Interactive Educational Multimedia, number 9 (November 2004), pp. 32-47
http://www.ub.es/multimedia/iem

The virtual construction of the mind: the role of educational psychology

Carles Monereo

carles.monereo@uab.es

Dept. of Educational Psychology
Universitat Autònoma de Barcelona

Abstract

New virtual minds are populating our classrooms. The new occupants of our schools are technological natives: children and adolescents for whom the computer is a fundamental part of everyday life. For them, the interfaces used by ICTs – the language of communication, interaction and learning – are internalised to the point of becoming as embodied and natural as speech itself.

This virtual construction of the mind is an unavoidable phenomenon. It brings with it a set of major risks if it is not systematically supported and supervised by educationalists. Because of their age, most educationalists are *technological migrants* who have had to make the jump from the culture of the printed word to the culture of digitalisation, but who at the same time bring an armoury of resources for managing information presented in textual form – the format that still predominates in ICTs. Without the aid of these resources the new generations may be overwhelmed by a barrage of information that is potentially valid and useful but may also be seriously manipulated, unreliable, or vacuous.

This article explores ways in which education, and specifically edumatics (the use of computing inside the educational environment) can respond to the need to construct a virtual mind able to deal successfully with the challenges of the future: what we call a strategic virtual mind.

1. The 'virtualised' child.

Imagine for a moment a child whose only link to the world is via computer: a kind of "digital savage", like the *enfant sauvage* found by Jean Itard in the woods of Aveyron. Unlike Itard's child, whose interaction with the world was shaped by his contact with wild animals, our child will have grown into adolescence through the mediation of forums, chats, websites, distribution lists, video conferences. What would the mind of such a child be like? What kind of mental representations would he produce? Would he

be able to transfer knowledge learnt on the web to the world of tangible, three-dimensional objects?

A first point to make – an obvious one – is that, unlike his counterpart in the woods, no virtualised child actually fitting this description could exist, since we do not have devices that are able to self-program, manage their "intellectual life" autonomously, or decide when to vary the flow of data or when to switch on or off (at any rate at the current stage of technological development, in September 2004). If a creation of this kind were possible, it would exist inside a *Matrix*-style environment[i], immersed in a three-dimensional world, able to effect sensorimotor interactions with objects and to move around a space perceived at all times as real[ii].

Eventually, this imaginary subject could finally construct a mind that adapts to this parallel world and develop a range of skills to survive in it, but, as was the case of Itard's child (who in the end was unable to develop appropriate human speech), these skills would probably be of no use to him in an "embodied", "encultured" world like ours.

In relation to our embodied representations Ihde (2004) reminds us that humans always experience objects in a multisensory way. Our bodies also try to extend themselves multisensorily; even in monosensory media, for example in a telephone conversation, we exaggerate our intonation, we gesticulate, we change our body posture, and accompany these actions with expressions of coldness, warmth, anger, and so on. The experiences and sensations received in a world with distinct psychophysical and spatio-temporal characteristics would produce major changes in the representations of our body, a new *sensorium* that would entail different ways of perceiving, feeling, relating to time and space, new ways of recognising and relating to each other (Martin-Barbero, 1998).

As for the forms of enculturation, there is no doubt about our need to relate with other flesh-and-blood members of our species in order to learn to be humans; not only to be able to develop a language that is intelligible to other humans, but also to acquire strategies for managing and transforming knowledge and skills of interrelation with others. In our virtual reality scenario, the interfaces that allow communication would have a decisive influence on the forms of organising, interpreting and attributing meaning to the information received, and so the structure and functions of this mind would vary – probably without our noticing[iii], but radically all the same.

So this (thankfully imaginary) virtualised child[iv] would have serious difficulties in managing the world of the tangible and objectual that we know. The reason is crystal clear; he would have no knowledge of the image and position of his ego in this other reality, or of the cultural keys that would allow him to extract meaning from his perceptions and experiences.

Leaving these stimulating mind-games behind us, the fact is that the young students who arrive in our university lecture rooms are a long way from suffering from a *technological disability*. We can regard them as technological *natives*, that is, individuals who since their infancy have shared a large part of their learning and communication experiences with various types of computerised systems based on digital technology on a permanent, everyday basis. The ways in which this new student

body process new information and approach problem-solving differs radically from those of the generation that grew up with printed texts. Continuing with our metaphor, this generation can be seen as technological *migrants* who, with a greater or lesser degree of success, have moved from the world of Gutenberg and Caxton to the galaxy of Internet. Just as the steps from oral culture to written culture and then from writing into printing had clear repercussions for forms of learning and thinking, the transition from the printed culture to this new digital culture will have diverse consequences for our cognition. The possible effects are summarised in the table below.

	Identity	**Dominant epistemological conception**	**Locus of knowledge**	**Dominant language**	**Result**
Printed Culture	Technological *migrants*	Objectivism	Individual-Compartmentalised	Verbal	*Lettered* mind
Digital Culture	Technological *natives*	Relativism	Distributed-Connected	Multiplicity	*Virtual* mind

Table 1. Some of the dimensions of analysis of the two cultures.

