A SHORT TREATISE ON CYBER DISTANCE LEARNING AND SOCIAL CHANGE IN BRAZIL

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Abstract: *Although widely critical and descriptive, this paper has as main objective to discuss a theoretical model of artificial intelligence for distance learning based on real expectations about the bearings of this modality of teaching/learning in Brazil, emphasizing the evolution of information technology and its impact on the Brazilian society. It summarizes the foundations of a meta-language for the formalization of the functional structure of the cyber teacher – a service that simulates the dynamic behavior of the human teacher – providing some autobiographical intellectual notes in the fields of education, science and technology.*

Keywords: *cybernetics; artificial intelligence; education; knowledge society; motivation; technology*

INTRODUCTION

An expert is a man who has made all the mistakes, which can be made, in a very narrow field.

– Niels Bohr

Brazil faces today a dilemma in education. To get the international position that aims, being more egalitarian, inclusive and independent in science and technology, it needs to go through an extensive review of educational processes at all levels. To do this, it must invest large sums in a transformation that will certainly take many decades. At the same time, as it can not afford such a prolonged wait, the Brazilian Nation draws on palliative countermeasures that aggravate even more its institutional weaknesses, leaving exposed before the international public opinion the fragility of its social institutions. Inglorious has been the professorship struggle against the defense of mediocrity. Television, once indispensable ally to carry out education and entertainment for all ages, now was shifted toward the role of an intimate enemy by individuals to whom any demand of thought would be lethal. Never "freedom" was a word so devoided of meaning. Even the music, ineffable art of transcendental nature, now seems never to have served to our education. What remains everywhere is the abominable sound of pseudo-bushman vocals with their squawks and all their hatred for popular culture and harmony. Tedious and vulgar melodic lines are repeated continuously without poetry, giving lessons of musical, lexical and aesthetical ignorance. As it could not be worse, I find myself appalled by the grotesque end of such supreme art in the loud noise of the funks. I have to agree with Pierre Lévy, when he says that,

> *When we hear the Japanese playing Beethoven or the Chinese singing Verdi, we should not think they were seduced by the 'Western' song. This song is not a 'Western' one, it is universal, and this is because it can touch the hearts of all people.* (Lévy, 2001).

It is the ability to feel our hearts touched by music that was lost with the lack of education. Without this capability, the spirit becomes an easy prey of the bad-tasting, of the bizarre.

That frivolous intellectual nonsense is a product of mindless processes of counter-cultural contamination started in the 1960s and founded on the irrational rejection of anything originated in logical thinking. Bunge (1980) pointed out a sort of "rebellion against reason", and he said that "this

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spread between American youth and, partly, also the European, as part of the contestatory movement generated by U.S. intervention in Vietnam.

The distrust and even the hatred of science, and the concurrent popularity of pseudo-science and occultism, are unparalleled in modern cultural history of the West. [...] This anti-science reaction spread throughout Europe and is becoming appreciable in the Third-World".

Against this not encouraging background, distance learning (DL) can be an important instrument of opposition to the educational apathy in which the Brazilian society is plunged, since used in a rational manner. I have discussed the very fact that current applications of distance learning have yet to take a long way trip towards the introduction of strong components of artificial intelligence for reasons that I will discuss throughout this treatise.

OVERVIEW ON SOCIAL AND TECHNOLOGICAL EVOLUTION OF THE POST-WAR WESTERN WORLD

To organize a consistent history is a difficult task, rarely well done in details. About DL it is a great exception the study of Casey (2008). Many times we need to contextualize the events not only in time, but in a psychological variable that relates our own beliefs about the aspects that constitute the background of the target object, although we know to be impossible to cover everything in a limited space. Only then we can approach the desired understanding. This section is not intended to exhausts the theme, but only provide an overview of the evolutionary process of society in its informatics stage, showing some of the main points of paradigmatic rupture in IT and their reflections in the so called distance learning.

The social evolution of the human kind is essentially based on a trilogy of human values in the following levels: communicational, informational, and epistemological. The detailed study of this evolution would transcend the scope of this treatise. So, let us concentrate on the Post-War West World, emphasizing the dynamics of labor relations since the Fifties until today.

