risks of making technical errors, or by not being competent enough in front of the learners. Teachers have been known to change their behaviour considerably depending on the interactional strategies adopted in differing social contexts. Troyna & Foster (1988, 294–295), for instance, cite research results concerning ways and situations in which teachers adopted varying perspectives according to social contexts: they adopted a 'professional' perspective in official meetings; a 'personal' perspective in the common room, and a 'survival' perspective in the classroom. They were also seen to transfer different types of information to different groups of learners also when they consciously aimed at precluding the knowledge–transfer paradigm. There is very little research-based knowledge about how teachers might behave when faced with network-based teaching and learning situations. Therefore, it is very important also to let teachers train themselves for these new situations and challenges. In this respect, the constructs of voice and power are crucial.

As part of the TriO project, four teachers from Vesala Comprehensive School analysed the issue of voice and power among their pupils in the spring of 2000. They started by remarking how voiceless some of their pupils were, and then they explained how they could be empowered. For instance, a major aim should be to do away with social exclusion by promoting learner participation and collaboration. In this, information and communication technologies might prove useful. They also believed that a lot of learning would be achieved by means of a groupware tool (by using the City of Helsinki Media Centre's Mauri, for instance). Children often argue, they reported, that "an expert is like a crocodile: a big mouth but small ears":

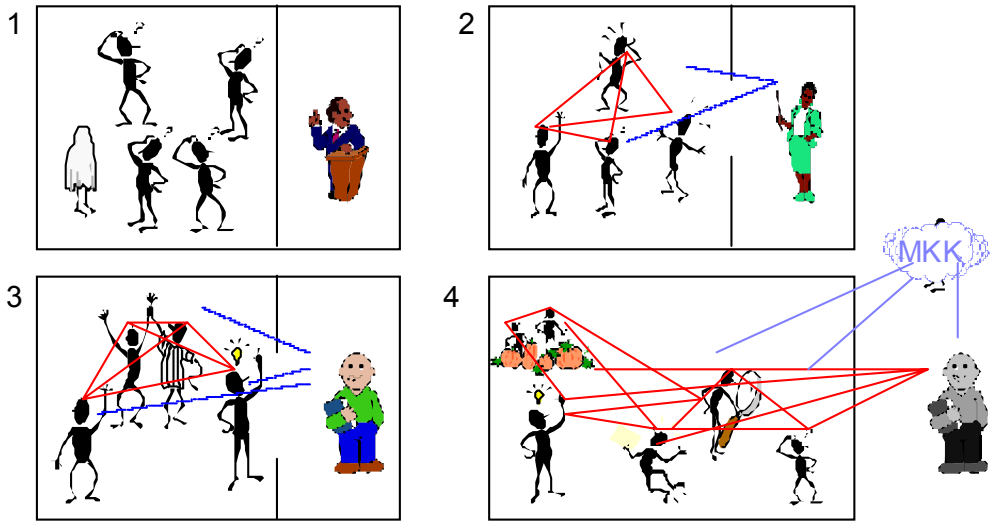

Figure 10. Enhancing co-operation Between Learners and the Teacher Via the Use of a Groupware Tool (as seen by the Vesala Teachers, May 2000).

Figure 10 refers specifically to communication situations in which a groupware tool (Mauri in this case) was used at Vesala to enhance the links between not only the learners, but also between the learners and the teacher and any outside communicators (such as MKK = the Media Education Centre researchers).

One could also argue that delegating power to the learners, one helps them get empowered, socially and mentally. In fact, individual empowerment could be considered as one of the most important objectives in network-based education, though it should not be achieved at the expense of losing communal features that are intrinsic in working on the web and in most telematic applications.

Media literacy (*medialukutaito*) is the term we use for the command of the discourse of this studying environment. We could have adopted the term **media competence** instead, but as it has certain connotations in Anglo-American discourse (competence is more and more often used to refer to some kind of basic or minimum level of expertise, while proficiency, for instance, implies a more dynamic, active and higher level of performance). In our experience, in Finnish it would also be justified to talk about *medialukuhalu* ('media appetite'), which would imply an active inclination to use multimedia in a communicative way. Terminology in this field is clearly not yet established, so it remains to be seen which of the terms, if any, will gain ground in the near future. The concept itself, i.e., a certain skill or proficiency to achieve a fair or better command of modern ICTs is obviously required.