Indeed, those of us born in the twentieth century are in the course of migrating from one culture to another and, as is the case of people who leave their native land for another, the levels of integration in today's dominant culture (that is the culture of ICTs, Information and Communication Technologies) varies greatly from group to group: from those whose immersion has been almost complete to those whose attempts to make the switch have failed resoundingly. Perez Tapias (2003) compares lucidly and rather poetically the situation of owners of *lettered* minds with the Ulysses of the Odyssey, that "lost internaut" condemned to sail on with no destination, or, even worse, back towards a homeland, the printed word, that is slowly vanishing.

For their part, those born in the twenty-first century can be considered as *natives*. Their lives will inevitably be mediated by ICTs and a large part of their learning and social relations will be forged both *in* and *through* them. The result is that the mediation by ICTs will appear to be transparent, invisible, almost natural.

The epistemological conceptions that predominate in the two groups are also diverging rapidly. For the older generation there have always been universal truths, both scientific and moral; whoever utters or transmits them, they remain truths; they must be passed on via formal education institutions. But for the younger generation, "everything depends"[v]: all truths are relative and depend on who, when, how, and why they are stated; they are never independent of their utterer or their context.

This trend has also been found in studies of the ways in which scientists and film-makers or TV producers approach the use of computers in their work. The scientists' perspective is realistic and instrumental, whereas professionals in audio-visuals (the culture predominant today among the young) behave like radical social constructivists (Ihde, 2004). Indeed, any computer program that aims to produce some form of learning is a faithful reflection of the implicit epistemological and educational conceptions of its authors.

The two groups also differ as to where knowledge is *located*. Technological *migrants* regard knowledge as something that they possess, something that they carry around with them; technological *natives* see it as something that they obtain through a set of applications and instruments. This distinction modifies substantially notions such as intelligence, wisdom or ability. In the Information Society (IS) the most intelligent, wise and able members are not those with the fullest, most structured minds, but those who have the fastest and most efficient access to information – the broadest-ranging, most exclusive network of *links*. To take this point further: for *migrants* knowledge is located in an individual memory, but for *natives* it is dispersed. For the new generation it is stored in mobile phones, hard disks, *WEBs*, and digital files. Of course it is also stored in social communities, many of them virtual.

This possibility of permanent, unlimited access (which is the general principle of the techno-utopia: that any information can be obtained at any moment and in any place) means that the borders between the traditionally compartmentalised social scenarios of education, work and the family are beginning to break down. We now use our home computers to work, to chat with our friends, to read the news or to follow the latest developments in music and the arts.

As for the idioms in which the two groups think and communicate, *migrants* are inseparably united to linear languages underpinned by logic, sequence and strict rules of comprehension and production (textual, mathematical, musical notations, or whatever). These are far removed from the global, flexible and simultaneous languages of television, used by *natives,* with their vast array of audiovisual and graphic applications. So it appears that these and other dimensions (which for reasons of space we cannot consider here) seem to be creating a gulf between the *lettered* mind and the *virtual* mind.

To understand the format of this virtual mind (which is still under construction) Comba and Toledo (2004) use the image of the *bricoleur*, borrowed from Levi-Strauss, to describe the way in which internauts construct their knowledge with the resources that they have at hand at any one time:

a) Internauts tend to organise the performance of tasks personally, with a fairly high level of improvisation, deciding at each moment the pace of their work, the precision required, how it is presented, and so on.

b) They tend to make new combinations of computer programs and their functions, choosing pre-existing algorithmic and heuristic procedures in a relatively strategic way, but accommodating them to their personal preferences or skills.

c) They re-cycle what has been already been made, using parts of other texts, graphics, (either their own or belonging to others) to produce something new. By *cutting and pasting*, *saving as*, and so on, they put together an original patchwork.

This pragmatic approach, consisting in many cases of putting together "odds and ends", aims mainly to resolve one-off problems in a rapid, self-regulated but relatively unplanned way. It values the immediacy of the response and the provisional nature of the product, to the detriment of the systematisation of the process and the durability and quality of the result. The advantage of this approach is that it can create a flexible and

adaptable mind, but on the negative side this mind may be fragile and vulnerable. In the next section, we will look at the many dangers that this mind may face.

2. Risks and dangers for a virtual mind.

Two clear conclusions can be drawn from the above section: (a) The signs are that immersion in a world mediated by ICTs promotes the construction of a new kind of mind – virtual, relativist, socio-technologically wide-ranging and able to decode a multitude of languages. (b) A mind constructed basically via computer-mediated experiences may encounter difficulty in adapting to the real world.

