Chapter 2

CONSTRUCTIVE INTERACTION WITH CHANGE

Implications for learners and the environment in which they learn

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Abstract: Reflections regarding changes in the learning landscape and their implications for the (lifelong) learner are placed against the backdrop of an ecological perspective on learning. Learning—individually and as a feature of social behavior—is defined in relation to constructive interaction of complex adaptive systems with their wider environment. Human existence involves more and more that people interact online. Consequently, such interactions have increasingly become a crucial dimension of learning. Adapting to life—and thus also to learning—on the Net poses a certain challenge to those whose major life experience predates the digital era. However, more important than the changes brought about by technological innovation as such are the challenges posed by increased complexity of the world in which we live, the nature and scale of the problems it faces, and the changed nature of our productive and transformative presence in the world. The latter challenges require a fundamental rethinking of the purposes for which we learn, given the complex thinking educated individuals must be capable of. They also call for a strategic reorientation of the processes and environment that afford such learning. Tentative answers will be offered and questions will be raised regarding the implications of the referred challenges for today's learners and the learning ecology in which they operate.

Key words: Learning landscape; learning ecology; lifelong learning; learning - human learning - animal learning - machine learning; learning (definition of); constructive interaction with change; worldview; collaborative reflection; International Board of Standards for Training, Performance and Instruction (ibstpi); Learning Development Institute (LDI); Association for Educational

Communications and Technology (AECT); consciousness - primary consciousness - higher-order consciousness; definition of human learning; Book of Problems dialogues; adaptive behavior (four levels of); complexity (levels of); complex thinking; diversity; transdisciplinarity - transdisciplinary thinking/mindset; disciplinary approaches/perspective; discipline-based knowledge; earth identity; online learner/learning; e-learning; m-learning; instructional design; distance education; emotion/emotional; embodied presence; mentoring/mentor.

1. CONSTRUCTIVE INTERACTION WITH CHANGE—THE REASON WHY WE LEARN

A good student is one who learns to think with his own head.

Italian-born French pianist Aldo Ciccolini in an interview with Radio France on August 16, 2005

Humans distinguish themselves from other animals in their ability to go beyond merely adapting to their environment. They are actively and consciously involved in changing it. The change produced by some is the reason for others to react to such change, either by seeking to accommodate it in their lives or by producing further change. Thus, change has become a permanent feature of the human condition and so has the need to interact with it.

Our interaction with change can range anywhere on a continuum from destructive to constructive. In fact, not infrequently are our actions detrimental to ourselves or others. Nonetheless, it is natural for a species that is able to consciously contemplate the consequences of its actions to always seek behavior that, collectively, is considered constructive. For that to work it must be assumed that, as a species, we are able to entertain a dialogue among ourselves about what is right and wrong and that mutual understanding on ethical issues can be reached at levels that remain relatively uncorrupted by the forces of political and economic power. Considering the complexity and extent of challenges and problems faced by humankind at the current juncture in time, it makes sense for such a dialogue to extend across the planet. We may still be considerably removed from such an ideal state of affairs, however, it would be a mistake if we would not seek to define learning for the world we want, rather than for the world we have.

1.1 So, what is learning?

For a book that explores what learners ought to be equipped with in order to flourish in today's changing learning landscape, I must first address the question 'What is learning?' My initial reflections on what it means to learn are based on personal experience. After all, attributing meaning is a personal matter.

As we transit through life, our perceptions about what it means to be a learning individual, what learning entails and how it impacts people will be marked by our personal experiences. Thanks to our ability to learn we change constantly and often profoundly throughout life. While this happens, the diversity of who we are as human beings and the different, constantly changing, circumstances in which we find ourselves cannot but produce a rich variety of ways in which we attribute meaning to the experience of learning. While any person's personal experience will be singular, it will easily be recognized that the examples that follow are far from extraordinary. Other people's learning life, while different from mine, will be both similar and similarly singular.

I spent a significant portion of my younger years preparing myself to become a physicist, going through formal university training. Having become what I wanted to be according to my boyhood dreams wasn't the end of my learning life, though. For instance, later in life I also learnt to make documentary films and did so entirely on my own through extensive reading and experimenting with 16 mm film equipment. In addition, I familiarized myself with and eventually became proficient in the Spanish language, starting my learning endeavor off by using a self-instructional book with accompanying audio recordings while later on using the real world as an opportunity for practicing my newly acquired skills. Interestingly, when I tried to do the same for Arabic I failed miserably on multiple attempts, whichever method I tried. I had meanwhile become an ardent advocate of self-directed learning, with part of my professional activities being dedicated to the development of distance education in different parts of the world. It wasn't easy, therefore, to admit my failure. It was even more difficult to accept my success when I finally learned Arabic effectively in a traditional face-to-face environment.

From the age of eight onward and throughout my adolescent years, as well as occasionally thereafter, I benefited from individual guidance by people much better than I when I learnt to play the piano and other keyboard instruments, such as the organ and harpsichord. I am still learning, often by trying things out for myself and by carefully listening to the performances by others.

In my late forties and fifties I familiarized myself with the instructional design field. Like in the case of physics, I did so in the formal context of a university environment, but this time only after serious negotiation about how I would use that setting. During that same period, I also learnt to construct complicated musical instruments, such as harpsichords, having acquired basic woodworking and cabinet making skills as a child by watching my father (the same way I learned such things as maintaining and repairing my bike). Other skills I still had to learn by following detailed written guidance or just by inventing them, based on what is perhaps best described as the use of common sense.

Besides the above more obvious instances of learning, I learnt numerous other things, such as overcoming shyness, accepting tragic and irreversible loss, and interacting gently with most of those I meet. None of these things were ever taught to me in any formal way or setting. I had to find out for myself, interacting with those whose advice I chose to accept and whose model I sought to emulate.

Looking back, and comparing my own learning experience as sketched above with the learning histories I got to know of other people, what strikes me most is the fabulous variedness of learning throughout people's lives. Such variedness reflects itself in many different dimensions, such as the purposes for which we learn, the specificity of our diverse motivations, the modality of the learning effort, its duration and the ways in which we seek to become different from who and what we were before the learning took place. While few would doubt that we can often dramatically change, thanks to our ability to learn, it frequently remains a mystery what suddenly seems to flip the switch between being an apprentice and the master of one's abilities.