Level I is the level of active performance, active "doing". It is the level on which network-based teaching materials (or, generally speaking, any web page or CD-ROM-based multimedia program) manifest themselves in ways, modes and fashions that the user feels are real. In consequence, it is fair to argue that

we could then talk about **didactically relevant, situated or mediated learning experience**. What is fundamental in this experience of sensing reality as real is that the user can be cognisant of the metaphors that have been used, in other words, (s)he is capable of acting purposefully without wasting too much time first interpreting the meaning of the (virtual) "scene". Level I approaches the traditional human/machine interface design process in that the user has to be provided with navigational and survival guidance in a way that is easy to understand and which advances from one episode to another following some transparent logic.

9 DISCUSSION

The multidimensional model presented in this article was initially constructed using the top-down principle; in other words, we have advanced from broad background flows (e.g., Level VI) towards real-time and on-line action (Level II, the action or teaching environment, and Level I, the on-line level of the studying environment). It would, however, be important to consider what would have happened if we had moved "bottom up" by starting with real-time communication situations (Level I) as faced by people sitting in front of the computer screen or using a mobile telephone, for instance. We believe that this approach would also have led us to reflect on the hidden premises that the instructional designer or the person responsible for the teaching would have embedded in the software or in the applications to be used.

If, for argument's sake, we start from Level I, the model should still be built as a logical structure relevant to didactics and media education, and not be eclectic or fragmentary, as on-line situations often tend to be. Again, our metaphor of going to the theatre might be used: we are guided by earlier presuppositions such as leaving our overcoats in the cloakroom (but in some countries theatregoers take their coats and umbrellas with them into the theatre itself, so intercultural awareness may bring about different behaviour). In the same way, the "stage" of Level I should open up, "lend itself to" the user as transparently as possible. In this article, we do not deal with traditional and still highly important foundations of how to design a computer screen; rather, we would think it important to underline a larger view and an educational rationale behind the technologies used.

There are different ways of "concretising" Level I: for instance, one could start by analysing the elements of (technical) legibility as opposed to (psychological) readability. In an earlier discussion of this issue, Tella (1991, 39–40)

started from Cronbach & Snow's (1977) Aptitude–Treatment Interaction Model (ATI) which predicts that learners' individual differences interact with the ways in which they are being taught and which then lead to differing learning results. An addition by Salomon (1979) to this model deals with the 'coding elements of a medium', which in his opinion ought to be taken into account more deeply than the medium *per se*. In Salomon's terminology (1979, 3), media are "our cultural apparatus for selecting, gathering, storing, and conveying knowledge in representational forms. Representation, as distinguished from raw experience, is always coded within a symbol system". Following in the footsteps of Salomon, Pederson (1986; 1987) was one of the first to emphasise the fact that any medium (a teaching medium or a teaching method) consists of a number of symbol systems which relate cognition to learning. Any symbol system can be divided into its coding elements, which deliver instruction in specific ways. In network-based education, *display* (the computer screen; the telephone screen) is among the main symbol systems. It is made up of several coding elements, such as colour, graphics, sound, rate, timing, format, clarity, print size. (Pederson 1986, 36; Pederson 1987, 112)

Table 3 exemplifies some symbol systems and coding elements associated with computers and relevant to network-based education. Some of the coding elements are defined by the programmer, while others can be manipulated by the user. For example, when using a word-processor or an HTML editor, the user may choose rather freely what text size (font) to use, so (s)he can manipulate one of the coding elements (font size) of one of the symbol systems (display). On the other hand, in other software, the user cannot change the layout of the screen. Legibility, or textual clarity, is usually better in a computer-mediated environment than in a pen-and-paper environment, although this is not necessarily always the case. Curiously enough, the font size of one of the IDLEs used in the TriO project was criticised by one 9-year-old pupil and a middle-aged lecturer, which clearly shows, in our opinion, how important it is to pay enough and adequate attention to the symbol systems and to their coding elements.

Table 3 shows the human/machine interface and the front end script combined. They both deal with the ways the user interacts with the computer (hardware and software), or rather the question is how the instructional designer and the end user interact. We firmly argue than in network-based education, the teacher will need a firm and well-justified conception of the teaching–studying–learning process, including the conceptions of learning and knowledge. Likewise, it is important that the instructional designer should be capable of designing an interface that allows the users to understand the principles that lie behind the visible "screenfuls". In fact, our model is intended to throw some light on the

ideas, concepts and mental models that might be "beyond" the on-line screen. In this sense, the symbol systems and their corresponding coding elements of different media would obviously deserve a lot more attention and research so that we would better understand and then be able to utilise their educational potential.