From the second half of the twentieth century, social changes took place at a speed never seen before. So rapid has been the process of change within cultures that became impractical, if not meaningless, to characterize crisp evolutionary stages; multiple and successive breaks of paradigms occur at short intervals, giving us the impression that we are not able to follow them; in part, indeed, we are not, which brings an uncomfortable feeling of uneasiness. However, despite all the difficulty, we can highlight certain dominances, showing general characteristics more or less prevalent on most human activities over a given period.

According to my view, the last fifty years experienced at least three major social dominances in global three phases, namely: (1) hermetic (communication society), (2) specialist (information society) and (3) eclectic or holistic (knowledge society).

The communication society (dominance on the communication level), predominantly in the 50s and 60s, reaching the mid-1970s, mirrored the cultural emphasis in the media. In a sense, it represented the peak of the industrial era, with important technological acquisitions soon made available to the people; it was also the time of such classics as "The Media" by Marshall McLuhan (1911-1980) and "Linguistics and Communication" by Roman Jacobson (1896-1982). It is considered that the effective beginning of distance education in Brazil occurred in this phase in 1969 with the inauguration of *Radio Cultura* and *TV Cultura*, both belonging to the *Fundação Padre Anchieta*.

While humanity was about to experience a cultural revolution that could radically change the beliefs of the man until then, the field of professional education in the Western world went following under the influence of the old traditional model of the child who kept on the careers of their parents. So simple like this, study and profession kept a univocal relationship; you got a degree to pursue the matching career. It was almost inconceivable that someone failed to perform the function for which it had prepared on behalf of other activity, except for extraordinary reasons. Any specialization, when desired, was nothing more than a dip of the individual within its intellectual dilettantism: no windows to the interdisciplinary knowledge. Of course, in scientific thought there was more openness. For instance, linguistics, as conceived by Edward Sapir (1884-1939), showed linkages with other scientific disciplines, and he

said about the linguist of that time which "unless it lacks a certain amount of imagination, he can not fail to participate in some or all of the interests that bind interdisciplinary linguistics to anthropology and cultural history, sociology, psychology, philosophy, and, more remotely, to the physiology and physics". Scientific practice, by its very nature, requires opening, but in the general context of the civilizing process, it represents a very small share of activity in society. Similarly, in the world of the arts, heedful eyes look for things far beyond the most immediate reality, transcending linear thinking. Finally, the labor market has absorbed relatively well the university offer during communication society.

In the information society (dominance on the informational level), from 1975-76 until the early Nineties, the predominant profile was that of the specialist par excellence. It was not enough a certain formation; it was required a true skill (expertise), a total concentration on the focus chosen, leaving even less space for intellectual interdisciplinarity. The labor market valued the personal investment to detain some specific knowledge, but the model just became spoiled by the excessive fragmentation of areas of specialization to the point of leaving a trail of professional stereotypes that still distort and undermine the progress of government business activities. The result of such compartmentalization has been disastrous for those who needed to adapt to a market much more volatile, saturated and plagued by methodological fads. The problems to be attacked had become much more complex in the twilight of the last century and could no longer wait for more unilateral solutions. Creativity and adaptability became increasingly essential among professional qualities, announcing a rapid and sweeping change of paradigm.

In the society of knowledge (epistemological dominance), which little by little stabilizes since the mid Nineties, an open and constructivist attitude is prevalent, emphasizing a panoptic vision which can see the weave of interactions involving the globalized world. There is no longer the obsession by specialization typical of the Eighties. The understanding that no true knowledge is isolated and the perception of the numerous technical reprints, purely market manipulations of old concepts that were already dominated in the Seventies, led to a frantic search for the new, with forays into areas as biology, quantum computing, human ecology, bioethics, and many other, far surpassing the technological limits of everyday informatics. The immense variety of human actions and stimuli of the modern world requires a professional profile of multifaceted manager, capable of performing by his universalistic vision of what holds around. This professional is not a "Jack of all trades" at all, but an intellectual with many interests trained to acquire many knowledges. Information systems evolve in order to benefit, so to speak, the intelligence of the decision maker. In addition, the action of the modern man does not take place in physical space only, but in a complex cyber amalgam:

> *But the space of contemporary geographical experience – the erdospace – overreach the perceptions of the common physicalism, going to blend to the digital space. It no longer makes sense to separate the physical from the virtual, even less if we take seriously the prediction of the substantial combination of man and machine like the cyborgs of Haraway (1991), the megamachines of Mumford (1970) – civilizations as machines from the structural and operational standpoint – the collectives man-machine of Latour (1993) – men as planetary actors through the networks – or the humachines of Luke (1989), true collectives of digital networks manipulated by society.* (Serpa, 2002).