Besides, it is not a mere matter of acquiring or having new abilities. Such abilities are quite futile if they are not integrated in an emotionally and intellectually meaningful overall perspective, i.e. one's life project or worldview. While I learnt many component skills, such as solving second-order partial differential equations; planing a piece of wood; editing a sequence of film shots; or presenting an argument in written form, those are not the things I feel added real value to my life. Without the more comprehensive perspectives of becoming a theoretical physicist, able to contribute to my field of interest; building musical instruments that I or other people would want to play; producing a documentary movie on an issue I felt passionate about; or being a contributing intellectual, none of the above skills, however competent I might have become at performing them, would have meant much to me.

Thus, my perspective on learning is one that is in the first place determined by awareness of the various comprehensive roles we wish to play in life. We want to be a good parent, a skillful carpenter, an effective

teacher, a creative physicist, or a performing pianist who thinks with his own head rather than imitating someone else's performance.

1.2 A matter of definition

This book continues a process of collaborative reflection that started much earlier, first online and subsequently face-to-face during the 2005 annual convention of the Association for Educational Communications and Technology (Learning Development Institute, 2005). That reflection came in the wake of the initiative of the International Board of Standards for Training, Performance and Instruction (ibstpi, n.d.) to conduct a study of the competencies of successful online learners. In preparation for the above collaborative reflection 32 questions were formulated (Learning Development Institute, 2005). In this chapter I intend to address a small subset of those questions and will start off with one I originated myself, namely 'What does learning actually mean?' In fact, the previous section serves as a prelude to my exploration of that question. While initially formulating the above question and providing a rationale for it, I suggested that a response to it has something to do with one's perception of what it means to be human. So, I start from there.

My view of what it means to be human is a down-to-earth materialistic one. I see members of the human species as nothing more, but also nothing less, than pieces of organized matter-energy—just the same as rocks, plants, and other animals. What makes them special and somehow unique is the fact that, in the course of evolution, humans became endowed with sufficiently high levels of consciousness to allow them to reflect on their actions, to hold things in mind and contemplate them, carrying out thought experiments, and to foresee, to an extent, the consequences of what they intend to do. What exactly consciousness is; to what extent some form of it might be present in other species or be an exclusive feature of humans; what allowed it to emerge; and what the neuronal correlates are of consciousness are questions regarding which only recently some tentative insights have started to develop (e.g., Edelman and Tononi, 2000; Carter, 2002; Greenfield, 2002; Edelman, 2004; Koch, 2004; Koch 2005; Steinberg, 2005).

While consciousness is not exclusive to humans, the particular level to which it evolved probably is. Edelman (2004), for instance, distinguishes between primary consciousness and higher-order consciousness, the latter having been made possible by neuronal development that eventually led to "the acquisition of semantic capability, and finally language, [which] gave rise to higher-order consciousness in certain higher primates, including our hominine ancestors (and arguably a number of other ape species)" (p. 58). It is this higher-order consciousness that confers, according to Edelman, "the

ability to imagine the future, explicitly recall the past, and to be conscious of being conscious" (pp. 58-59).

Consciousness allows us to experience joy and sorrow as we transit through life. It is the cause of the eternal amazement with which we stand, generation after generation, in awe of who we are, where we came from, what we are here for, and where we are going. It is at the origin of our sense of belonging, of being part of a larger whole, an experience to which we give expression in religious beliefs; mythologies; evolving worldviews based on the methodical and disciplined pursuit of scientific insight; and great works of art. Within the above perspective, being human means having the unique faculty of participating consciously—for a brief moment—in the evolution of the universe. The latter affirmation, I hasten to add, is both an outrageous claim and a call to humility.

If one accepts the above vision of what it means to be human, then learning must be conceived of in a similarly broad perspective of purposeful interaction with a constantly changing environment to which we must adapt while being ourselves the conscious participants in creating the change. 'Constructive interaction with change' thus ought to feature prominently in a definition of human learning at this level, expressing what learning is ultimately all about. Besides, it should be recognized that not only individual human beings partake in such constructive conscious interaction with change, but that this same behavior equally applies to social entities at a variety of levels of complex organization of which humans are part.

Moreover, learning as conceived in this perspective is intimately interwoven with life itself. It is therefore not something one engages in merely from time to time, but rather a lifelong disposition, one that is characterized by openness towards dialogue. Hence, I define human learning as the "disposition of human beings, and of the social entities to which they pertain, to engage in continuous dialogue with the human, social, biological and physical environment, so as to generate intelligent behavior to interact constructively with change" (J. Visser, 2001, p. 453). When I first proposed this definition, I used the term 'undefinition' for it, referring to its intended purpose to remove the boundaries from around the existing, too narrowly conceived definitions of learning. I still think there is a great need to look at learning from a broader perspective than we habitually do and find others thinking likewise, such as the authors who contributed to the special issue of *Educational Technology* on broadening the definition of learning (Y. L. Visser, Rowland, & J. Visser, 2002) and the transdisciplinary group of researchers who participated in the two *Book of Problems* dialogues at the 2002 and 2003 annual conferences of the Association for Educational Communications and Technology (Learning Development Institute, 2004; J. Visser & M. Visser, 2003; J. Visser, M. Visser, & Burnett, 2004).

However, I also recognize that in daily discourse the word 'learning' is used in a great many ways, each of which relates to only aspects of what is implied in the above definition. The next section therefore identifies different levels of human adaptive behavior, each of them having something to do with the reasons why we learn and the different kinds of learning we engage in.

1.3 Four levels of adaptive behavior

Human adaptive behavior, and thus the learning associated with it, occurs at least at the following four levels of organizational complexity, some of which we share with other organisms (J. Visser, 2002, November, n.p.):

Level 1: Interaction with threats and opportunities in the environment through genetically transmitted preprogrammed responses, e.g., fight and flight responses.

Level 2: Acquisition of essential environment-specific abilities, such as mastery of the mother tongue, driven by an inherited predisposition to do so.

Level 3: Deliberate acquisition of specific skills, knowledge, habits and propensities, motivated by individual choices or societal expectations, usually by exposing oneself to a purposely designed instructional—or self-instructional—process.

Level 4: The development and maintenance of a lifelong disposition to dialogue with one's environment for the purpose of constructively interacting with change in that environment.