The metaphor of human cognition as a processor is partial and inadequate if it does not consider the decisive importance of the body, which not only contains it but shapes it. The biological structure on which our ideas of the world *run* is not static or independent of them, as is the case of a computer's hardware. Our ideas modify our biological structure and thus embody a representation of the world (Pozo, 2003). In fact, our body imposes a series of restrictions on ICTs – for example the requirement that everything must be perceived sensorily and must rest on physical supports that can be manipulated by our senses and motor organs, or the need for explicit, visible information (the working memory) and for stored, readily available, but implicit information (the long-term memory)[vi].

Let's look now at the area of education. Since the phenomenon of the construction of a virtual mind seems to be unavoidable today, we should ask not so much *whether* we should accept and contribute to the process, but *how* we should do so: how we should use ICTs in the educational setting to construct minds that are virtual but also embodied, able to face the challenges of a changing, complex society such as our own. To answer this question first we need to determine the dangers, the likely effects of non-intervention; second, we need to establish what types of human beings and what types of mind we want to produce, and indeed what kind of world.

In this section we focus on the potential dangers of not intervening, of allowing our pupils to become *cyborgs*. We will leave the second question – what kind of virtual mind we should be constructing – to the next part.

H. Dreyfus's theory (2001) is particularly relevant to a study of the psychosocial risks of exposing students to ICTs. The theory can be summarised as follows: the interactions propitiated by ICTs, especially Internet, reduce pupils' social commitment and negatively affect their learning of skills that enable them to perceive reality and to give it meaning. Dreyfus's arguments seem unassailable; let's look briefly at three of them:

(a) The use of ICTs promotes relativism and epistemological confusion by affording to all information the same value of truth and relevance, given that the hierarchisation of data and the establishment of hyperlinks is free and arbitrary.

(b) The interpersonal skills promoted by ICTs are very limited and insufficient for an appropriate "one-to-one" interaction. In the traditional classroom interaction aspects such as intonation, gesticulation and facial expressions, the physical appearance and body language, clothing, smell, membership of a specific social

group and so on are all signs that confer reliability and credibility on the procedure.

(c) As the direct relationship with objects and events disappears, uncertainty, unpredictability, risk and vulnerability are practically eliminated. Internauts can change their identity or their opinions at will or switch off the computer when they feel even slightly questioned or threatened: the direct consequences, if any, are minimal. In this way fundamental aspects of our physical and social experiences – the vulnerability of the self, the need to take precautions, the need to show respect for, and commitment, to others, the responsibility for one's own actions and the ability to distinguish between what is fundamental and requires effort and what is trivial and can be ignored – break down and vanish.

To these warnings of a general nature we could add several two specific points that emerge from research and reflection in the socio-educational setting[vii]:

➞ Crashing on the Internet: For Umberto Eco, "any excess of information may generate silence" (quoted by Marti, 2003). Indeed, one of the most immediate and evident effects of the web is the difficulty of finding and selecting relevant information; looking for a particular needle in a big bag of needles, says Dreyfus ironically. It is wrong (or naïve) to think that new users, these technological natives with their virtual minds, will spontaneously develop efficient search and selection skills without any need for training simply because that they are in continued contact with computers. In fact all the signs indicate that this "curse of excess", to quote Alfons Cornella[viii] (2004), will increase, as will the difficulties that students have in finding what they are looking for.

➞ *Infoxication*. This neologism, a cross between "information" and "intoxication", draws attention to the difficulty – not to say the impossibility – of establishing the credibility and reliability of a certain piece of information found on the web. With digital technology one can create (in the strict sense, from nowhere, without there being an original sign) "virtual realities" which may be confused with real events, producing what Turkle (1998) termed graphically "the Disneyland effect", in which fiction replaces reality. A purely virtual mind may have great difficulty in discriminating between well-founded opinions and speculation, reliable data and subjective claims, arguments and inventions, and very often between manipulated and impartial reporting. Again, it is vital that this mind should acquire criteria and indicators that can allow it to judge this information on its merits, and to create its own discourse.

➞ The informalisation of education. Marti (2003) and others have reported that students learn increasingly at home in an informal spontaneous way without rules, guidelines or any *voices of authority* that serve to judge the value or point of a particular learning activity. Without guidance of this kind the knowledge acquired is usually partial, superficial, and fragmentary.

➞ Infoautism or technoautism. T. Cantelmi and coworkers (Cantelmi and Giardina, 2002) studied the difficulty certain children have in expressing their emotions and communicating outside the AI environment. Without reaching these extremes, research into computer-mediated communication (see for example the review by Gálvez, 2004) shows that the feeling of anonymity that the environment provides favours disinhibition, the masking of one's own identity and even the habit of *flaming*.

To these undesirable behaviours we should add the paradox described by Wolton (2000): at a time when communication is easier than ever, the difficult thing is to find someone who is ready to listen in an active way; "we are more interested in what we have to say than in what the other person wants to say to us", says the author.

