Innovation:

Scientific Necessity and Artistic Choice

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The history of humankind is dramatically marked by the invention and adoption of innovations. Innovation has allowed the human species to bring about crucial change in the conditions of its own existence and development. It remains a matter of continued reflection whether such change should be seen as good or bad, or rather, where along the continuum between good and bad the mark of its impact should be drawn.

Against the backdrop of the amazing reality that somewhere in the universe, at some point in time, human life started to develop, the question may be asked if it really matters at all what we, humans, do. After all, the solar system to which our planet belongs is but a peripheral event in the galaxy of which it is a part and that galaxy, in turn, is but a tiny little corner of the universe. Are we not totally insignificant? Perhaps we are. Yet, I believe the question to be relevant.

We have reached a stage at which it is clear, as Edgar Morin (2002) points out, that “planetary humanity is mortal” (p. 81). He also notes that humanity, as a planetary phenomenon, is mortal exactly because our civilization has produced the means of destruction that have made it mortal. In other words, while we do not know if anything like human life exists, may have existed or may perhaps at any time exist elsewhere in the universe, we have become innovative enough to be able to put an end to that same

form of life if we so choose. I submit that decisions that may lead to or lead away from our self-annihilation ultimately depend on our capacity to reflect on ourselves, on our actions, and on our place in the universe, a capacity that remains, unfortunately, underdeveloped. The state in which large segments of our educational systems find themselves may, at least in part, be held responsible for such underdevelopment of the mind. Allow me therefore to observe on the occasion of the inauguration of the "Cátedras de Innovación Educativa" that this important program should attend in a parallel fashion to both *innovation for education* and *education for innovation*. We must both be able to develop the innovations through which we can make education better *and* develop the kind of education that allows us to better live with innovation, particularly to take care of our innovative behavior wisely.

The prehistory of innovation

Everett Rogers (1995) defines innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption." One such a new idea was the introduction of the planned practice of agriculture some 10 000 years ago, thereby replacing the much more haphazard practice of hunting for and gathering of food. It is estimated that at the time when this happened about eight million people populated the earth. The effect of this first major innovation 10 000 years ago can be seen right now. Let's have a look at the numbers and what caused them to change.

The introduction of agriculture made it possible for people not only to obtain food more efficiently but also to produce food in excess of what they really needed for the satisfaction of their immediate needs, allowing them to store it for later use. This took away an important self-regulating mechanism that kept the world's human population at a more or less stable level determined by the immediate availability of nature's resources, basically in the same way in which the population size of other animals is kept to a reasonable proportion. If there are too many animals for the available food, a larger number of them will not get enough food and die. The invention

of agriculture disrupted that equilibrium for humans, resulting in a gradual uncontrolled increase of the world population, which remained unnoticed for a long time. However, as, according to Newman (no date; see Figure 1) the growth rate was *more than exponential*[1], it was unavoidable that the situation would, at one time, become explosive. Thus, it took only 8000 years – really not a very long time if one considers that hominids have been present on earth for several million years – for the world population to grow to an estimated quarter of a billion by the beginning of the Christian era and then to find itself doubled by the year 1600 when it had reached a total of half a billion. After that it took only two hundred years to double again. So there were one billion people around the year 1800. The number grew threefold in the next century and a half, reaching three billion by 1960. And then it took only four decades to double and reach the six billion mark. Newman calculates that "our ability to feed everyone using our current farming techniques under ideal conditions will end around 2020."

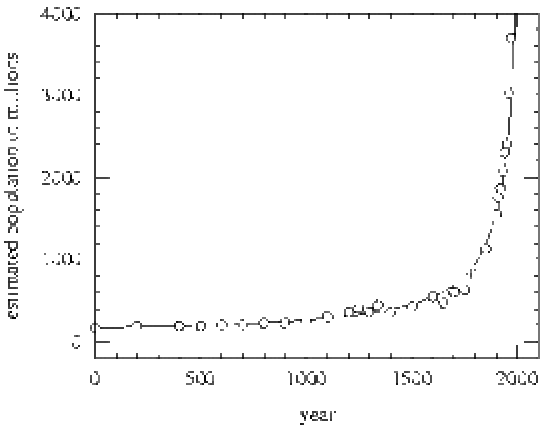

Figure 1: The more than exponential rate of growth of the world population (Source: Newman, no date)