It can be argued (J. Visser, 2002, November) that the above four levels of learning-related adaptive behavior in humans "represent a progression of increasingly higher levels of consciousness about one's role in life and in the world" (n.p.). Besides, "the four levels are not entirely distinct from each other" (n.p.). In fact, they often interact. Moreover, while the levels of adaptive behavior correspond to a hierarchy of increased consciousness about one's existence, the learning associated with these levels does not necessarily represent a similar hierarchy. Take the acquisition of skills such as 'to represent graphically the relationship between two variables' or 'to repair a punctured tire.' These are associated with Level 3 adaptive behavior. On the other hand, the procedures to acquire the skills in question are relatively simple and thus low level. A competent instructional designer will be able to explain the processes involved, sketching them out on the back of

an envelope. In contrast, educational communication professionals, particularly those involved in helping humans to avoid, for example, health risks associated with their reproductive behavior (Level 1), are still searching for answers to the question how to intervene and promote effective learning in this vastly complex area, which involves attitudes and values, as well as related cognitive and motor skills and the ability to moderate emotion (e.g., Patel & Yoskowitz, 2005, May).

The comprehensive definition of learning provided in Section 1.2 above is of interest particularly if one wishes to contemplate learning from a perspective that includes the fourth level of adaptive behavior. It applies at the most comprehensive level of being human, the level at which we are most distinctively different from anything else that learns, such as non-human animals or machines. It goes beyond the narrower definitions that underlie most learning theories, starting with Hilgard's (1948) definition, which states that "learning is the process by which activity originates or is changed through training procedures…as distinguished from changes by factors not attributable to training" (p. 4), a definition that, according to De Vaney and Butler (1996), who cite it, has been particularly influential on the thinking of the behavioral school. More recent definitions no longer describe learning as the sole consequence of training or instruction. Driscoll (2000), analyzing different learning theories, concludes that current definitional assumptions about learning, in addition to referring to learning as "a persisting change in human performance or performance potential," specify as the cause of such persisting change "the learner's experience and interaction with the world" (p. 11).

Not everyone is happy with a comprehensive definition like the one referred to in the previous section. In the first place, such a broad definition is difficult to use in the operational context of intentionally designed instruction. Besides, it may be seen to stress the obvious. See for a brief polemic on the latter issue the exchange between Chadwick (2002) and J. Visser & Y. L. Visser (2003). Discomfort with more comprehensive definitions of learning probably arises from the fact that most common definitions of human learning contemplate adaptive behavior at Level 3, the level that most education professionals have been prepared to deal with to the exclusion of other levels. There is nothing wrong, at least not in principle, with focusing on a particular level and thus delineating learning more restrictively than is done in my earlier cited comprehensive definition as long as one is aware to be dealing with a particular segment or aspect of the rich reality of human learning. Jonassen (2002), for instance, uses a definition of learning referred to in connection with another question raised in this dialogue (De la Teja, Question 23, p. xx in this volume), which focuses on learning as a "willful, intentional, active, conscious, constructive

and socially mediated practice" (p. 45). While this definition stresses a number of undoubtedly important aspects of learning at Level 3, it excludes for instance the vast area of incidental learning associated with Level 4. However important a particular segment or aspect of learning may be at a practical level of intentional intervention in changing human performance capability to serve accepted societal goals—which in today's world is usually related to the interests of the prevailing economic model—by closing one's eyes to human functioning at a higher level of adaptive behavior one is at risk of developing human beings who increasingly lose the capacity to intervene in ever more complex situations at a time when the major problems the world faces are exactly situated at such higher levels of complexity.

In view of the above rationale, I thus argue that, at whatever level we interact with the development of human learning, we should always do so within the perspective of the highest level of complexity within which we expect people to be able to operate. Against the backdrop of that argument it is sad to observe how increasingly formal education, up to the highest level, is being dealt with as if it were a mere commodity (see for arguments defending this position Daniel, 2002, and Daniel, 2003, and for opposing arguments Jain et al., 2003).

2. A CHANGING LEARNING LANDSCAPE

Now that I have explained on the previous pages what I mean by learning, I shall attempt to clarify next what I see as the major characteristics of the current learning landscape, as contrasted with the challenges and opportunities learners of past generations were facing. I highlight two areas, namely (1) the changed nature of change and (2) the changed nature of the problems, challenges and opportunities we face. The latter area reflects the reality of a world which cannot be fully understood if we are unable or unwilling to engage in complex thinking processes.

2.1 Changed change

Humans, as adaptive organisms, have of course changed extremely little over long periods of time, periods that cover many generations. Whatever changes there may have been, evolutionary processes are too slow for such changes to become noticeable within timeframes of the order of magnitude of a couple of generations. Conversely, the world in which humans live has undergone dramatic changes over the last one to two generations, changes that are much more dramatic than ever before. The process is ongoing and is

expected to become even more spectacular (Spohrer, 2003, October). The major changes have to do with the phenomenon of change itself. Change has changed.

In the past, the rate of change was slow enough for each generation to prepare itself during the initial phase of its existence for the circumstances into which it was born. Those circumstances could be expected to prevail without much alteration throughout the lifespan. Thus, members of a particular generation were able to spend the rest of their lives living with what they had learned while they were young, being able to deal with most situations. Moreover, older generations still alive were perceived as storehouses of acquired wisdom that members of younger generations could access and validly apply in their own lives. That time has gone and it has gone forever.

By contrast, the world of the 21st century is characterized by change that is often perceived as turbulent and having a high level of unpredictability. The current and future generations will have to live with such unpredictability. This requires a high level of insight in and control over one's own capacity to learn, to an increased extent at Level 4 referred to earlier in this chapter, and to do so in a lifelong perspective. Learning to learn, in a conscious way, should therefore be a prime concern, starting from the time infants are being raised and continuing throughout life.

The wisdom of the elders is undoubtedly still to be treasured, but it will only remain a valid resource in the context of intergenerational dialogue as long as third and fourth age citizens retain the capacity to reframe, rethink and redefine their acquired insights in ever changing circumstances and younger people have the capacity and entertain the predisposition to incorporate such invaluable knowledge into their current reality. Furthermore, the possibility for such older citizens to share their wisdom and to make it interact with the learning of members of the younger generations may well be conditioned by their ability to use the technologies of the day and their associated symbol systems, which are a natural part of the world of the young, but with which older people often only become familiar with considerable difficulty, requiring them to learn as well.

2.2 Changed problems, challenges and opportunities

Another way in which the learning landscape has become crucially different from what it looked like before has to do with a shift in emphasis regarding the purposes for which we learn. Put differently, it has to do with the nature of the problems, challenges and opportunities the world faces and the responsibilities we assume as actors in a problematized environment. Here I see the following key challenges:

- Complexity rather than linearity.
- Uncertainty, chance and ambiguity rather than relative certainty.
- Interconnectedness that challenges the ways in which we care for our creative diversity.
- Science and technology challenging our perceptions of what it means to be human.
- Power of potentially serious destructive intervention perpetrated increasingly at the level of individuals and relatively small groups.