Table 3. Symbol systems and coding elements on communications networks (Pederson 1986; 1987; cf. also Tella 1991, 40).

Symbol System	Coding Elements
Display	• Colour • Graphics • Sound • Speed • Timing • Form • Legibility (Textual Clarity) • Publicity • Text Size

Human/Machine Interface and Front End Script	• Starting and Ending Procedures
	• Fluency of Communication
	• Readability
	  • Editing the Screen
	  • Saving Procedures
	  • Feedback
	  • Branching
	  • Auto Control
	• Intelligence Level between Human/Machine Interface, Program Controlling Communications Network, and Communications Software
	  • User Accessibility
	  • On-Line Prompts
	  • Retrieval of Notices
	  • Sorting and Classifying
	  • Indexing
	  • Cleaning Up

As far as Level II (the action or teaching environment) is concerned, it would be natural to discuss what sort of assignments are used in respective domains of science or knowledge, what sort of cybertext would be needed or should be created, and to what extent and how the user could, generally speaking, write new cybertextual paths. It would also be interesting to think of the new imagined and possible worlds that would emerge from deploying terms and concepts of different sciences and domains of human knowledge.

One of the key concepts at Level II could be that of **decontextualisation**: the general context is separated from the context-specific action or from the teaching context that is meaningful and pedagogically apposite. The difference between Levels II and I is that the general decontextualisation of Level II is transformed at Level I into specific **recontextualisation** in which process the recontextualising elements come from different subjects or domains of science. In other words, at Level I, the users are incessantly, and mostly in real time, creating a new context, a recontext of what is enabled by the presence of the upper levels of the model. In the same way, we could argue that the decontextualisation taking place at Level II is only possible if we take into account the different means, artefacts and skills we described at Level III (the learning environment).

The six levels are therefore in complex and continuous interaction with one another. They all mirror the complexity and multiplicity of the phenomena that are interlinked and incorporated into our multidimensional model. No one single level is adequate to explain how we should plan a teaching program to be used on the web, or network-based teaching materials in general, or how such a program should be assessed, for that matter.

It is important to note that not all concepts that are central in pedagogy or in didactics are represented in this model. One could argue, for instance, that the concept of **motivation** should be added to one of the levels. Again, one could ask where in this model **learning** takes place. In our opinion, questions of this kind are off the point. As a term, motivation is not in the model, but various degrees of immersiveness, stimulation and activation are embedded in several of the concepts. In our understanding, dialogism at Level VI (the level of background flows), for instance, already embraces elements that are conducive to communication that could be called motivated and subject-oriented. Equally importantly, the so-called **topicalisation hypothesis**, i.e., the fact that the person involved in the teaching–studying–learning process, can himself or herself decide what sort of content matter is chosen implies a clear positive influence on inner motivation. Voices and power (multi-voicedness) at Level I (the on-line level of the studying environment) are clearly linked to motivation. At Level II (the action or teaching environment), the notion of cybertext gives the user em-

powering opportunities to create new paths, to discover uncharted territories (much as constructivism invites us to do), and so forth. Motivation is thus embedded in several levels and concepts, and thus it would not be appropriate to isolate it from the whole into one of the levels alone.

What about learning, then? Where does it occur? Again, we feel the question is wrongly posed. Our Level III is called the learning environment, but our whole way of thinking is based on merging the three components, teaching—studying—learning, into one large entity, which only works if all the three components are in constant and beneficial synergy with one another. In this sense, 'learning' certainly occurs on several levels as part of the holistic process. Perhaps a more relevant question would be to ask what sort of learning takes place when network-based education is integrated into school settings.

All in all, the choice of the concepts in this model is deliberately grounded on the discussion we have had earlier in the fields of telelogically-defined media education (cf. e.g., Tella 1997) and modern information and communication technologies, rather than on the perspectives of psychology.