➞ Infopariahs. The expression was coined by Adell (1997) to refer to the groups at high risk of being excluded from ICT environments. In the above section we discussed the new generation who were born in the era of the ICTs and the older generation that has migrated towards AI, but there are other sectors of the population with substantial educational needs who may well find themselves on the wrong side of a "digital gulf" that adds another barrier to their adaptation and development. Inside this risk group are ethnic and linguistic minorities, inhabitants of developing countries (especially women), rural areas, ghettos and marginal sectors of the population, the disabled, and so on. At government level and in teaching centres steps should be taken to overcome these difficulties of access and, as far as possible, to lessen the effect of this kind of technological illiteracy.

➞ Educational infomercantilism. The last danger lies in turning the prolific *e-learning* courses into mere packages information prepared for rapid, unthinking consumption, a kind of "*data fast-food*" which enables students to pass examinations and obtain qualifications quickly and cheaply, without really consolidating the knowledge that they possess. Rather than an interactive being, the student becomes an *interpassive* one (Pérez Tapia (2003) when his or her supposedly free, conscious activity is only reactive and controlled by the people who set the material, the means of access, the language, and so on.

In this context, we cannot speak of the Knowledge Society, nor of learning, nor even of the Information Society. Perhaps the best term would be the *Information Economy*, interested only in the pay-offs to be obtained from the large-scale exploitation of ICTs. These points have all contributed to the revival and consolidation of teaching formats that we thought were actually a thing of the past: relics of behaviourism, based on imitation, repetition, trial and error, *cut & copy*, so widespread in traditional teaching (and so despised), which have now, perhaps surprisingly, acquired a patina of modernity and are praised to the skies by some of the most fashionable proposals in *e-learning*.

These are the risks to which a virtual mind is exposed in cyberspace. How is education, and specifically edumatics[ix], reacting to prevent these risks, or at least to minimise them?

3. What education should we provide students with virtual minds?

In its attempts to meet the challenges outlined in the above section, formal education has (with a few honourable exceptions) swung back and forth – the law of the pendulum – between choosing the easy option of introducing hasty innovations and a paralysing refusal to introduce any change at all.

Numerous educational innovations over the years have put the cart before the horse: that is to say, the techniques and methods – the *hows* – have often been prioritised as the expense of the reason for their existence, the *whys*. Instead of thinking clearly about

how a new technology could contribute to attaining specific educational goals, in many cases the technology was obtained just for the sake of it, and only later was a use found for it – and not always a positive one[x]. In the case of ICTs this situation is permanent and recurrent. A large-scale analysis of the most frequent edumatic practices in schools and of their impact on the significance of the learning of the students would probably yield depressing results. Indeed, a recent report by the OECD (2004) qualified the use of ICTs made in secondary schools in developed countries as disappointing: the majority of computer applications were conventional (according to 47% of teachers), reinforcing the idea that students are educated in the interests of technological progress rather than, for example, with the aim of instilling notions of justice, peace, solidarity and so on.

At the other extreme, educational institutions have often been accused of stagnation, traditionalism and conservatism in facing the challenges posed by the IS and the introduction of ICTs into the syllabus. Indeed, at a great many centres the incorporation is slow, but whether or not this slow pace really reflects inflexibility and stagnation is highly debatable. There is a famous story attributed to S. Papert (quoted by Negroponte, 1999), which is repeated constantly at congresses and seminars: a nineteenth century surgeon transported into a modern operating theatre today would not understand a thing, but a mid-nineteenth century schoolteacher visiting a modern day classroom would understand perfectly what was going on because so little in educational practices has changed. The argument seems slightly misleading to us, since a time traveller from the past would also recognise the love of a parent for their children, the passion of a couple in love or the political or religious convictions that a group of people might have. Spouse, family, religion or politics are lasting social institutions, and if they have endured it is because no better substitutes have been found. However, in the educational setting the argument seems valid. Perhaps the persona of the teacher, the presentation of a voice of authority, face-to-face interactions, cannot be easily substituted: nor is there anything able to substitute them. If this is so, then the resistance of many teachers should be interpreted not as a sign of a reactionary, entrenched position, but as a prudent, responsible attitude that should remind us that the education of the future members of the society is a matter that is too important to be left in the hands of applications that obey the laws of the market rather than genuine educational purposes.

I still believe that any teacher that can be replaced by a computer (or any other mechanical or automated device) should indeed be replaced. Probably, what we should devote our efforts to studying is the one-to-one relationship that make teachers irreplaceable, and the ways that ICTs contribute to the construction of knowledge which is what makes them essential.

On this last point – ICTs as semiotic mediators – authors such as Coll and Marti (2001), Marti (2003), Rodriguez Illera (2004), Badia and Monereo (in press) have stress these important advantages:

- Formalism: interaction with the machine, today, requires the deployment of precise procedures in a particular order, and an ability to use classic semiotic systems such as verbal or mathematical notations.

- Interactivity: There is a direct reciprocity between the actions of the user and the reactions of the computer which, in general, are visible on screen. These reactions, in

addition, can adapt considerably to the nature of the content and to the user's intervention, and can offer help at different stages of a learning or problem-solving process.

- Self-regulation: ICTs facilitate users' control of their actions and decisions by making them visible; users can thus analyse them and share them with others. Here, the computer has a real part to play in the development of metacognitive skills.