The above challenges are best appreciated against the backdrop of our evolutionary history. Most recent estimates put the age of the universe at 13.7 billion years (WMAP, 2005). Recent findings suggest that some form of life was present on earth at least 3.43 billion years ago (Allwood, Walter, Kamber, Marshall, & Burch, 2006; Awramik, 2006). Hominid development is supposed to have started between five and ten million years ago (Institute of Human Origin, 2001) whereas human development may have started somewhere between 100 to 200 thousand years ago (Templeton, A.R., 2002).

For ease of comprehension, let us compress the timescale to seven days and let us pretend that the universe came into being at the start of the first day. Then early forms of life would have started to emerge on the sixth day. Hominid development would have started just about five minutes ago and human development a mere six seconds ago. Less than half a second ago on the chosen time scale (in reality 10,000 years) the so-called agricultural revolution took place, replacing the haphazard practice of hunting and food gathering by the sedentary practice of growing crops and raising livestock in an increasingly organized and planned manner, allowing food to be produced in excess of what was needed so that it could be preserved and stored for later use. This took away an important self-regulatory mechanism that had so far kept the world's human population at a more or less stable level—believed to have been eight million people—determined by the immediate availability of nature's resources in particular habitats. In fact, it replaced nature's control of humans by human control over nature and marked the start of a continual process of innovation building upon innovation, as each new innovation is usually at the origin of a new set of challenges and opportunities, calling for further intervention. It turned us into a species that actively and consciously uses its capacity to create knowledge for the purpose of changing the world in which it lives, riding on the waves of innovation by creating new innovations.

The consequences in that short time span of 10,000 years—less than half a second on our metaphorical seven-day time scale—have been stupendous. For instance, for millions of years the population size of our evolutionary ancestors had remained more or less stable at a level that nature could

support. As the practice of agriculture abolished the self-regulatory constraint on population growth imposed by nature, we started to grow, little by little in the beginning, with ups and downs caused by the onslaught of and recovery from episodes of endemic diseases, but growth became increasingly more rapid the larger the population size and the better health, sanitary and nutritional conditions became. Thus, in 1960, after several million years of hominid development, the world population stood at three billion. It took no more than 40 years for it to double to six billion just before the end of the last century. Such startling expansion could not have taken place had it not been accompanied by ever more rapid technological development that could mitigate the problems created by too many people having to share only limited resources. The process led to fierce competition for available resources and thus the development of warfare and defense technology; it also led to the more beneficial processes of development of technologies through which additional or alternative resources could be accessed and already available ones could be used more efficiently.

Tremendous amounts of resources and effort continue to be expended until today on means to exert power over one another by force. This has escalated to such an extent that, according to Robert Nelson of the Union of Concerned Scientists in a discussion about the Reliable Replacement Warheads program (Science Friday, 2006), half a billion people can be killed in the first 30 minutes of a thermo-nuclear war using the currently existing nuclear capability of the US. The inability of the world, despite the tremendous efforts undertaken at the level of the United Nations system, to harmonize our scientific and technological capability with our political prowess to create a better and more just world is eloquently expressed in the title (and content) of a recent book, *Space-age science and stone-age politics* (Avery, 2005).

The above is but one of the many complex challenges facing today's world. There are many other challenges of a similarly complex nature. They are often intertwined with one another, further increasing the complexity of the problem space in which 21st century humans operate. They have to do with such questions as how to feed the nine billion people that are expected to populate the earth by the year 2050; how to care for and preserve our cultural and linguistic diversity in a world of all-encompassing open communication networks in which there is a risk of asphyxiation of weak cultures by dominant ones; how to use the resources available on the planet in a perspective of sustainable interaction with the environment; how to create a world in which living together in harmony is not under constant threat of the tensions caused by blatantly visible disparity in wealth and power; how to redefine what it means to be human in a world of scientific and technological development that increasingly allows humans to interfere

with their very humanness; or how to ensure that humans around the globe behave so as to minimize the risk of pandemics, HIV and AIDS being a case in point.

In all the above cases there is an essential need to develop thinking that transcends the traditional disciplinary approaches. In other words, dealing with these issues requires a transdisciplinary mindset. Both the current structure of available educational offerings and related student attitudes are generally not conducive to developing the kind of deep and comprehensive insight that preconditions transdisciplinary thinking. There is little difference in this regard between the various levels at which the educational system operates, be they primary, secondary or tertiary. Marshall (2006) speaks in this connection of "an unbalanced learning environment [in which] the need for a deeper context of schooling is imperative" (p. 6). The school teaches separate content areas, or 'subjects,' often administered by different people, subject specialists, who are not seen to collaboratively serve a purpose greater than they themselves and their specific discipline. It leaves to the learner the task of bringing the parts together, creating meaning out of what is being taught, and to seek and discover the connections, building a whole that is more than the separate parts and that eventually encompasses the learners themselves, individually and socially. But the learner is already emotionally disengaged and rarely accomplishes what is assumed to happen. The reason is a simple and obvious one. Marshall asserts concisely the issue at stake when she explains that "learning occurs when meaning is constructed and…meaning is constructed when emotions are engaged and conceptual relationships and patterns are discerned and connected" (p. 7).

The underlying assumptions of how we learn and teach in school date back to the seventeenth century when Descartes introduced the principle of separation of what belonged to the mind (*res cogitans*) and what belonged to nature (*res extensa*), the assumption being that subjectivity is at odds with the serious pursuit of knowledge and that only the objectively verifiable counts. There is no doubt that the development of science as such has greatly benefited from applying Descartes' teachings, but it has at the same time detached those who know from what they know and led to sciences that are disconnected from the cultures to which they belong. Good scientists, of course, know better and they have always violated the principle as necessary, allowing science to move forward in a stepwise fashion. Bronowski (1978) calls it "a self-correcting activity" (p. 122) and explains:

> Science is an attempt to represent the known world as a closed system with a perfect formalism. Scientific discovery is a constant maverick process of breaking out at the ends of the system and opening it up again and then hastily closing it after you have done your particular piece of work (p. 108).

Morin (2005) takes up the theme of complex thinking eloquently and comprehensively in a small compilation volume of his extensive work called, modestly, *Introduction à la pensée complexe* (Introduction to complex thinking). In his foreword he argues that the case for complex thinking cannot be made in a simplistic manner. The argument is in and of itself complex and must culminate in exercising thought capable of dealing with the real world, of entering into dialogue and negotiation with it. Such complex thought incorporates, according to Morin, as much as possible of the historically developed processes of reductive thought (pensée simplifiante), but refuses the mutilating consequences of a simplification "that sees itself as the representation of what real there is in reality" (p. 11 - my translation).