Despite recent emphases on constructivism and socio-cultural perspectives, many current teaching practices still go back to behaviourist or objectivist learning theory and are often considered good teaching. These elements include habits such as splitting the learning material into tiny parcels of information in order to have them learnt as quickly as possible, giving feedback as soon as possible, and paying negative attention to learners' errors and mistakes. We believe that network-based education offers more constructivist challenges to learners, provided that the teacher and the instructional designers are aware of these opportunities. For instance, NBE offers large amounts of information for learners to analyse and to work on while building up their own knowledge from that material. These amounts of information are often talked about in the public discourse, though one should also bear in mind that the shelf-life of information is dwindling all the time, i.e., the value of information is decreasing more rapidly than its usability which, again, emphasises the importance of choosing the proper information to work on.

The behaviourist theory relied on the concept of objective knowledge, independent of an individual's reality. Now, according to the constructivist theory, knowledge is always something learners have to construct themselves. If we take into account the latest social constructivist perspectives, we could further argue that all learning is individually based but socially co-constructed, so that we could talk about "managed" group learning or, as Tella & Mononen-Aaltonen (1998) put it, about co-construction or appropriation of knowledge,

which should be encouraged in the planning and evaluating of network-based education and teaching materials.

••

To sum up, our ultimate objective has been to construct a novel multidimensional model that would contain some of the central emphases of media education and didactics, and which could be employed in the formulation of the principles to be used in the planning and assessment of network-based education (teaching, studying and learning), and of all the various materials used in this process. As demonstrated above, all the levels of the model are in organic contact with each other. They can be thought of as filters or magnifying glasses, through which the rest of the levels are realised.

Nevertheless, this multidimensional model is recommended for use together with an educational framework which should always occupy the first position. Discussing this framework might include questions such as:

- What are the educational problems to be met (and hopefully solved) by using different tools, means and applications enabled by network-based education?
- What is the teacher's and the learner's perspective in network-based education? Are these needs and expectations met by using modern technology?
- What sorts of aims and objectives should be conceptualised prior to the introduction of network-based education?
- How are different theories of man, learning and knowledge accommodated in a network-based learning environment?
- How are different teaching, studying and learning strategies employed when working in a network-based learning environment?

If thinking about and responding to these questions are included in the process of reflecting on our model, we believe this might lead to the educationally relevant use of modern technology, and to a more humane way of enhancing the potential of network-based education.

10 REFERENCES

Aarseth, E. 1997. Cybertext. Perspectives on Ergodic Literature. Baltimore & London: The Johns Hopkins University Press.

Alderson, G. & DeWolf, M. (eds.) 1984. Guide to Effective Screen Design. Computers in the Curriculum. Chelsea College, University of London: Pegasus Printing Company.

Appelbaum, P. M. & Enomoto, E. K. 1995. Computer-Mediated Communication for a Multicultural Experience. Educational Technology/November–December, 49–58.

Arnett, R. C. 1992. Dialogic Education: Conversation About Ideas and Between Persons. Carbondale: Southern Illinois University Press.

Ascott, R. 1993. Telenoia. Lecture at the 'Telecommunication and Art' Symposium. Helsinki, 15 April 1993.

Balle, F. 1991. The Information Society, Schools and the Media. In Eraut, M. (ed.) Education and the Information Society: A Challenge for European Policy. London: Cassell, 79–114.

Bauman, Z. 1995. Life in Fragments: Essays in Postmodern Morality. Oxford: Blackwell.

Bourdieu, P. & Wacquant, L. J. D. 1992. An invitation to Reflexive Sociology. Chicago: Polity Press.

Brown, A. L. & Campione, J. C. 1994. Guided Discovery in a Community of Learners. In McGilly, K. (ed.) Classroom Lessons: Integrating Cognitive Theory and Classroom Practice. Cambridge, MA: MIT Press/Bradford Books, 229–270.

Brown, P. & Fraser, C. 1979. Speech as a marker of situation. In Scherer, K. & Giles, H. (eds.) Social Markers in Speech. Cambridge: Cambridge University Press.

Bruner, J. 1985. Vygotsky: A Historical and Conceptual Perspective. In Wertsch, J. V. (ed.) 1985. Culture, communication, and cognition: Vygotskian perspectives. Cambridge, MA: Cambridge University Press, 21–34.

Cronbach, L. J. & Snow, R. E. 1977. Aptitudes and Instructional Methods: A Handbook of Research on Interactions. New York, NY: Irvington.

Dalton, D. W. 1989. Computers in the Schools: A Diffusion/Adoption Perspective. Educational Technology/November, 20–27.