It was in this world where knowledge supplants the simple information with the space acquiring new dimensions that flourished the major computer centers in Brazil concerned with education.

DISTANCE LEARNING FROM 1960

In full communication society, Ted Nelson launches, in 1965, his Xanadu Project, assigning the name to the old hypertext idea to create "text from text" as a way to overcome the difficulty in dealing with a lot of information. Nelson envisioned hypertext as a kind of cyber-literary environment in which with texts embedded in texts it would be possible to establish a sonic and visual ramification of windows for textual information. The Xanadu project brought the ideal of creating a global library bringing together all the literature. The introduction of the concept of hypertext in educational experiences represents an unprecedented telematic march for the evolution of distance learning.

A breakthrough characterized by introducing the concept of hypertext was the main computational engine of the first generation of distance learning in the mid-1980s, and then called CBT (computer-based training). The acronym CBT has won several synonyms: CSLR (Computer-Supported Learning Resources), CAL (Computer-Aided Learning), CAI (Computer-Aided Instruction or Computer-Assisted Instruction) and CMI (Computer-Managed Instruction). The goal is the same, namely the use of information technology to support teaching / learning. Since the Internet had not yet reached the public, the CBT technology was applied preferentially complementing classroom activities.

According to Romiszowski (1994), the structure of the CBT would be classified as three types of environment: prescriptive, democratic and cybernetic. In the prescriptive environment, the programs are not flexible; they are generally developed in tutorial format, with examples, exercises and games, being insensitive to the application level of user's knowledge and unable to adjust itself according to the presentation. The student can access different areas of the application based on your progress and your abilities, but he should proceed through a specific module before taking the next step. In a democratic environment, the program allows students to realize how learning is, or on what matters is learning; the learner can freely choose the area of your preference, moving through different paths to the same end. In the cyber environment there is an artificial intelligence engine managing all learning.

It is a very common mistake to ignore this phase, going directly from school by correspondence and television to teaching via Internet. The principles now usable in distance learning, such as responses with feedback, suggested routes of learning according to the student achievement, intelligence to learn the choices of students, and others, were applied and developed in CBT. During this fertile period, however, distance learning was limited to the actions of business training in stand alone format or in local networks, and specific training to the use of software tools. Therefore, restricting the history of distance learning over the 80s to the implementation of complementary common telecourses supplemented by packets of printed materials would ignore the part that culminated in the modern cyber solutions for virtual universities.

In Brazil, despite all the advances promoted in CBT between 1984 and 1990, there are no current applications in distance learning with the major technological gains in instructional simulations obtained at that time. In general, it is reasonable to assume that, from the genealogy of the CBT, modern distance learning is categorized as a specialization or dismemberment of CSLR. However, little has been seen in Brazil that incorporates artificial intelligence in order to establish "networks of synapses" (I will speak of them later), tying the full study progress of each student, suggesting ways depending on the individual and providing different useful feedback for different paths of learning ("tips" to encourage review and adjustment, recommendation messages for further readings depending on the route of the learner, etc.). Most distance learning systems still remains tied to hybrid CAI and CMI applications. The intelligence factor is not only sophistication, but a determinant itself of the credit which will be set to the course. After all, the absence of the on ground sentient mentor, able to talk and provide information, represents a severe gap that can only be minimized by a simulation of his pedagogical intelligence. The simulated intelligence attracts students to the extent that they act with the impression of being watched. We must remember that self-teaching instructional approach is not suitable for the vast majority of students; they have to be lead more closely and convincingly. Tutor and teacher at distance in space and time can be a solution when it is the case to overcoming geographical barriers and financial difficulties, but does not supply the natural appeal to the contact and diligent teaching of the human master. In my view, this lack justifies a considerable portion of evasion of distance courses in undergraduate and graduate levels; without the typical elements of artificial intelligence, many people end up losing interest. It was for this reason that in 1986 I developed the idea of "networks of synapses".