Elsewhere, Morin (1999) draws specific lessons for what should be considered key issues for education for the future. True to his argument referred to in the previous paragraph, he calls these lessons 'complex lessons.' I include this 66-page document by Morin among the 'resources for further exploration' at the end of this chapter and encourage my readers to delve into these complex lessons, which are available online. Here I limit myself to a simple itemized listing of the main issues dealt with by Morin. Following is a paraphrased representation of the description that Morin outlines himself in the foreword to his complex lessons. Each of the bullet headings is a direct quote from Morin's referenced work. The rest is my own words and interpretation as well as commentary, except for the parts in quotation marks and referenced as such. I note that Morin's focus is on teaching; mine in this chapter is on learning and the role of the learner. My reformulation of Morin's ideas reflects my specific focus and vision.

- *Detecting error and illusion*
  Under this heading, Morin alerts to the fact that the school focuses on knowledge but generally fails in letting the learner discover what knowledge is, denying the knower the privilege of knowing what it means to know; to be aware of the often fragile underpinnings of what we think we know; to be armed against misconception, error and illusion.
- *Principles of pertinent knowledge*
  The question raised here relates to the habit of schools to confront learners with compartmentalized knowledge while failing to provide them with the opportunity to connect the parts among themselves and combine them into a whole that is more than the simple sum of the parts. Knowledge becomes pertinent by placing it in context. Doing so is the task of the learner—not that of the teacher, but it is the teacher's task to ensure that the opportunity exists as well as to help the learner prepare her or his mind to always seek the "mutual relations and reciprocal influences between parts and the whole in a complex world" (p. 2).

- *Teaching the human condition*
  From our perspective as human beings (and what other perspective could we possibly have?), our humanness in all its multifaceted ways (biological, physical, social, cultural, etc.), seen as an integral component of the larger environment of which we are part, is the basis for our human presence and intervention in the world. Rediscovering what it means to be human, getting to see the "indissoluble connection between the unity and the diversity of all that is human" (p. 2), is the formidable challenge the learner faces when presented with the thoroughly disintegrated discipline-based knowledge that habitually characterizes what we still call education.
- *Earth identity*
  This idea relates strongly to the points I made earlier in this section. Many of the problems, challenges and opportunities we face are of a planetary nature. It is no exaggeration to state that the future of our species is crucially dependent on how we relate to our earth identity. Thus, the way we learn and what we learn should take our planetary identity into account. Morin argues that therefore "the history of the planetary era should be taught from its beginnings in the 16th century, when communication was established between all five continents" (p. 2). I see no reason why this should be limited to the last five centuries. There has been significant cultural interaction among the peoples of the earth for much longer and major ideas that emerged thousands of years ago in one place continue to impact today's planetary population across the globe.
- *Confronting uncertainties*
  Under this heading, Morin quotes the Greek poet Euripides as saying, 25 centuries ago: "The expected doesn't occur and [the gods] open the door for the unexpected" (p. 3 in Morin's text). He goes on to say that these lines are "more than ever relevant" (p. 3) today. Indeed, as I have argued above, change is no longer what it used to be and one of the key capabilities that citizens of the 21st century must possess is the ability to interact constructively with ambiguity, chance and unpredictability. Contrary to that conclusion, and as a consequence of how in the educational context knowledge tends to be presented as a series of separate areas of sure facts and procedures, learners continue to be faced with the challenge of figuring out how to "navigate on a sea of uncertainties, sailing in and around islands of certainty" (p. 3) and to discover how, in fact, the various disciplines they become familiar with are often far less focused on certainty than they appear or are presented to be.
- *Understanding each other*

It has long been known that it is generally better to first listen to each other, attempting to see the world as it is seen through other people's eyes, before taking action that might harm others and ourselves. The time at which I am writing these words, however, shows no shortage of serious violations of this principle. Such violations have become particularly dangerous as we live in times when the power to exercise significantly destructive action is not limited to states but is equally a weapon of coercion in the hands of individuals and small groups, such as terrorist cells. The problem is exacerbated by the pervasiveness of communication infrastructure that is able to show what happens in one part of the world almost instantaneously to everyone else on the globe. In a world of immense disparity and heightened levels of violence this cannot but create profound frustration and difficult to manage anxiety among individuals and governments. Thus, profound change of attitudes is of the essence. Or, as Morin argues, "Mutual understanding among human beings, whether near or far, is henceforth a vital necessity to carry human relations past the barbarian stage of misunderstanding" (p. 3). I have argued elsewhere (J. Visser, 2007) that "increased networking around the globe is an important condition for the formation of dynamic learning communities that are sufficiently global in outlook to become a basis for learning to live together (Delors et al., 1996) with the global concerns of our time" (p. 643). Not only is 'understanding each other' a key requirement for our time; it so happens that technological developments during the last two decades have made it easier for learners to find opportunities across cultural and geopolitical boundaries to practice the concept and give it personal meaning.

- *Ethics for the human genre*
  Morin observes correctly that ethics is not the product of lessons taught. Ethics takes shape in the mind as one becomes more and more aware of one's identity, both individually and as a member of communities, the society, and the human species. Moreover, such elucidation of who one is and what meaning one wishes to attribute to one's life also leads to a sense of belonging, to finding one's place in the universe, a spiritual awareness that may find expression in religious experience, artistic creation and metaphysical perception. Thus, Morin asserts that "all truly human development must include joint development of individual autonomy, community participation, and awareness of belonging to the human species" (p. 3, 4). Ethics is both personal and communal/societal. This has important implications for what ought to be done in preparing auspicious conditions for value clarification from an educational point of view. However, whether such conditions are in place or not, it remains a key challenge to the learner to always seek to participate in relevant

contexts that allow for the development of a sense of individual, societal and species-related identity. A complicating factor in this regard continues to be the disintegrated way in which the world appears to learners in the perspective offered by most institution-based efforts at educating them. As long as schools do not attend to this problem, the burden is on learners to reconstitute the world from the pieces offered to them and to develop their sense of self, and of being good earth citizens, while interacting with other learning human beings who similarly engage in such efforts. The world of online learning is perhaps among the most propitious environments allowing important inroads to be made into this area of concern.