Derrida, J. 1993/1994. Specters of Marx. The State of the Debt, the Work of Mourning, & the New International. Translated by Peggy Kamuf. London: Routledge.

DeVito, J. A. 1997. Human Communication. Seventh Edition. New York: Longman.

Duffy, T. M. & Jonassen, D. H. (eds.) 1992. Constructivism and the Technology of Instruction: A Conversation. Hillsdale, NJ: Lawrence Erlbaum Associates.

Frankfort-Nachmias, C. & Nachmias, D. 1992. Research Methods in the Social Sciences. New York: St. Martin's Press.

Habermas, J. 1974. The public sphere. New German Critique 3.

Heidegger, M. 1950/1975. The Anaximander Fragment. In Early Greek Thinking: The Dawn of Western Philosophy, trans. David Farrell Krell and Frank A. Capuzzi. New York: Harper & Row, 41.

Holquist, M. 1990. Dialogism: Bakhtin and his world. London: Routledge.

Huhtamo, E. 1995. Encapsulated Bodies in Motion: Simulators and the Quest for Total Immersion. In Penny, S. (ed.) Critical Issues in Electronic Media. New York: State University of New York Press, 159–186.

Jonassen, D. H. 1995. Supporting Communities of Learners with Technology: A Vision for Integrating Technology with Learning in Schools. Educational Technology/July–August, 60–63.

Kerr, S. T. 1996. Toward a Sociology of Educational Technology. In Jonassen, D. H. (ed.) Handbook of Research for Educational Communications and Technology: A Project of the Association for Educational Communications and Technology. New York: Simon & Schuster Macmillan, 143–169.

Kiviniemi, K. 2000. Johdatus verkkopedagogiikkaan. Kokkola: Keski-Pohjanmaan ammattikorkeakoulu. Keski-Pohjanmaan ammattikorkeakoulun julkaisusarja A: Tutkimuksia.

Kozulin, A. 1996. Vygotsky in Context. In Vygotsky, L. S. Thought and Language. Newly revised and edited by Alex Kozulin. Cambridge, MA: The MIT Press.

Kozulin, A. 1998. Psychological Tools. A Sociocultural Approach to Education. Cambridge, MA: Harvard University Press.

Kynäslahti, H. 1999. Mediakasvatuksen tutkijoiden verantoja ja ylipaikallisia kenttiä. (Verandas and translocal fields of researchers of media education.) Kasvatus 30 (3), 255–264.

LeBaron, J. F. & Bragg, C. A. 1993. Modeling Constructivism in Distance Education Designs for Higher Education. In Estes, N. & Thomas, M. (eds.) Rethinking the Roles of Technology in Education: The Tenth International Conference on Technology and Education. March 21–24, 1993. Massachusetts Institute of Technology, Cambridge, Massachusetts. Volume 1. Austin, TX: The University of Texas at Austin, College of Education, 86–88.

Lehtonen, M. 1998. Merkitysten maailma. (The World of Meanings.) 2. painos. Tampere: Vastapaino.

Lintula, A. 1999. Vuorovaikutusta verkkoympäristössä. (Interaction in a network environment.) Kasvatus 30 (3), 240–253.

Lin, X., Bransford, J. B., Hmelo, C. E., Kantor, R. J., Hickey, D. T., Secules, T., Petrosino, A. J., Goldman, S. R. & The Cognition and Technology Group at Vanderbilt 1995. Instructional Design and Development of Learning Communities: An Invitation to a Dialogue. Educational Technology September–October, 53–63.

Mannisenmäki, E. 2000. Oppija verkossa – yksin ja yhdessä. Teoksessa Matikainen, J. & Manninen, J. (toim.) Aikuiskoulutus verkossa: Verkostopohjaisten oppimisympäristöjen teoriaa ja käytäntöä. Helsingin yliopiston Lahden tutkimus- ja koulutuskeskus, 109–120.

Meisalo, V. & Tella, S. 1988. Tietotekniikka opettajan maailmassa: Tietotekniikan opetuskäytön ja didaktiikan perusteita. (Information Technology in the World of Teachers: Foundations of Instructional Uses of Information Technology and Information Technology Education.) Helsinki: Otava.

Molenda, M. & Sullivan, M. 2000. Issues and Trends in Instructional Technology. In Branch, R. M. & Fitzgerald, M. A. (eds.) Educational Media and Technology Yearbook 2000. Englewood, Colorado: Libraries Unlimited, 3–13.