ARTIFICIAL INTELLIGENCE IN DISTANCE LEARNING AND THE CYBER MASTER

One of the most welcome technologies now applied to distance learning is the teleconference

environment, ideal for remote relationships. Teleconferencing is a virtual meeting by means of telecommunications, where participants separated by geographical distances can simultaneously interact with each other. The main appeal of such systems is to offer all the features present in real environments at low costs and operating in web browsers (Windows, Mac OS or Linux). They allow interactivity between various persons and information transmission in a virtual environment where each participant can see and hear the others, interacting with them as if they were physically close. In particular, these systems are used with three closely interrelated functionalities: education, formation of virtual communities and knowledge management. In this sense, the human dimension seems to gain expression in the training or communication involving large numbers of people very far between by means of voice and video embedded in a fast and uniform transmission. All the typical tools of the modern dynamic teaching / learning can be concurrently used, such as PowerPoint presentations, collaborative work in real time using word processor and online whiteboard, file transfer, chat and personal annotations with notepad.

Among the aspects of intelligence currently available in the advanced teleconferencing at Brazil, I cite the functionality of interactive whiteboard, so that each participant can interfere on the diagrams and texts of the others, and the optimization of the image transmission. About the latter, one should remember that in the technology of image transmission, intense efforts have been made in the construction of algorithms able to compose basic images, updating only the areas where there is movement or change in brightness, elevating the degree of synchronization of the process, as well as visual quality.

Embedded artificial intelligence is applicable in many ways as evidenced by Garrett & Roberts (2004) and Gregg (2007), including in plagiarism detection, generating statistical reports to be analyzed by the tutor or human teacher. In this case, the system performs a service of search looking for patterns or matches in texts and monographs to be placed up against the available databases and archives. Also expert systems for program advising can be implemented in such manner that it is required asks on basic questions regarding learner's particular interest and professional background before providing feedbacks and making recommendations for further guidance. In fact, present model offers a design to deal with the problem of the individualized presentation of teaching materials, a great difficulty in the development of intelligent adaptive distance learning systems. The huge complication of the learning control module is lowered by a scan performed on the increasing base of possible tracks. The scan executes the analysis of the paths of the learner comparing to the tracks stored in the base and to the previous data about his particular interest and professional background. In the domain area, the service will identify relevant expressions in the base accordingly the track contents. Of course, statistics on the incidence of the choices in the learning will be considered to change and guide the instruction process.

It is true that to mimic human intelligence is an action that belongs more to the world of fiction than to the real world. The instructor would need to replicate the human ability to imitate the patience to repeat several times if necessary, the same content under different forms of presentation. The complexity of the brain is above the practical possibilities of simulation, and it does not depend on the technological level, but rather constraints imposed by nature. As the great Fred Hoyle said (1986), no matter how much science and technology advance, we can not do with a stone much more than we did at the time of the Egyptians; things are what they are and we can not overcome their intrinsic natural restrictions. However, as rightly pointed out the Nobel Prize Herbert Simon, a lot of originality and variability of behavior of living creatures is due to the wealth of its environment and not the complexity of their own internal programs (Simon, 1965). From this place, it becomes more objective the search for a simulacrum of the teacher, though extremely simplified, however, conceived to "capture" the variability of the environment of teaching/learning, adapting to changes and acting with some degree of autonomy.

According to Piaget (1982), intelligence is the ability of the organism (or system) to adapt to a new situation. Therefore, a flexible and self-instructional system that can adapt to the changes of the students

and to their levels of knowledge is an intelligent system. About artificial intelligence, Millington and Funge argue that,

> *…there are many things that computers aren't good at which we find trivial: recognizing familiar faces, speaking our own language, deciding what to do next, and being creative. These are the domain of AI: trying to work out what kinds of algorithms are needed to display these properties*. (Millington & Funge, 2009).

From these considerations, within the context of agent-oriented architectures, we come to the concept of Intelligent Agent (IA), a small program that alone have not great capability; but when interacting it performs efficiently complex services with artificial intelligence (AI). A computer system based on AI is thus composed of logical, autonomous and socially organized devices that solve problems and are capable of flexible actions. In DL, the AI interacts with the student's environment and makes decisions regarding the release of instructional materials, giving reports for supervisors from the choices of the student, gradually improving the process of decision-making. It is, therefore, a system of distance learning in which human and artificial agents collaborate to fulfill the instructional goal. In fact, the agent instructor partially simulates the human teacher in order to synchronously assist students in their journeys.