Once an innovator always an innovator

The above reference to today's consequences of one of the earliest known instances of human innovative behavior may look frightening. However, it should also be realized that we wouldn't be who we are if we had developed differently. The same trajectory of innovative behavior has made it possible for humans to free themselves of the chores of looking after their basic needs, thereby creating for themselves the

[1] Newman notes: "Contrary to popular belief, the population of the world is not growing exponentially. It's growing a great deal faster than exponentially."

conditions for the development of things like music, art, science, religion, and humor, or, in other words, to make it possible for them to enjoy life rather than to just live it.

Clearly, every innovation – and the example of agriculture given above is a powerful illustration – is potentially both a source of happiness and a cause of problems. A source of happiness because, when the new idea, practice or object is perceived as good, it will be adopted to solve one or more existing problems. At the same time, it is also bound to upset existing equilibria, thereby causing new problems. Those new problems call for the next generation of innovations to be developed whose adoption will generate the next set of problems that call for yet more innovations. And so it goes on. Having started on an innovative course, we can't leave it anymore. Innovation is what characterizes us as a species. By nature of our being we have to live with it. That being the case, we better ask ourselves, "How do we best live with innovation." The kind of universities we create and operate, and what we do within them, has, in my view, much to do with answering that question.

To adopt or not to adopt, that is the question. Or is it?

The definition of innovation put forward by Rogers (1995), which I referred to earlier, posits that perceived newness of an idea, practice or object is at the core of generating innovative behavior. From the perspective of traditional diffusion of innovations research, the implicit assumption has always been that anything that is new is there to be adopted and diffused within a community of users. Thus, the terminology that characterizes the groups that are slow or fast at adopting clearly reflects favorably on the latter and unflatteringly on the former category. The possibility of conscious refusal to adopt is not being seriously entertained.

For the purpose of our discussion here, I propose that we take a more cautious stance. As our knowledge and our abilities to transform knowledge into tools and action advance and new things appear all the time, we essentially face, on a continual basis, a spectrum of options ranging between the extremes of adopting and not adopting a

particular innovation, rather than just the either-or choice between adoption and rejection. Usually this means that we have to deal with questions regarding the scale at which something should be adopted and, more importantly perhaps, how best to integrate what we adopt with what we already have and with all manner of other new things that at the same time come within sight.

I make the above remark against the backdrop of the existing trend to think of educational innovation primarily in terms of the mere adoption of particular new technological tools and facilities, such as computers and Internet-enabled communication, or the introduction of new modalities of interaction among learners and their teachers, such as in the context of so-called virtual learning environments, often accompanied by the total negation of valuable practice attained through the tried and tested use of previous technologies. This particular tendency may leave us with no more than only the *appearance* of innovation without anything fundamental having changed.

We innovate because we know more

Well, our perception of something as new has, of course, everything to do with the state of our knowledge and our power to imagine. Something is new to the extent that it is at dissonance with what we already know and what we think to be possible. Something new becomes a candidate for adoption when we are able to imagine its possible uses. But not everything that gets adopted contributes to human well-being. An innovation becomes a useful contribution to the well-being of humankind not simply because it was possible to imagine a possible use for it and thus to adopt it, but when its adoption was conceived of in the framework of a larger conception of what the future world should look like. Because my future world is also someone else's future world, the *social construction* of visions about our shared future world is thus an essential condition, requiring that imagination be at work both at the individual and at the social level. These latter considerations, concerning the world we aspire to, raise questions about what is good and what is bad, as well as questions about what is beautiful and

what is ugly, in other words, they lead to the raising of ethical and aesthetical questions. The former considerations, on the other hand, have to do with the state of our knowledge and how knowledge evolves; in other words, they pertain to the realm of science.

Science moves forward in a stepwise fashion. Jacob 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)

Every time the system of scientific knowledge regenerates itself as a consequence of that maverick process, we start viewing the world in a different light and a host of options presents itself. That is why I refer in the title of my intervention to innovation as a scientific necessity. As our knowledge changes we are compelled to change our behavior, correcting what we did wrong in the past and exploring opportunities we didn't have before. So, that is the scientific part, the knowledge part, of what I am saying in the title. We can't be stupid and not follow through on the new knowledge we create. New knowledge propels us forward.