Mononen-Aaltonen, M. 1998. A Learning Environment—A Euphemism for Instruction or a Potential for Dialogue? In Tella, S. (ed.) Aspects of Media Education: Strategic Imperatives in the Information Age. Media Education Centre. Department of Teacher Education. University of Helsinki. Media Education Publications 8, 163–218.

Mononen-Aaltonen, M. 1999. Verkkopohjainen opiskeluympäristö ja dialogin tukema tutkimusopetus. (Network-based learning environments and dialogue-supported research-focused teaching.) Kasvatus 30 (3), 223–239.

Mononen-Aaltonen, M. & Tella, S. 1999. Ajatuksia jatkoksi: Kohti suunnittelun ja arvioinnin periaatteiden monitasomallia. TriO-projektin (Opetus, opiskelu ja materiaalit verkkopohjaisessa opiskeluympäristössä: Verkko-opetuksen arviointi- ja kehittämisprojekti 1999–2000) väliraportti. Helsinki: Mediakasvatuskeskus ja Opetushallitus, 41–46. (Julkaisematon)

Mononen-Aaltonen, M. & Tella, S. 2000a. From Brawn to Brain: Towards an Emerging Minds-on Approach in Integrated Distributed Learning Environments (IDLEs). ED-MEDIA 2000. World Conference on Educational Multimedia, Hypermedia & Telecommunications. June 26–July 1, 2000. Montréal, Canada.

Mononen-Aaltonen, M. & Tella, S. 2000b. Verkkopohjainen opetus ja oppimateriaalit: suunnittelun ja arvioinnin periaatteiden monitasomalli. Teoksessa Buchberger, I. (toim.) Opettaja ja aine. Ainedidaktiikan symposiumi 4.2.2000. Helsingin yliopisto. Opettajankoulutuslaitos. Tutkimuksia.

Mowlana, H. 1997. Global Information and World Communication: New Frontiers in International Relations. Second Edition. London: Sage.

Oksanen, U. 1999. Mediakulttuuri ja multimedian metaforat. TriO-projektin (Opetus, opiskelu ja materiaalit verkkopohjaisessa opiskeluympäristössä: Verkko-opetuksen arviointi- ja kehittämisprojekti 1999–2000) väliraportti. Helsinki: Mediakasvatuskeskus ja Opetushallitus, 27–32. (Julkaisematon)

Ollivier, B. 1992. Communiquer pour enseigner. Paris: Hachette.

Pederson, K. M. 1986. An Experiment in Computer-Assisted Second-Language Reading. The Modern Language Journal 70 (1), 36–41.

Pederson, K. M. 1987. Research on CALL. In Smith, W. F. (ed.) Modern Media in Foreign Language Education: Theory and Implementation. Lincolnwood, IL: National Textbook Company, 99–131.

Penny, S. (ed.) 1995. Critical Issues in Electronic Media. New York: State University of New York Press.

Quéau, P. 1993. Le virtuel: Vertus et vertiges. Mayenne: Floch.

Reeves, T. 1997. Evaluating What Really Matters in Computer-Based Education. [http://www.educationau.edu.au/archives/cp/reeves.htm] (03.07.2000)

Salomon, G. 1979. Interaction of Media, Cognition, and Learning: An Exploration of How Symbolic Forms Cultivate Mental Skills and Affect Knowledge Acquisition. San Francisco: Jossey-Bass Publishers.

Seels, B. 1997. Taxonomic Issues and the Development of Theory in Instructional Technology. Educational Technology/January–February, 12–21.

Smagorinsky, P. 1995. The Social Construction of Data: Methodological Problems of Investigating Learning in the Zone of Proximal Development. Review of Educational Research 65 (3), 191–212.

Tella, S. 1991. Introducing International Communications Networks and Electronic Mail into Foreign Language Classrooms: A Case Study in Finnish Senior Secondary Schools. Department of Teacher Education. University of Helsinki. Research Report 95.