In the second half of the 1980s, Gloria Gery discussed in the context of CBT the fundamental cycle — stimulus – response – analysis – feedback — playing in frequent repetitions for the construction of knowledge, once started the process of teaching-and-learning. In this context, she was proficient with an insightful argument about interactivity:

> *In straightforward terms, interactivity is the incorporation of repetitive, frequent, and meaningful iterations of a stimulus-response-analysis-feedback cycle into material that is presented in a medium that permits it. Essentially, creating an interactive learning experience is the process of structuring and sequencing variations of this cycle into a series that, when experienced by the learner, results in progress toward knowledge or skill acquisition. Typically, the more interactivity the better, particularly when the interactions are systematically chained together by either the learner or the course to move the learner along the knowledge continuum.* (Gery, 1987).

Of course, this cycle is intrinsic to any instructional unfolding, whether formative or informative, or for specific trainings. But as noted in the fragment, there are variations of the cycle that largely determine the progress towards knowledge. Similar variability can only subsume the real charming of creative teaching if it was designed in order to provide a cyber-network of synapses, able to emulate the human attitude. As well observed Onilza Martins,

> *It is essential that a linear learning does not occur in distance education. The expectation of easy dissemination of knowledge by electronic media makes the process trivial and impedes the students to search for, to develop and to disagree with everything that comes ready*. (Martins, 2008).

But, what is a network of synapses? From the physiology of the brain, a synapse is a physical connection between two neurons. Each neuron stores an amount of information, so that the connections or synapses that are established among neurons originate millions of intellections requested for the associative thinking. New connections are possible and they are created from the stimuli to reasoning, especially abstract reasoning. The brain is thus a highly complex network of synapses, whose nodes are the specialized cells called neurons.

Certainly, to transpose the concept of network of synapses in a pragmatic way to be useful in DL is not trivial. Let us understand it. The neuron in DL is represented by a certain core of information, i.e, a stored content. Under the concept of intelligent network, various contents in the ground state of the system (before the first access of the learner) should be associated with a certain topology, and will be subject to new associations (synapses) accordingly the external stimulus (participation of the learner). For this simulation to be possible, the author of the application should provide the largest number of connections, leaving "latent" these latter until they are "evoked" by the student. The entire trajectory of the student is scored and recorded step-by-step under pre-established evaluation criteria. Each path can eventually be found during the instruction of another student in a situation where the automatic

scan detects useful instructional similarities (reuse cycle).

The idea of the network of synapses also lies in the concept of hypertext, although it does not exist in hypertext the dynamic simulation of intelligent autonomy. But the branching tree of related contents, making possible virtually unlimited routes of learning, is entirely analogous to the quick provision of a network of synapses.

Since I studied semiotics with Umberto Eco, I always worry about the signic representation of theoretical models as a way to systematize and document knowledge. So, we can say that an engine of artificial intelligence applied to DL is a map M on i contents C_i, endowed with a topology T, which carries a particular synaptic connection S in an intellection I, so that

$$M_{i(T)} : S_i \left\langle C_1, C_2, C_3, ... C_i \right\rangle_{(T)} \Rightarrow I_{i(T)}. \qquad (1)$$

The intellection I is, for all practical purposes, the understanding that the student constructs from the joints made among various contents of an instructional course. The topology T defines the logical sequence of topics (eg, a content C_k is only accessible if the contents C_i e C_j have already been assimilated); it prescribes the teaching order that certain contents should be presented. For instance, let us take the synaptic articulation

$$\underset{i\,=\,1,..,3;\; j\,=\,4}{S} \left\langle C_i, C_j \right\rangle_{(T)} := \left\langle \left\langle C_1 \succ \left\langle C_2 \prec\succ C_3 \right\rangle \right\rangle \succ C_4 \right\rangle. \qquad (2)$$

The symbol $\succ$ means one-way path of a semantic content to another, while $\prec\succ$ denotes transitivity between contents. The symbols "$\langle$" (*bra*) and "$\rangle$" (*ket*) delimit blocks of knowledge that form well articulated superior knowledge. The topology T assures us that from the content C_1 we get both the contents C_2 and C_3, being that the access to one automatically transmits to the other, but only starting from C_1 and reaching C_2 and C_3 we reach the content C_4.