On the other hand, new knowledge doesn't simply dictate *how* we should move forward. There are usually a great many ways in which we can follow through on our ever-expanding capabilities. So, that's where another human faculty comes in, the ability to be artful, to be imaginative, to make choices.

Not by science alone

Somewhere in our not so distant history, artful and scientific behavior became separated. I believe it is important to once again make the connection between the two. Art and science, imagination and knowledge, belong together, not just in the minds of

scientists and artists, but in the minds of human beings in general. Science and art are the two sides of the same coin.

Today's global culture, which carries a strong imprint of the mechanisms that govern the market and thus attributes a high priority to the principle of profit making, sends out strong messages to do away, on a continual basis, with what is old and to replace it by ever newer products. A simplistic logic is proposed to consumers worldwide, namely that new is good and old is bad. One sees this simplistic logic at work particularly in the area of the development and commercialization of technological products. Consequently, many people see the adoption of new technological tools as the most important aspect of innovative behavior. This naive view is unfortunate. Innovation is not a matter of slavishly following the dictate of the "new is better" maxim, it is not merely about unimaginatively responding to new discoveries and new knowledge. For innovation to benefit the larger goals of human well-being on a scale that transcends the immediate and eventually touches upon the interests of humanity as a planetary species, a more comprehensive level of imagination and creative behavior is required. Bronowski (1978), whom I quoted earlier, refers to the kind of personality that displays such a level of creativity as "one that looks on the world as fit for change and on himself as an instrument for change" (p. 123). There is thus a clear connection in Bronowski's vision of creativity and imagination between the individual and the world at large.

The dual relationship between education and innovation

I have mentioned earlier that I see it as important for a program such as the "Cátedras de Innovación Educativa" to be concerned with the relationship between education and innovation in two directions. On the one hand, it is necessary to develop innovations through which we can ensure that education will better serve the goals of developing human learning to its fullest extent possible. On the other hand, one of the areas in which human learning, and thus education, requires the greatest improvement is in preparing human beings to better cope with their own ingenuity, in other words to

better live with their innovativeness, to help them to be innovative while serving the best interests of humanity, both at large and in the long run.

Beyond the appearance of innovation

One of the *appearances* of innovation that is most visible in the world of education of today is the introduction of an impressive variety of technological tools, mostly having to do with computers and computer networking. The phenomenon goes hand-in-hand with the spread of new forms of distance education, frequently referred to as virtual education and e-learning. Traditionally, distance education used to be based on the distribution by mail of bulky print as well as recorded audio and video materials, sometimes complemented by the use of radio and TV broadcast, telephone and fax. Such mechanisms are now being replaced by the integrated use of digital technologies, often referred to as ICTs (Information and Communication Technologies) or NICTs (New Information and Communication Technologies).

There is little doubt that the capabilities of the new ICTs are unsurpassed when compared to yesterday's "new media," a term that has been used time and again to refer the emerging technologies of a particular period (see e.g. UNESCO: International Institute for Educational Planning, 1967a & 1967b). The digitization of information, in combination with the advances made in computer networking and the invention of hypertext markup language, has allowed vast amounts of information to be available to people around the globe. It has also greatly increased the speed, ease and economy with which information can be transmitted. More importantly still, the digitization of information also has great advantages from a pedagogical point of view, particularly as digitally available information can be converted by the user – i.e. the instructor or the student – into such varied formats as text, graphics, audio or video. It can thus be made to interact in the most effective way possible with users whose expectations, past experiences, and learning styles are all different. But does it make a real difference?

De Castell, Bryson and Jenson (2002) call it a “potent irony” that educators, “confronting a range of enormously powerful, radically transformative digital tools...have sought to render their and their students’ encounters with and uses of these transformative tools (a) familiar and (b) comfortable,” thus failing to explore new uses of new means. When applying new technologies, the tendency often is to take the traditional form of classroom-based education as the model and then recreate the same situation with new means, without critically reviewing the shortcomings of the original model and consequently getting beyond them, making the next step forward. We thus end up with notions like the virtual classroom and virtual school that try to replicate as closely as possible the earlier models of face-to-face education with which people feel familiar and comfortable.