Having said the above, and while I recognize that the 'online learning space' is a relevant and important dimension of today's learning landscape, I shall argue below that I consider the notion 'online learner' an irrelevant and unhelpful concept—as do, for instance, Van Merriënboer and Stoyanov in their contribution to this volume (pp. xx-xx). The online learning space is there in addition to the various other spaces in which people learn. The online learning space may at times be the dominant dimension of the environment in which one learns; at times it may be complementary or supplementary, or a merely rudimentary dimension of the learning space. The fact that it is there, and that the tools through which it exists represent a certain level of technological sophistication, requires of today's learners to be conversant with those tools and their various uses. Some of those uses may be culture sensitive, which adds a further challenge, considering that the online learning space is not restricted to a single culture.

3. LEARNING ON THE NET

Rumors about the superior usefulness of the Internet and its potential impact on learning are generally greatly exaggerated. Such exaggeration has led to a deformation of the perspective on the importance of technology for learning and the raising of expectations that are hardly ever met (e.g., Salomon, 2002). Those who make claims about the superior impact of technology often compare bad education via traditional means with the application of more enlightened principles of facilitating learning using technological means, tacitly assuming that the same level of enlightenment would not be possible in a technology-poor environment. I do not agree with such an assumption, which I view as uninformed and often based on limited imagination. Good thinking, good learning and good education can take place in almost any circumstance as long as the actors involved in the processes concerned are properly inclined and possess some basic

competencies, the ability to listen being one of them. I contend that being passionate about what one teaches or learns is immensely more important than whatever technology. In fact, it remains an interesting question waiting to be researched to what extent technologization of the learning environment might adversely impact actors' disposition to develop passion about the matters at hand. The reportedly extraordinary abilities of Richard Feynman—a physicist whose passion for his subject is well documented—to teach to captivated audiences using no more than chalkboard and chalk, lends support to my contention (Sykes, 1994).

The problem of overemphasizing the importance of technology is furthermore exacerbated by the advertising practice of a commercial sector that does not miss an opportunity to induce into a naïve public the belief that there is a positive correlation between having the right gear and mundane measures of achievement practiced by the school system, such as making the grade. Defining technology *per se* as a factor of influence distorts visions of how pedagogy should be improved. Or, as Fishman (2006) argues: "Technology employed for 'business as usual' leads to the usual outcomes. You don't create improvements in teaching or learning by introducing technology; you create improvements in teaching and learning by improving teaching and learning!" (p. 2). Consequently, the challenges to learners and to those who help them learn generally have to do with issues that are unrelated to technology.

3.1 Is there such a thing as an online learner?

During the online dialogue and workshop that preceded the writing of this book, I raised the question "Is the online learner a distinct subspecies among the wider species of learners in general?" (J. Visser, Question 1, p. xx in this volume). The underlying thoughts that accompanied my question, particularly the reference to Dreyfus's (2001) claim that the online environment is incapable of accommodating "emotional, involved, embodied human beings" (p. 48) in ways that allow those who learn to reach proficiency and expertise, triggered off another question, namely "What really is embodied learning, and how does it affect the effectiveness of instructional modalities?" (Y. L. Visser, Question 29, p. xx in this volume). Stirling (see pp. xx and xx in this volume) draws attention in Questions 4, 5 and 6 to the expectations created in learners due to their participation in online learning environments, features of which, and the ways in which those features are being used, affect the learners. In Question 8, Spector (p. xx in this volume) also refers to learner expectations, suggesting that "many expect more in terms of improved learning from an online course than a face-to-face course." I doubt whether this is indeed the case, but agree with

both Stirling and Spector that it is reasonable to assume that the environment in which one learns creates expectations—perhaps not only in the learners, but also in those who facilitate the learning—that are determined, at least in part, by the characteristics of that environment. Van Merriënboer suggests (Question 10, p. xx in this volume) that the entire concept 'online' may just be too broad to usefully generate specific research questions. This suggestion, on the one hand, underlines that the environment is a likely factor (or set of factors) of influence, but, on the other hand, it also points to the need to become more specific in describing the various defining characteristics of learning environments. I would argue that, by extension of the same argument, such a differentiated approach in referring to the learning environment is similarly relevant in the case of online, face-to-face and hybrid learning settings.

Nonetheless, the online learning environment has its own specificities. For instance, it is able to facilitate kinds of learning, such as through global collaboration and online gaming (LaPointe's Questions 14 and 15, pp. xx and xx in this volume) and allows kinds of learner behavior, such as 'invisible' and anonymous participation (Beaudoin's Questions 16-18 and Y. L. Visser's Question 26, pp. xx-xx and xx in this volume, respectively) that are far less likely to occur in traditional settings. Besides, there are technical possibilities in the online environment that potentially allow new learning spaces to be opened up (see e.g. Bransford's Question 22, p. xx in this volume) that may less easily come to mind to learners whose sole perspective is that of the face-to-face context. On the other hand, Rogoza's Question 30 (p. xx in this volume) highlights the fact that, whatever the potentiality of the online environment, the reality often remains below what is potentially possible. Besides, as suggested by Question 26 (Y. L. Visser, p. xx in this volume), this same environment may be responsible for generating in students a number of unintended and undesired behaviors that detract from reaching online learning's full potential.

When in the 15th century the printing press was invented and print materials came into wide use among the general public, the appearance of that particular technology did not result in the emergence of p-learning and p-learners. When Jan Amos Comenius published his Orbis Sensualium Pictus in 1658, calling attention, by doing so, to the importance of appealing to learners' senses by including illustrations in instructional text rather than capitalizing on learners' ability to process verbal information, it didn't result in isolating i-learning as a particular kind of learning, nor did the advent of instructional radio lead to r-learning or that of instructional use of TV to t-learning. Against the backdrop of a centuries old history of the use of media in education, there seems little logic in the current tendency to reserve a special place for such things as e-learning and m-learning for those

instructional practices that involve the use of electronic communication via computer networking and handheld mobile devices, respectively.

The beauty of learners is that they are, well . . . learners. They come to the world hardwired to explore their environment (Gopnik, Meltzoff, & Kuhl, 1999). They create their own path through life while moving along, together with their fellow learners. Faced with different opportunities in which particular modalities—such as face-to-face instruction or education at a distance via a variety of media—may be dominantly available, good learners—those who have not bought into the idea that there is only one way in which to learn—will find their way not just by exploring the initially chosen option but equally by accessing multiple additional opportunities beyond the given one. They escape from domestication and become feral (see also Hall's contribution to this book). Defining someone as an e-learner or distance learner, even within the framework of a particular instructional context, is tantamount to discouraging such a person from engaging in wider explorations and failing to recognize the enormous wealth there is in learning when left to determine its own path.