- Dynamism: ICTs allow the presentation of information to be changed over time by manipulating some of the variables. In this way, a wealth of simulations can be created with which the user can manage problems similar to those that arise in the real world.

- Multimedia: ICTs favour the recoding of the same information in many representation systems, thus optimising their understanding.

- Hypermedia: ICTs allow simultaneous access to information hidden in texts via non-predictable links.

These six characteristics effectively confer an unprecedented educational potential on ICTs, but, as Marti (2003) reminds us, the mere act of exposing students to a technology does not automatically produce changes in cognitive skills. For changes of this kind to occur, the application must be systematic and should be combined with face-to-face teaching sessions for the objectives that require them. The application should last for a sufficient period of time and should be committed above all to socially negotiated educational goals that answer the questions: What kind of citizens do we aim to create in compulsory education? What kind of professionals in higher education? And what kind of specialists in masters' and doctorate courses? Put another way, what kind of virtual minds should we aim to develop in the educational setting with the aid of computers?

Let's briefly review (with some help from Adell, 1997), the various types of virtual mind that edumatics has sought to promote. We can identify four broad options:
The **aided mind:** closely linked to the idea of digital literacy. This is the position traditionally defined as "learning through computers". The machine aids the mind to automate and simplify tasks, facilitates communication, offers structured information for decision-making, and so on. In Pozo (2003)'s graphic image it favours the development of "informivorous learners", who devour data on the web but remain functionally independent. The computer here is an instrument that facilitates data handling, but is outside the functioning of the cognitive system.

The **expanded mind,** which shares certain cognitive functions with ICTs. Various types of data (addresses, dates, ID, professional notes and so on) are transferred to the artificial memories of computers, electronic diaries, mobile phones, and are permanently accessible to the biological mind. The machine is like a prosthesis, expanding certain functions and thus forming part of the mind itself. This perspective is usually termed "learning with computers", given that it produces a fluid, interdependent cooperation between the mind and the machine.

The **multimedia mind:** a mind transformed by continued use of the virtual environment. A number of the functions of the mind are appropriated; when faced with

a particular learning problem, the mind behaves in the same way as a computer. The repeated and internalised use of, for example, word processing programs or data bases affects the way in which subjects organise the data they perceive and the way in which they mentally produce their texts. Menus of insertion, edition, format and so on become *mindtools* (Jonassen, 1996). But these are also "learners obsessed with representation" (Pozo, 2003), specialists in constructing distinct versions of the same phenomenon or event that they can activate as the context requires.

The **self-referenced or strategic mind**, that is, reflected in other minds via communication systems both *on* and *off-line* (chats, forums), but also via various systems for personalising the functions the computer performs, teaching it the way to find, select, organise, put together or present the information (for example via agents, profiles, protocols, etc.). ICTs take on the role of *alter ego* and can perform a variety of metacognitive functions: as a privileged "psychological laboratory" that allows us to simulate and experience multiple ways of being (identities), of interacting (discourses), learning (strategies); as a reflection of our conceptions and representations, facilitating their redescription and conscious analysis; as a cognitive register, the depositary of the traces and signs which we leave while performing a specific task, and which we can retrieve in order to learn from our errors and thus regulate our future behaviour. So this is a mind able to learn to learn and think via technology: but not from the perspective described above, in which the interfaces tended to become mental language(s), but from a more interpsychological position, in which dialogue with other virtual communities and with oneself, via, obviously, the restrictions imposed by computational syntax[xi], would favour the negotiation of meanings, the acquisition of learning strategies and, eventually, the construction of a more conscious cognitive image, one that is flexible and able to adapt to contextual changes.

Our choices regarding the kind of virtual mind we decide to promote will have a definite impact on the pupils' development, but also, we dare say, for the society that these individuals will contribute to forming. What would a world be like that is dominated by aided, expanded, multimedia or strategic minds? Let's leave this invention for now and consider the question in a way that seems more useful and sensible to us. In the light of the risks lying in wait for the pupils of the twenty-first century that we mentioned in the previous section – the danger that technology will become if not its own reality then the dominant reality – what can we do as educationalists, education theorists and managers? What kind of virtual mind can best resist the dictatorship of technology, and work towards the world that we desire?

In our view, our *self-referenced* or *strategic* mind may be the best placed to adopt a critical, autonomous and adjusted approach to the challenges of a changing society. What do we need then to promote this type of virtual mind? There must be a better option than the typical situation, in which pupils are left to their own devices in front of the computer screen, without any type of guidance to act as a filter or any means to decode the bombardment of information that is received.