Simonson (1999) calls for strategies that provide “different but equivalent learning experiences” (p. 29) to learners in face-to-face classes and in online classrooms. This so-called equivalency theory, while recognizing the differences in instructional contexts between the two modalities concerned, may do little to promote a fundamental rethinking of what goes on inside the learning space, whether virtual or real, the implicit assumption being that the face-to-face classroom is the norm and that equivalency rather than improvement should be sought. As we contemplate such new modalities as e-learning, we often seem to forget that the most important part of that term is contained in the last eight letters of it, the prefix “e” being quite irrelevant.

To get beyond the mere appearance of innovation, pertinent questions must be asked about what it means to be learning in the circumstances of the 21st century, a period in human history that is indeed quite different from the previous century. As we are getting new tools to work with, we should take the opportunity to reinvent what we are doing instead of replicating it. Ways must be found to employ our awesome technological capability to discover how we can encourage people to develop mind, rather than to continue age-old patterns of knowledge transmission by some and knowledge acquisition by others.

Mind and competence

Innovation is a process driven by questions. What are currently the important questions? In the second part of my lecture I want to contemplate a number of areas where I believe our attention should be focused to provide useful direction to our innovative behavior in areas that pertain to human learning. Of course, the practice of education is part and parcel of that concern. Education represents how, together, we care for each other's learning.

Universities play an important role in the context of how we care for each other's learning. In the first place they are themselves centers for the development of learning for those who are part of their respective learning communities. By this I mean both students and faculty as well as all of those among the supporting staff who actually see themselves as taking part in the development of learning in the academy, including – quite explicitly also – their own learning. This may actually equally apply to the janitor, the secretary, the student, and the professor. To the extent that universities don't lock themselves up in an ivory tower, they also play an important role in how humans care for each other's learning in a much wider sense, namely by providing leadership and guidance to what happens in a wide array of other situations in which people learn, such as in the school system, the media, or the family.

Considering what I just said, I am grateful to the University of Guadalajara for giving me the opportunity to speak to an audience of academics involved in diverse areas of higher education development in the State of Jalisco, and perhaps elsewhere in Mexico, particularly as the occasion of my talk marks the inauguration of an important program destined to stimulate educational innovation. As I implied earlier, the kind of universities we create and operate, and what we do within them, will ultimately determine how well we are able to live with human ingenuity. I therefore start of by raising questions about the connection between mind and competence.

I use the term competence as referring to our ability to perform particular tasks. Those tasks can be intellectual tasks or motor behaviors, and they may also involve attitudinal dimensions of overall disposition to make specific choices in appropriate circumstances (I am using here Robert Gagné's [1985] terminology). Mind, on the other hand, has to do with our ability to act consciously within the context of the accumulated and critically appreciated experience of humanity's development. It integrates our actions within the perspective of that ongoing development, building the bridge between the past and the future.

According to the Encyclopaedia Britannica (1999) there are three fundamental assumptions that underlie the concept of mind: thought or thinking; knowledge or knowing; and purpose or intention. The word mind goes back to the Anglo-Saxon "gemynd," which means memory. I should like to point out here that of late, due to the pervasive use of the word memory in the context of computer terminology, the meaning of the word memory is at risk of shifting towards that of a passive device used for the storage of information. For the purpose of our discussion of the concept of "mind," the word "memory" should be interpreted in an active sense, related to our capacity to will. Of course, storing information is one of the things we do, but we do much more while being mindful: we give information meaning, intentionality. Thus, a close relationship develops between our ways of knowing and our way of being in the world.

Those of us who are involved in the development of curricula and courses or who are concerned with the design of instruction often put great emphasis on ensuring that learners attain well defined competencies. Such emphasis is based on the assumption that complex human behavior can be broken down in component behaviors and that the successful autonomous execution of all component behaviors, as well as the composite behavior made up of the various component behaviors, is the desired endpoint of a well-designed instructional intervention or educational event. The behaviors in question, to which the specific competencies relate, are frequently narrowly defined in terms of people's usefulness for particular jobs.