[http://www.helsinki.fi/~tella/95abst.html]

Tella, S. 1994. Uusi tieto- ja viestintätekniikka avoimen oppimisympäristön kehittäjänä. Osa 1. (New Information and Communication Technology as a Change Agent of an Open Learning Environment. Part 1.) Department of Teacher Education. University of Helsinki. Research Report 124.
[http://www.helsinki.fi/~tella/124abst.html]

Tella, S. 1997. Media and Man—On Whose Terms? Aspects of Media Education. In Tella, S. (ed.) Media in Today's Education. Part 1. Proceedings of a Subject-Didactic Symposium in Helsinki on Feb. 14, 1997. Department of Teacher Education. University of Helsinki. Research Report 178, 11–21.
[http://www.helsinki.fi/~tella/178mediaedu.html]

Tella, S. 1998. The Concept of Media Education Revisited: From a Classificatory Analysis to a Rhizomatic Overview. In Tella, S. (ed.) Aspects of Media Education: Strategic Imperatives in the Information Age. Media Education Centre. Department of Teacher Education. University of Helsinki. Media Education Publication 8, 85–150.
[http://www.helsinki.fi/~tella/mep8tella.html]

Tella, S. 1999a. Firmer Links between Telematics, Multiculturalism and Foreign Language Learning Methodology. In Selinger, M. & Pearson, J. (eds.) Telematics in Education: Trends and Issues. Elsevier, 105–118.

Tella, S. 1999b. Mediakasvatus – aikamme arvoinen. (Media education for our times.) Kasvatus 30 (3), 205–221.
[http://www.helsinki.fi/~tella/tellakasvatus.399.pdf]
[Abstrakti http://www.jyu.fi/ktl/kasvat99.htm]
[Abstract http://www.jyu.fi/ktl/journal.htm]

Tella, S. 2000. Achronos: Reflections on Timeless Time, Media and Communication. Teoksessa Buchberger, I. (toim.) Opettaja ja aine. Ainedidaktiikan symposiumi 4.2.2000. Helsingin yliopisto. Opettajankoulutuslaitos. Tutkimuksia.

Tella, S. & Mononen-Aaltonen, M. 1998. Developing Dialogic Communication Culture in Media Education: Integrating Dialogism and Technology. University of Helsinki. Department of Teacher Education. Media Education Centre. Media Education Publications 7.
[http://www.helsinki.fi/~tella/mep7.html]

Terashima, N. 1993. Telesensation—A New Concept for Future Telecommunications. TAO First International Symposium. Japan: TAO International Symposium 6–7 Dec.

The Usability Group (TUG).[http://www.usability.com/umi_links.htm]
(22.2.2000)

Tiffin, J. & Rajasingham, L. 1995. In search of the virtual class: Education in an information society. London: Routledge.

Troyna, B. & Foster, P. 1988. Conceptual and Ethical Dilemmas of Collaborative Research: Reflections on a Case Study. Educational Review 40 (3), 289–300.

Uljens, M. 1997. School Didactics and Learning. Hove, East Sussex: Psychology Press.

Underhill, A. 1989. Process in humanistic education. ELT Journal 43 (4), 250–260.

Vahtivuori, S., Wager, P. & Passi, A. 1999. ”Opettaja, opettaja, teletiimi ’Tellus’ kutsuu …”: Kohti yhteisöllistä opiskelua virtuaalikoulussa. (“Teacher, teacher, teleteam ‘Tellus’ calling …”: Towards communal studying in virtual school.) Kasvatus 30 (3), 265–278.

van Manen, M. 1990. Beyond Assumptions: Shifting the Limits of Action Research. Theory into Practice XXIX (3), Summer, 152–157.

von Uexküll, J. & Kriszat, G. 1958. Streifzüge durch die Umwelten von Tieren und Menschen. Ein Bilderbuch unsichtbarer Welten. Bedeutungslehre. Hamburg: Rowohlt.

Wertsch, J. V., Del Río, P. & Alvarez, A. 1995. Sociocultural Studies of Mind. Cambridge: Cambridge University Press.

Willis, J. A. 1995. Recursive, Reflective Instructional Design Model Based on Constructivist-Interpretivist Theory. Educational Technology/November-December 5–23.

NB. This article has been reprinted with permission. The original reference is as follows:

Tella, S. & Mononen-Aaltonen, M. 2000. Towards Network-Based Education: A Multidimensional Model for Principles of Planning and Evaluation. In Tella, S. (ed.) Media, Mediation, Time and Communication: Emphases in Network-Based Media Education. Media Education Centre. Department of Teacher Education. University of Helsinki. Media Education Publications 9, 1-58.