Challenging the well known opinion of McLuhan (1998), we think that those of us who belong to the printed culture, those of us who are migrating towards the new world promised us by the ICTs, are in fact ideally placed to teach the new generations "(the way) forward through the rear view mirror". This is so for two reasons:

a) Today's computers are still hybrid tools – crosses between typewriter and television, just as the shape of the first cars closely resembled carriages, and the first aeroplanes resembled birds. Confirmation of the fact that the typewriter and the television are the forerunners of computers is found by just asking why in order to communicate we must type words rather than utter them, or why we need a physical space for our work station or why the interface is visual and presented on a screen. Indeed the uses of the first word processors applied the prior knowledge gained from typewriters to computers, typing out the word *return* at the end of each line of text and thus failing to use one of its automatic functions.

b) In spite of the much-vaunted image culture, by far the greatest part of the material that circulates on the web is based on rather conventional textual structures and is coded in standard systems. Those of us who grew up in the printed cultured have a wide repertoire of procedures for managing, composing and decoding texts and these skills continue to be essential for efficient browsing.

ICTs are eminently social creations, indebted to the conceptions, knowledge, procedures and values of the second half of the twentieth century. Although they mark the start of a revolution at all levels, they are not really a break with the past; in fact they are closely linked to it.

One unfortunate effect of their use may be that these new virtualised minds fail to learn the set of procedures and strategies that lettered minds used to retrieve, understand, analyse, synthesise, interpret, infer and evaluate information. Pupils may develop ICT-aided and expanded minds, but without the acquisition of these resources these minds will be alienated and indoctrinated, at the mercy of ICTs are those who have control over them.

The other extreme seems just as pernicious: to hinder the development of ICTs and their impact on these future virtual minds by reducing *e-learning* programs to "illustrated talking books", demonising and rejecting any technological advances and failing to exploit their audiovisual advantages. Clearly, those of the older generation who did not migrate in time towards the ICTs are unlikely to be able to help younger students in this process of change and adaptation.

Our attempts to help these minds to be strategic and to survive in a world when in fact we are unable to foresee developments in anything but the short term will require quite a sophisticated juggling act. What educational syllabus, what skills are required for students to be able to construct virtual minds that are self-referenced and strategic? No one knows.

What we can do, if we heed the conclusions of thinkers and researchers in the field, is to put forward an agenda of themes and problems that we must deal with and resolve in the years to come. Finding solutions to these problems will enable us to formulate an edumatic proposal with some chance of success. Here are some of the themes that appear to be particularly relevant:

1) Exploring the relative merits of face-to-face and virtual teaching environments and to determine contexts in which one is to be preferred to the other. As we noted above, this is an essential step. In any case, the superiority of blended education over

exclusively classroom or distance learning is becoming widely accepted. Table 2 displays the strong and weak points of the respective environments for specific educational aims:

EDUCATIONAL AIM	CLASSROOM ENVIRONMENT	VIRTUAL ENVIRONMENT
Keeping up with developments in a particular domain	- When part of the information is not digitalised or when the student cannot manage it autonomously. - When face-to-face contact with the speaker has an added value.	When the information is digitalised and is accessible to students
Resolving typical problems	When help must be given personally.	When a generic regulation of the students' activity is required
Changing attitudes	When personal empathy and a direct physical impact are needed.	When a logical analysis of a conflict is considered sufficient.
Evaluating progress	When the group has a low level of autonomy and requires permanent supervision.	When there are technical means available to supervise the learning of the students (e.g. digital portfolios).

Table 2. Uses of the classroom or virtual environments depending on educational aim.

2) Seeking to achieve transfer between classroom and virtual environments. If no specific provision is made, and if the teaching conditions do not demand it, it is unlikely that there will be transfer between the two environments – not even the astonishing visuo-motor skills many students show when playing video-games[xii].
For this transfer to occur we need to use methodologies which can be applied in both scenarios, and which prioritise metacognitive reflection.

3) Foreseeing, accepting (or if appropriate resisting) the disappearance or substitution of forms of knowledge which, according to the title of the book by Simone (2001), we are gradually losing. Indeed ICTs ascribe great importance to conversational interaction, and simultaneous reading is gaining ground over sequential reading; but it would be a risk to claim, as the book does implicitly[xiii], that sequential reading is more complex than simultaneous reading and reinforces a more banal, generic and superficial way of thinking. In fact, the superimposition of codes requires a greater cognitive effort to gather together all the information received and then to understand it.

In the same way, voices as authoritative as the writer Goytisolo (2001) have also expressed their alarm at the decline of verbal culture, and have drawn attention to the danger that correct orthography, or indeed all forms of writing, may disappear: "Just as calculators have made mathematical operations a thing of the past, school children may eventually forget how to write, and spelling will become the sole responsibility of the computer". It is certainly likely that the more algorithmical processes of writing will become the work of the machine, but writing cannot by any means be reduced to spelling or syntax: many literary figures (such as Vargas Llosa in Spanish or Saramago

in Portuguese) frequently break the rules. We believe that what we should guarantee as educators is that our students should be in charge of all tasks that require a human mind – an intelligent mind. Will the society of the future require minds that are simpler, more banal and superficial? It seems unlikely: think of the challenges posed by global terrorism, rampant pollution or global warming, just to mention three topical examples.