There is indeed much practical as well as research evidence that shows the value and effectiveness of the systematic analysis of the conditions that allow people to acquire such specific competencies as I just mentioned. However, the resounding success of systematic instructional design has also resulted in under attention to aspects of human behavior that can be less well expressed in terms of measurable competencies. Such aspects are nonetheless crucially important in a world in which it is increasingly necessary for individuals and organizations, not only to be competent, but also to be able to judge the potential consequences of their actions and take responsibility for how they use their competencies. I am referring here to the conscious adoption by individuals or organizations of an 'overall way of being in the world' while they engage in one or more of life's individual or organizational pursuits.

Such a consciously adopted 'overall way of being in the world' is what I earlier referred to as 'mind.' The development of mind includes the development of competencies but is not restricted to it. What I am trying to say is that specific competencies should be developed as part of the wider concern to develop mind. This requires instructional designers and curriculum planners to balance specific instructional factors with non-instructional ones. The latter kind of factors can be seen to operate in the larger environment in which a particular instructional system or educational experience is embedded.

Some of the kinds of mind that could form the overall setting within which particular learning behavior takes shape are the scientific mind, the poetic mind, the entrepreneurial mind and the spiritual mind. These different minds or mindsets are not disjunct. Rather, they overlap. By way of example I could mention that, at the Learning Development Institute (LDI), we have started attending to mindsets as the overriding framework for the development of competencies, focusing initially on the scientific mind.[2] The scientific mind comprises such dimensions as the spirit of inquiry; the power of imagination; the spirit of collaboration; the quest for beauty; the desire to understand

[2] The Scientific Mind (TSM) is one of four focus areas for research and development in LDI.

and to do so profoundly; the aspiration to create; the courage to be critical (including the preparedness to appreciate other people's critique); the will to transcend existing boundaries; the spirit of building on prior knowledge; the search for unity; and the spirit of construction.

The important point to remember is that, while we create new ways to develop human learning, we must work towards a better balance between mind and competence, mind having priority over competencies, but both being equally essential, in the sense that one can't do without the other. The mind can't work properly without basic competencies being in place, but putting competencies in place without at the same time developing an overall mindset means putting humanity at risk of engineering its own demise.

Ethics and aesthetics

In what I just said, I have dwelled extensively on the importance of the development of mind. The following observations are closely related to the idea that attention to our overall way of being in the world, and how we relate to its past and future, should have precedence over the concern with specific competencies. Ethics and aesthetics deal with such very basic questions as what is good and what is bad as well as what is beautiful and what is ugly. Being able to raise these questions in one's mind is of great importance for any decision making that impacts on what the future world will look like, even if such decisions concern seemingly small things.

The two areas of concern are deliberately taken together here. In doing so I won't hide from you that I take as a starting point my own feelings, rather than what I happen to know of the more formal intellectual pursuits of philosophical inquiry into aesthetics and ethics. Considering that my evolutionary make-up is probably not dramatically different from yours, I assume that you have feelings too and that you may want to agree, based on your own feelings, that our sense of what is good and bad has something to do with what we find beautiful or ugly. I, for instance, think that life is

something incredibly beautiful and I am fascinated by our ability as humans to contemplate our own being alive, to be conscious, painfully and joyfully conscious, of the temporal nature of our life. It leads me to have reverence for life, to treat it with the utmost respect and to be horrified when I see that some of my fellow human beings act contrary to what I see as a very basic principle.

Similarly, I find great beauty in the diversity within and among things. Consider olive trees in the wild. They are all olive trees, yet they are all different and it would be an offense to my sense of beauty of they were not. Or take people of different cultural backgrounds who find themselves in the same territory, the same city, as a consequence of regional and global economic forces, political processes, or simply because of migratory movements occasioned by the exploitation of one group of human beings by another group of human beings. They confront the choice of hating each other or loving each other, or doing a bit of both. Their appreciation of the beauty of diversity will largely determine what they adopt as a rule of thumb for good and bad behavior towards each other.