Thinking back of the learning experience I know best, my own, I'm pretty confident that I would never have learnt Arabic had I stuck to the idea that I should meet this challenge through self-instruction; I would not have become a competent musical instrument builder had I limited myself to merely following the guidelines of the harpsichord building manual that I had at my disposal and had I not sought further advice from other builders and craftsmen and experimented with several techniques of my own invention; I would not have deepened my understanding of physics had I not supplemented an already excellent university program with weekly discussions and work sessions with a fellow student and friend who had similar interests and had I not explored what was on offer at other universities in related fields; and, finally, my personality would have remained underdeveloped had I not been able to find my ways in the school of life and become increasingly better at feeling comfortable with who I am and at ease with the limitations of my being.

Obviously, one shouldn't generalize from the above (biased) sample-of-one. However, I would not have brought up my personal experience had it not been largely convergent with the findings of an analysis of the stories of the lifetime learning experience of hundreds of people from around the world (Y. L. Visser, J. Visser, 2000, October; J. Visser, Y. L. Visser, Amirault, Genge, & Miller, 2002, April; M. Visser, & J. Visser, 2003), covering a spectrum ranging from academics in Europe and the USA of different ages to illiterate Aymara farmers in rural Bolivia. That research, which started accidentally at another annual convention of the Association for Educational Communications and Technology (J. Visser, Berg, Burnett,

& Y. L. Visser, 2000, February), shows a similar propensity in those whose learning stories were collected to situate themselves as learners in environments that include a wide choice of learning spaces beyond those formally designed for specific instructional purposes. The learning human being wanders among those various spaces and should be encouraged to do so. Part of the work that schools could usefully undertake would be to make their students aware of and conversant with that wide range of learning spaces to which they potentially have access.

It will be clear from the above that my answer to the question whether online learners should be considered a subspecies among learners in general is a clear NO. 'Online learner' is at best an unhelpful concept. As said, its use could encourage learners to adopt too narrow a mindset in considering their options.

3.2 There are no online learners, but learners do go online and they do so increasingly often

Some learners spend most of their learning time offline and will occasionally complement their learning effort through online explorations. Other learners may, in a particular context, primarily be driven by instructional events afforded to them online, but they will undertake additional offline explorations as well. Yet others will have opted initially for a hybrid learning environment, including both online and offline experiences, but they would still venture beyond what is given to them, offline as well as online. The crux is that intelligent learners, whatever their initial entry point into a particular learning effort, will continue to look around them, driven by their natural curiosity, to further enrich their learning experience both online and offline in any way they consider useful through all means at their disposal. I recognize that the above point of view clashes with some of the original core assumptions of the instructional design field. I am equally aware, though, that, over time, the field has become more open to alternative views that attribute greater importance to the autonomous role played by the learner. Such an alternative perspective is relevant and important considering that change in human behavior is not merely a goal in the context of predetermined social or economic processes—such as to serve corporate interests—but may often relate to human needs and desires in much more complex, non-linear ways, based on the long-term intricate interrelatedness of individual, communal and societal interests.

Dreyfus (2001) argues that learning by means of instruction develops according to the following seven stages: (1) novice; (2) advanced beginner; (3) competence; (4) proficiency; (5) expertise; (6) mastery; and (7) practical wisdom. He reasons that only the first three stages can adequately develop in

the distance education mode. According to Dreyfus, reaching proficiency and expertise require "emotional, involved, embodied human beings" (p. 48), something that he fears the online environment is incapable of accommodating. Moreover, apprenticeship, which is necessary for the last two stages, calls for the physical presence of experts of flesh and blood.

I find Dreyfus's (2001) seven-stage analysis of the learning-through-instruction process relevant and useful. I also agree with him that emotional embodied involvement on the part of both learners and those who help them learn is crucial in the instructional context, particularly if the learning effort is directed at reaching more than mere competence. However, Dreyfus's conclusion that such emotional, involved and embodied presence is impossible in the distance education mode only holds if it is assumed that the various actors involved in what starts off as a distance education effort don't move beyond their starting point. If, however, as I argued earlier in this section, those same actors—who are all learners in the true sense of the word, whether their formal role in the educational process qualifies them as such or as instructors or facilitators—continue their explorations beyond the conditions of their starting point, Dreyfus would be wrong. Then competent learners (and other actors in the learning environment) will always find opportunities in their wider environment to create such embodied presence to the extent that they find useful to them. This requires a kind of 'learning intelligence' that involves entrepreneurship; creativity; the ability to communicate personal goals and negotiate conditions to reach them; and the autonomous capacity to monitor one's interactions with the world. In the wider context it requires 'mentorship' in the true sense of the word to be reinvented.

The term "mentor" derives from ancient Greek mythology. The story can be found in Homer's Odyssey. Mentor was the trusted friend of Odysseus and the tutor of his son Telemachus. We are told in the Odyssey[1] that the goddess Athena, the daughter of Zeus, on several occasions, appeared in the form of Mentor to give advice to Telemachus and Odysseus. The term "mentor" has since become synonymous of the kind of personal relationship that typically seeks to benefit the person who is being mentored. The beauty of Homer's account is, of course, that it tells us that you don't have to be Mentor himself to perform his functions. One can assume the shape of Mentor, as Athena did.

In essence, mentoring is a role that can be seen to represent one of the best sides of human nature, the disposition to dedicate oneself to the well-being of another person. I believe, based on personal experience, that the proliferation of online communication has created propitious and unique

[1] The full text is available at http://ibiblio.org/gutenberg/etext02/dyssy11b.txt.

conditions for people around the globe to reconsider their options to serve as mentor for others and to benefit from mentoring.

4. CONCLUDING THOUGHTS

I started this chapter off by arguing that there are good reasons to look at learning from the perspective of the various comprehensive roles we wish to play in life rather than that of the acquisition of neatly specified isolated competencies or well-separated areas into which the various known disciplines have organized—and disaggregated—knowledge. Subsequently, I discussed that learning can be associated with adaptive behavior and that in humans one can distinguish adaptive behavior at four different levels of organizational complexity. I then dwelt in some length on the importance of defining learning in ways concomitant with the levels of adaptive behavior in relation to which we learn, defending that those who create the conditions for learning should always have in mind that humans ought to be able to function at the highest level possible. This led to the conclusion that learning is best conceived of in a broad perspective of purposeful interaction with an environment to whose constant change we must adapt while being ourselves the conscious participants in creating such change. Consequently I restated, with reference to earlier work, a definition of learning capable of representing such a broad perspective on learning and applicable to both individuals and social entities at different levels of complex organization.