4) Promoting the acquisition of a set of essential skills for surviving in the IS. A great deal has been written on the skills and abilities that an educational syllabus should include to prepare the students of the twenty-first century and their virtual minds. It is generally agreed that the following are needed (see table): skills relating to autonomous and strategic learning, cooperative learning, learning of multimedia and multimodal communicative resources, emotional learning, critical learning and on the meaning of one's own life (Gomez Hernández, 2000; Monereo and Pozo, 2001; Monereo, 2003; Monereo, in press). ICTs and the Internet, as we have discussed above, constitute an ideal environment for the development of these areas.

Socio-Cognitive Skills	**Related dimensions**
LEARNING TO LEARN	✓ *Lifelong Learning* ✓ *Autonomous Learning* ✓ *Self-Regulated Learning* ✓ *Lifewide Learning* ✓ *Strategic Learning*
LEARNING TO WORK IN A GROUP	✓ *Cooperative Learning* ✓ *NetLearning* ✓ *Institutional Learning*
LEARNING TO COMMUNICATE	✓ *Disciplinary Language* ✓ *Multimedial Communication* ✓ Priority: semantic aspects
LEARNING TO EMPATHISE	✓ Perspectivism ✓ *Emotional Learning*
LEARNING TO BE CRITICAL	✓ Contrasting opinions ✓ Argumentation
LEARNING TO SET GOALS	✓ *Self-Concept* ✓ *Self-Esteem* ✓ *Self-motivation*

Table 3. Socio-cognitive skills required to face the challenges of the Information Society.

5) Introducing edumatic applications in educational practice, taking into account the fact that every educational context will impose its own intrapsychological, interpsychological, institutional and technological restrictions (Coll and Marti, 2001). The process of constructing a mind, especially a strategic virtual mind, is inseparable from the context in which it takes place and the practices applied to guide learning along the intended path. The support of the entire educational community is not only a *desideratum*, but a *sine qua non*.

Therefore, the decisions taken regarding the design of teaching and learning activities, the teaching methodology and the educational objectives to be met will have an important bearing on the results. For instance, students' performance will vary according to whether they are able to access the Internet from any classroom, from a single specially designated classroom, and/or from their own home. Equally, their performance will depend on how the material is presented: through information provided in text (on paper or in digital form), through presentations by specialists (either *in situ* or via video-conference), problem-solving (in the form of case studies and simulations), the preparation of an individual or joint project (with the aid, for example of a *WebQuest*) and/or discussion (in forums, chats, distribution lists, and so on). And the results will also be different if students are asked to repeat, revise, elaborate on, or transform the material given, or even use it as a basis for their own creation.

These are some of the steps we feel should be prioritised. Winner (1987) opportunely reminds us of the dangers of failing to do so: "While it is true that systems of computation and communications, intelligently structured and wisely applied, might help a society raise its standards of literacy, education, and general knowledgeability, to look to those instruments first while ignoring how to enlighten and invigorate a human mind is pure foolishness."

So, to conclude: we must avoid prioritising technological miracles over educational aims. At all costs, we must be wary of mythinformation – the conviction that the widespread adoption of ICTs will automatically produce more informed, reflective and ethical pupils. Our students and their ever more virtual minds will thank us for our caution.

Bibliography

ADELL, J. (1997). Tendencias en educación en la sociedad de las tecnologías de la información. EDUTEC, num 7. http://www.uib.es/depart/gte/edutec-e/revelec7/revelec7.html.

BADÍA, A. & MONEREO, C. *Aprender a aprender a través de internet*. In Monereo, C. Competencias básicas e Internet. Barcelona: Graó (in press).

Cantelmi, T. and Giardina, G.L. (2002).*La mente virtuale*. Milano: Edizioni San Paolo.

COLL, C. & MARTÍ, E. (2001). La educación escolar ante las nuevas tecnologías de la información y la comunicación. In Coll, C.; Palacios, J. y Marchesi, A. *Desarrollo psicológico y educación*. Vol. 2. Psicología de la educación escolar; 623-652.

COMBA, S. & TOLEDO, E. (2004). Tecnologías digitales: los mundos posibles. En monografía: Corpus Digitalis. Semióticas del mundo digital. *deSignis*, 5; 117- 125.

CORNELLA, A. (2004). Más es menos: la maldición del exceso. *Papeles de Infonomía*, June 2004; 3-7.

DREYFUS, H.L. (2001). *Acerca de Internet*. Barcelona: Ediuoc, 2003.

Gálvez, A. M. (2004). *Posicionamientos y puestas en pantalla. Un análisis de la producción de sociabilidad en los entornos virtuales*. Unpublished doctoral thesis.

GOYTISOLO, J. (2001). El declive de la cultura verbal. *El País* (3 de marzo del 2001, p. 13)

GÓMEZ HERNÁNDEZ, J.A. (2000). *Estrategias y modelos para enseñar a usar la informacioón*. Murcia: editorial KR.

IHDE, D. (2004). *Los cuerpos en la tecnología*. Barcelona: UOC.