As I reveal to you a glimpse of my personal way of looking at the world, I know that some of you will agree with what you think I am trying to imply and others will disagree. That again is a good thing – and mind you that I am making an ethical statement here – because it calls for dialogue. As the nature of the issues and problems we face in the world and the scale at which they confront us change over time, there can be no easy answer to the questions about what is good an bad, and what is beautiful and ugly. As humanity evolves – now more and more as a planetary species – our ethical and aesthetic notions will always be a matter of continual dialogue.

Dialogue is a strong antidote against intolerance, against the impoverishment of the mind that results from interpreting ethics as a set of given rules for making simplistic choices in a world that is forcefully divided according to the practice of binary thinking (Nicolescu, 2002) in either good or bad, not accepting the ambiguity that “there is evil in good but also good in evil” (Morin, 2002, p. 82).

As we continually question the human condition and the condition of the world in which we live, the need for dialogue can hardly be overemphasized. Innovation in the environment in which we learn, new ways of promoting and facilitating learning, must thus take a serious look at the development not just of dialogue, but of the *capacity for dialogue*. This is not a matter of adding yet another discipline to an already crowded curriculum. Rather, the concern with ethics and aesthetics should be a transdisciplinary concern, one that finds its expression in what we do in and across each of the various areas of disciplinary pursuit the academy is concerned with.

The importance of problems

As a rare exception in the animal kingdom, primates have developed the capacity to solve problems. The capacity is modestly developed in non-human primates and much research remains to be done to get clarity about whether mental states play a role in generating problem-solving behavior in nonhuman primates, similar to how this is assumed to happen in humans (see e.g. Heyes, 1997). Recent research (Bower, 2002) holds our "common capacity for solving a broad range of problems, from coordinating social alliances to inventing tools" (p. 166) responsible for the "progressively larger brains evolved in primates of all stripes, not just humans" (p. 166).

Against the backdrop of the latter statement, it is surprising that this unique capacity, the high level of development of which is so characteristic for the human species, receives so relatively little attention in mainstream educational practice. An exception is the experience accumulated in various medical schools to use problem-based learning as a core strategy (see e.g. Albanese & Mitchell, 1993; Vernon & Blake, 1993). Jonassen (1997) notes that major "taxonomies of learning and instructional design models do not even acknowledge...[problem solving] as a learning outcome" (p. 65). This can probably be seen as both a consequence of the lack of attention given to problem-solving in the practice of education and as a cause for the perpetuation of that same lack of attention.

Nickerson (1994) has pointed to several of the reasons why the ability to engage in effective and purposeful problem solving is critical to the development of individuals and their communities. In order of increasing specificity, Nickerson argues that problem solving is: (1) at the core of the survival of individuals and communities interacting with an increasingly complex external environment; (2) essential to developing and sustaining a democratic society; and (3) an increasingly sought-after high-level cognitive ability in the knowledge workplace of today.

If anything is to change in educational practice, then here is an obvious area of work for those who are willing to engage in educational innovation. Unlike other animals, humans are poorly prepared biologically to adapt to their natural environment. The capacity to problematize and transform their environment is crucial for human beings (Visser, J. & Visser, Y. L., 2002). It allows them to produce change that benefits them as well as those close to them. Such change, however, may also affect, positively or negatively, others – and other life forms. Mastering the art of problematization and understanding its implications, also from a moral perspective, should therefore be seen as of key importance for those who grow up in the twenty-first century. New generations should come well prepared for a world in which many major issues they will confront during their life cannot be foreseen at the time they go to school.

Wisdom and the wise university

Thinking about what it means to be wise has a long history. Robinson (1990) offers a selective overview of how wisdom has been perceived and why it was being pursued throughout the ages. Wisdom is generally seen as distinct from merely being highly knowledgeable or skillful. In fact, this idea goes back to Plato, who recognizes, in Robinson's words, that "wise men *(daimones)* may be illiterate, and the utterly unwise may be adept and accomplished" (p. 14). To be wise is "to be a certain kind of person, temperamentally and morally won over to a love of harmony, beauty, and truth" (p. 15). Wisdom, according to Socratic philosophy, is to be found in contemplation and the

pursuit of truth *(sophia)*, in practical reasoning *(phronesis)*, and in the knowledge of the nature of things and how their behavior is governed by particular principles *(episteme)*. These historically developed notions of wisdom are not entirely disjunct from what I earlier referred to as a consciously adopted "overall way of being in the world."