In the next section I explored the fundamental changes that have taken place in the learning landscape, posing new challenges to the learner. Two areas were identified: (1) the changed nature of change and (2) the changed problems, challenges and opportunities humans face at the start of the 21st century. I also argued that technology is not among the determining features of the changing learning landscape. If indeed the changed nature of change and the changed problems, challenges and opportunities of our time lead to a fundamental reform of the kind of learning we engage in, then technological innovation will follow in its wake, rather than the other way around. What is needed in the first place is a profound rethinking of the key assumptions that underlie our vision of education. Based on Morin's (1999; 2005) work, I emphasized the need to focus on fostering complex thinking and cited seven key areas of concern defined by Morin to inspire much needed reform. I annotated these areas, focusing on their implications for the new roles expected of learners.

In the final section I discussed the online space as one of many spaces in which people learn and argued that defining learners as 'e-learners,' 'online learners,' or 'learners at a distance' does not do justice to the ingenuity of

most learners in exploring multiple learning spaces rather than just one. I thus argued that the concept 'online learner' is an unhelpful concept and that it is better to do away with it while recognizing that learners—in de broad sense of the word and whatever their entry point into the complex learning landscape—do go online, occasionally or frequently. Recognizing that such is the case, the question can be asked in what areas learners should be competent to take full advantage of the multiple learning spaces to which they have or can create access in today's learning landscape. I leave the question with the reader (see also Section 7 of this chapter), but wish to offer the following bullet points as prompts for further thinking.

Today's learners should be competent in at least the following areas:

- Mastery of foreign languages.
- Participation in or interaction with diverse cultural and social settings.
- Negotiation of one's learning niche within the prevailing learning ecology.
- Ability to listen.
- Ability to question.
- Ability to transcend the boundaries of disciplines, to look for linkages and to critically interact with change.
- Aptitude to interact affectively with other actors in the learning landscape.

Besides the learners, there are obvious implications as well associated with the above listing of learner competence areas for those who are responsible for creating a propitious learning environment, including teachers. However, the emphasis in my chapter is on the learner and not the teacher.

I finally wish to remark that the analysis provided in this chapter of the challenges that condition today's learning landscape contrasts sharply with how I perceive the current reality of academic life, both as regards students and faculty. The former are increasingly driven by pressure to obtain certificates, diplomas and degrees that give them access to jobs that may have little to do with what they actually learned in order to obtain those tokens; the latter live under the pressure of complying with the exigencies of an increasingly complex university bureaucracy, including the various formalities related to the ritual of tenurization. Within that context, education is more and more considered a commodity, a perspective that puts educators in the same category as other retailers, such as grocers. The fact that the commodity can now be traded online has exacerbated the situation. I believe this to be a dangerous development.

5. RESOURCES FOR FURTHER EXPLORATION

- The best resource for further exploration of the ideas expressed in this chapter is you yourself. The next best resource is the people in your environment with whom you maintain close enough a relationship to share your more profound experiences with them. Writing down your personal learning history (as I have done, to an extent, in this chapter) and discussing it with friends can often provide deep insight into the multifaceted meaning of learning and the factors that foster it.

- One of the books I have found most enlightening on the subject of human learning, ever since it first came out in 1999, is *How people learn: Brain, mind, experience and school* (Bransford, Brown, & Cocking, 1999). The book is more than worth its money for having it on your shelf, but it can also be explored online at http://www.nap.edu/html/howpeople1/. The same year that *how people learn* came out another interesting book, *The scientist in the crib: Minds, brains, and how children learn* by Gopnik, Meltzoff, & Kuhl (1999), also saw the light. It is an equally delightful read, one that reminds its readers of the tremendous opportunities in the life of the developing human organism nurture its capacities to learn.

- Film director Majid Majidi's movie *Children of Heaven* (available on DVD) portrays eloquently how multiple learning spaces complement, compete and interact with each other in facilitating human growth. Watching the movie, particularly when done together, provides countless opportunities for reflection, individually and collaboratively, about the meaning of learning in different situations. While the setting and circumstances depicted in the movie may be far removed from those that readers of this chapter may be familiar with, readers will have no difficulty identifying with the experiences often movingly rendered by the actors and actresses, prompting recollection of one's own experiences and the desire to recount them to others.

- The idea that one needs a teacher in order to learn was part and parcel of the traditional conception of education. It no longer is. Enhanced learner autonomy and modes of education that reduce the role of the teacher or that put the teacher at a greater distance from the learner have contributed to dethroning the teacher in favor of focusing on the centrality of the learner. However, the ease with which the hypothesis of the essential role of the teacher is sometimes discarded may require more serious review. To fully appreciate the teacher-student relationship at its best one must watch the interactions between two of the great pianists of our time,

Daniel Barenboim and Lang Lang in a masterclass conducted by the former. At the time of writing, excerpts of it can be found on YouTube. The complete masterclass is included in a six-DVD set with the title *Barenboim on Beethoven: The complete piano sonatas*.

- Finally, anyone interested in finding out what learning really is can best explore the idea by simply practicing it in a conscious way. Readers currently enrolled in a course or program should take the opportunity to reflect on their own learning as it happens and the circumstances that surround it. Those not formally enrolled find no shortage of learning opportunities—for free or for pay—by exploring the Internet. Broadcasters such as TVO, CBC, BBC, and NPR offer podcasts or vodcasts of weekly, annual or occasional lectures or lecture series on diverse topics as well as general interest programs, such as Science Friday, online or on CD or DVD. Universities and some major journals, e.g. Nature, do likewise. Besides there are large repositories of resources that support educators and students at various levels of formal education, such as the National Repository of Online Courses and the European Gateway to Science Education, XPLORA. A Web search for any of the keywords in this paragraph will reveal countless learning opportunities. Branching out in other directions will reveal even more. You've never had it so good.

6. QUESTIONS FOR COMPREHENSION AND APPLICATION

1. The author argues in this chapter that the ability to master any or more of the traditional disciplines is as such insufficient for citizens of the 21st century to interact constructively with today's problems, challenges and opportunities. He offers various examples. Identify and discuss one or more issues, other than the ones mentioned in this chapter, that require thinking processes that cannot be limited to disciplinary approaches and that must thus benefit from a transdisciplinary perspective.

2. The author offers at the end of the chapter a short itemized list of areas in which today's learners should be competent to be effective learners. (i) Based on your reading of the chapter, what are some other areas of learner competence that you should like to add to this list? (ii) Discuss how the areas of learner competence identified by the author and those you wish to add yourself relate to the rationale presented in this chapter.

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