JONASSEN, D. H. (1996). *Computers in the classroom*. New Jersey: Merrill Prentice Hall.

LÉVY, P. (1997). *La cibercultura, el segon diluvio?*. Barcelona: Ediuoc-Proa.

LÉVY, P. (1995). *¿Qué es lo virtual?*. Barcelona: Paidós.

MCLUHAN, M. (1998). *The medium and the messenger*, Cambridge, Massachusetts: MIT.

MARTÍ, E. (2003). *Representar el mundo externamente*. Madrid: Antonio Machado Libros.

MARTÍN-BARBERO, J. (1998). Heredando el futuro. Pensar la educación desde la comunicación. *Cultura y Educación*, 9; 7-17.

MONEREO, C. & POZO, J. I. (2001). Tema del mes: Competencias para sobrevivir en el siglo XXI**.** *Cuadernos de Pedagogia*, 298.

MONEREO, C. (2003). Internet y competencias básicas. *Aula de innovación educativa*; 126; 16-20.

MONEREO, C. (Coord.). *Internet y competencias básicas*. Barcelona: Graó (en prensa).

NEGROPONTE, N. (1999). *Ser Digital*. Buenos Aires: Atlántida.

OCDE (2004). *Identifies "Disappointing" Use of ICT in Upper Secondary Schools*. (http://www.oecd.org/document/0,2340,en_2649_34487_26302546_1_1_1_1,00.html).

PÉREZ TAPIAS, J. A. (2003). *Internautas y naúfragos*. Madrid: Trotta.

POZO, J.I. (2003). *Adquisición de conocimiento*. Madrid: Morata.

RODRÍGUEZ ILLERA, J. L. (2004) *El aprendizaje virtual*. Rosario: Homo Sapiens.

SCOLARI, C.A. (2004). Hacer clic. Hacia una semiótica de las interacciones digitales. En monografía: Corpus Digitalis. Semióticas del mundo digital. *deSignis*, 5; 73- 84.

SIMONE, R. (2001). *La Tercera Fase. Formas de saber que estamos perdiendo*. Madrid: Taurus.

TURKLE, S. (1998). *La vida en la pantalla. La construcción de la identidad en la era de internet*. Barcelona: Paidós.

WINNER, L. (1987). *La ballena y el reactor. Una búsqueda de los límites en la era de la alta tecnología*. Barcelona: Gedisa.

WOLTON, D. (2000). *Sobrevivir a Internet*. Gedisa: Barcelona.

[i] The film directed by Andy and Larry Wachowski, in which the brains of human beings are permanently stimulated by electrical signals that generate a virtual world with images and sensations resembling human civilisation.

[ii] Levy (1995, 1997) assimilates this meaning of "virtual" to the metaphor of the *cyborg* (an acronym of cybernetics and organism), where humans and technological objects live at the same level of reality and action and with the same ontological status. Today, via computerised clothing and stereoscopic glasses this situation can be experienced, albeit to a limited extent.

[iii] As Scolari (2004) says, interfaces are never neutral or transparent. They entail restrictions in terms of the norms of use, and more importantly favour particular ways of accessing meaning. In fact, the higher the quality of the interface, the more likely it is to be transparent to our consciousness: for example, the oral or written word, which appear to form an embodied part of our thought.

[iv] As Ihde (2004) says: "illusions can be harmless as long as the spectator recognises the difference between them and real life, provided whoever lives in the real world does not become a fictional character who believes that in fact he "lives" in the virtual reality (p. 35).

[v] "depende, todo depende": the chorus of a song by the Spanish pop group "Jarabe de Palo".

[vi] Of course, the configuration of modern computers corresponds to our predominant metacognitive metaphor: they work in the way that we think that humans think. Presumably a change in the conception of the human mind as a processor would lead to a change in the design in computers as we currently know them.

[vii] Note that here we are in the realm of speculation; furthermore referring to the challenges of the Information Society as if it were an independent entity unconnected with human wishes is of course misleading. The Information Society will be what humanity, or at least an influential part of humanity, decides it should be.

[viii] Cornella refers not only to the excess of points of information, but also the excess of new and more complex functions, which are continually being incorporated in the new versions of programs on the market, and which offer the average user far more options than he or she actually needs.

[ix] Educational applications using automated devices.

[x] Perez Tapia (2003) refers to the absurd unwritten norm in the technological media according to which everything that *can* be done *must* be done. It seems obvious that in education we should only do what has been stipulated by the projects planned and approved by the educational community.

[xi] Presumably this imposition will be less keenly felt when interfaces become more intuitive and closer to colloquial language: for example, when we are able to speak directly to the computer in much the same way as we would with a human interlocutor.

[xii] We are often surprised that the student diagnosed with ADHD due to conduct at school shows high levels of attention and concentration when playing on a computer. This suggests that our cognitive system adapts well to the change of contexts, selecting and prioritising certain behaviours over others.

[xiii] To quote the author: "the effort of reading cannot compete with the ease of looking" (Simone, 2001).