The scope of my lecture does not allow me to go into the depth of detail a subject of such enormous import as wisdom deserves. The best I can do is to refer you to a magnificent source of reading on the matter, namely the book "Wisdom: Its nature, origins, and development," edited by Robert J. Sternberg (1990). Several contributors to that book – Kitchener & Brenner (1990); Labouvie-Vief (1990); Meacham (1990); Pascual-Leone (1990); Robinson 1990) – have inspired the thoughts of two other authors, Awbrey and Scott (1994), whose paper on the construction of a wise university – a university that organizes itself so as to model wisdom and to generate wisdom in the members of its community – I highly recommend. Some of the work done in the workshop that accompanies this inaugural lecture is, in fact, based on that paper.

I must limit myself here to briefly outline some – not all – of the implications of the wise university for teaching and learning. At the affective, cognitive and metacognitive level, the wise university will have to be able to live with the reality that knowledge is never absolute or final, requiring members of the academy to be tolerant of ambiguity and uncertainty. Knowledge is always under construction. That construction process is being undertaken by human beings who, by virtue of their own involvement in creating knowledge, cannot think of themselves and their fellow human beings as outsiders of the process. Knowledge construction is therefore in essence a social and contextual process. That being the case, any form of pedagogy that negates or limits students' active and conscious participation in the construction of their own knowledge runs counter to the idea of a wise university. The task of teaching is thus in the first place one of catalyzing the learning process, focusing on its cognitive as well as affective and metacognitive dimensions. Last but not least, and this goes back to an

earlier argument in my talk, the development of knowledge is intimately linked to the development of imagination.

As to the key principles that should guide curricular and organizational matters in the wise university, the focus on problems, and thus on the development of the capacity to problematize, stands out. Clearly, the notion of problems in this context is not limited to those problems that are constrained and well-structured, having "convergent solutions that engage the application of a limited number of rules and principles within well-defined parameters" (Jonassen, 1997, p. 65). It also, and particularly, includes ill-structured problems. Jonassen describes ill-structured problems as possessing "multiple solutions [and] solution paths, [as well as] fewer parameters which are less manipulable" (p. 65). Ill-structured problems also "contain uncertainty about which concepts, rules, and principles are necessary for the solution or how they are organized and which solution is best" (p. 65).

Considering the social nature of knowledge construction, the wise university emphasizes collaboration, as opposed to competition, as well as dialogue within, across, and over and above the disciplines. It recognizes that most of the crucial problems the world is facing have long ceased to pertain to particular disciplines. It thus encourages, while valuing the heritage of disciplinary knowledge, the development of perspectives that transcend the disciplines, thereby reinventing the original meaning of the word "university" in a transdisciplinary context. It goes without saying that the wise university critically appreciates, on a continual basis, its own assumptions and its relevance in the world.

My innovation scrapbook

Much more I would have wanted to say in this lecture. Sound pedagogical principles require that I should not speak too long. However, let me leave you with my "innovation scrapbook," a series of rough notes concerning some areas that, in my view,

require the urgent attention of the educational innovator to which I have given insufficient attention among the issues I have already highlighted.

I did mention, in passing, the adjective "*transdisciplinary*" twice. Here I want to lift it out and elevate the concept to the status of a noun. Transdisciplinarity, as Nicolescu (1996) so lucidly explains, is distinct from two other concepts with which it is frequently confused, namely multidisciplinarity (the application of the knowledge of multiple disciplines to a particular problem) and interdisciplinarity (the application of methods and procedures of one discipline to a problem defined within another disciplinary area). Transdisciplinarity, on the other hand, means that one assumes a position not tied to any particular discipline and thus looks at a problem from a point of view that rises above the level of individual disciplines. Doing so typically leads the scientific community to join forces, rather than to enter into fruitless debate among irreconcilable positions that emanate from too narrowly defined perspectives related to the various distinct disciplines. The result is teamwork instead of competition and dialogue instead of debate.

The issue of transdisciplinarity has become particularly important as many of today's problems are so complex that they challenge the wisdom of earlier periods in the history of the development of science that have led to the level of specialization which we currently know. That specialization is powerfully expressed in the compartmentalization of knowledge into disciplines and in the rigorous divisions within universities whose departments don't talk to each other on scientific matters (they may though talk to each other on administrative issues). Educational innovation should address this challenge not by doing away with disciplines but by reinforcing them through their integration in broader frameworks of interest. I mention as examples the work of the Centre International de Recherches et d'Études Transdisciplinaires (http://perso.club-internet.fr/nicol/ciret/) and that of my own institute, the Learning Development Institute (http://www.learndev.org), which defines itself as

"transdisciplinary networked learning community devoted to excellence in the development and study of learning."

I also mentioned in passing the concept "*community*" on various occasions when I referred to the members of the academy. Much of current educational practice still focuses on the individual. That focus is reinforced by the existing systems of student evaluation and career promotion procedures for faculty. Like in the case of transdisciplinarity, innovation in this area – organizationally as well as in terms of educational processes – should not negate the importance of individuals but instead value them and their intellectual efforts, recognizing individuals' feelings of solidarity and interrelationship and their commitment to issues of common concern.

I have just mentioned the word "*feeling*" and did so deliberately, violating the tradition that, in the academy, one does not talk about emotions – except perhaps in the psychology department, where emotions are an object of study. Since Descartes it has been assumed that the pursuit of science is best done by separating the scientist from science, controlling, if not suppressing or eliminating, one's emotions, and certainly not to reveal them. It so happens, however, that science is a human endeavor and that humans best function in an integral manner, applying the combined force of their emotions and intellectual capacities to how they contribute, each of them individually and collectively through the communities of which they are a part, to the enhancement of human existence on earth. There is extensive evidence in the biographies and autobiographies of the great scientists throughout history of the role played by their passionate attachment to the issues they dedicated themselves to. As we raise new generations of scientists it seems only fair that we care for their combined intellectual and emotional growth. I should add to this observation that its importance augments as progressively more technologies put themselves between human beings, taking away the warmth of human relationships as they develop in a face-to-face context. While great advances can result from the further development of distance education, it is a key

issue for educational innovators in that context to meet the challenge of integrated emotional and cognitive development.

Finally, let me say a few words about *humanity's spiritual heritage*. My teacher, the renowned theoretical physicist Ralph Kronig, characterized in 1969 human beings as follows:

> The human being distinguishes himself from the animal, in addition to walking erect, through three peculiarities: He possesses a language which employs concepts, allowing him to use it as an instrument for the analysis of his environment and giving rise to science and literature; as *homo faber*, using the tools he creates, he is able to shape material objects, at the highest level in the form of technology and the plastic arts; finally, he is conscious of his mortality, basis, on the one hand, of his humor, on the other hand of his religious creations and also of both cheery and solemn music. Everything else is basically biology. (p. 14)

I am referring here specifically to the third peculiarity of humans identified by Kronig. Contemplating the temporary nature of their existence, human beings have, since earliest history, developed the sense that there is something bigger than themselves to which they relate. In the etymologically true sense of the word, this is a religious notion, though I am not referring here to institutionalized religion. Religious institutions evolved through the initiative of some in the worst case to exploit the religious feelings of others for their own purposes, in the best case to care for those feelings and create communities that allowed people to share and give expression together to their devotion.[3] Historians will be in a better position than I am to judge where the line between exploitation and service should be drawn in specific cases.

I bring this issue up in the conclusion of my lecture because the demise of yesterday's religious institutions seems to result on the one hand in fundamentalism and on the other in nihilism, the distinction between the two not being all that relevant.

[3] This may perhaps be seen as similar t o how financial institutions evolved, building on the habits of human beings to trade products and services using monetary means, allowing such institutions to both serve and exploit those human interests.

Decidedly, without pleading to reerect the institutions of the past, I should like to close by drawing your austere attention to the challenge posed to educational innovators by the phenomenon I've just highlighted, leaving you with the question: Can new forms to care for human learning reconnect us to humanity's spiritual heritage in ways that are adequate and relevant for our time?

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