Large chains of related contents can be represented this way, being documented the required topologies. More complex structures appear giving rise to chains of chains, i. e, sequences of tracks that can only be covered after the covering of other routes. Now, let us take, for instance, the previous intellection related to possible subsequent two tracks, $(\hat{\kappa})$ and $(\hat{\lambda})$, each of them associated to a topology with probabilities $\hat{\kappa}$ and $\hat{\lambda}$ determined by previous routes. So

$$\underset{\mu\,=\,5,..,8;\; \nu\,=\,9}{S} \left\langle C_\mu, C_\nu \right\rangle_{(\hat{\kappa})} := \left\langle \left\langle \left\langle C_5 \succ C_6 \right\rangle \prec\succ \left\langle C_7 \succ C_8 \right\rangle \right\rangle \succ C_9 \right\rangle; \qquad (3)$$

$$\underset{\mu\,=\,5,..,8;\; \eta\,=\,10}{S} \left\langle C_\mu, C_\eta \right\rangle_{(\hat{\lambda})} := \left\langle \left\langle \left\langle C_5 \succ C_6 \right\rangle \prec\succ \left\langle C_7 \succ C_8 \right\rangle \right\rangle \succ C_{10} \right\rangle; \qquad (4)$$

$$\begin{aligned} & I_{i(T)} \succ \\ & \left\langle \left\langle \left\langle \left\langle C_5 \succ C_6 \right\rangle \prec\succ \left\langle C_7 \succ C_8 \right\rangle \right\rangle \succ C_9 \right\rangle \right| \\ & \left\langle \left\langle \left\langle C_5 \succ C_6 \right\rangle \prec\succ \left\langle C_7 \succ C_8 \right\rangle \right\rangle \succ C_{10} \right\rangle \right\rangle \\ & I_{i(T)} \succ \left\langle S^{\hat{\kappa}}_{\mu\nu} \middle| S^{\hat{\lambda}}_{\mu\eta} \right\rangle. \end{aligned} \qquad (5)$$

The *bra-ket* with a central bar in expression (5) signifies a probabilistic description. This means that internal structure of the topology of the intellection (1) is entirely probabilistic. Indeed, the only question to be answered is: what is the likelihood of a particular synaptic connection from a certain sequence of thoughts? Or, in the learning ground, what is the probability to choose a certain track from a given intellection? Of course, this choice depends on the route recorded within intellection (1). Thereby, the connection between intellection (1) and tracks (3) or (4) is purely probabilistic until the instructor agent decides by one track based on the history of the learner throughout the building of $I_{i(T)}$.

As a matter of fact, the old realism, with its doctrine of precise location of the phenomena, is inadequate to the contemporary rationalistic practice. Nowhere the memory is localized in the brain, except vaguely in an envelope large enough to harbor a comfortable and safe epistemological approach. For distance learning, a topology with static content aligned, localized and totally predictable would lead to an intellectual apathy and disinterest.

We see that, for the implementation of the network of synapses, it is absolutely necessary the previous mapping of the widest possible range of

contents to be transmitted as well as the primary instructional tracks defined under rigorous didactic and pedagogical criteria. The complete explanation of the metalanguage outlined above, as well as the probabilistic model adopted, is beyond the limits of this treatise.

MEMORIES ON DISTANCE LEARNING

Although the term "distance learning" has been employed at least for one century, it was not until the mid-Eighties that occurred in Brazil the first serious initiatives to introduce in the instructional process, through the new microcomputer technology, a learning mode in which teacher and student are not simultaneously on the same physical place. Fans of the new arrived programs for computer-based training, or CBT, gradually took seat at the tables of discussion on the directions of modern education in face of economic difficulties and geographic barriers in Brazilian territory. At that time, when I was manager of a multi-media division, called "Advanced Instructional Systems" in DATAPREV — Data Processing Company of Social Security —, I had the opportunity and pleasure to meet and interact personally with some of the acclaimed great names regarding the training of human resources as Alexander Romiszowski, Thomas Gilbert (deceased), Barbara Grabowski and John Franklin Arce, who was my master. With John I produced an application to statistics learning implemented in Pascal, the *Statmaster*, and other instructional applications for personal computers in Pilot, ancient language originally developed in the Sixties. Gilbert was responsible, since the Sixties, by the introduction of a creative model of instructional design extremely effective, based on behavioral principles, under the designation of "Mathetics". The word "Mathetics" comes from Greek, meaning study or learning. Gilbert studied with the famous behavioral psychologist B. F. Skinner at Harvard University. It was in the enterprise world that he found greater resonance for his paramount contribution in the area of training, development and human resources management. Grabowski is currently Professor of Instructional Systems at Penn State University, Pennsylvania, and Associate Professor at Syracuse University, playing other activities not less important. When I met her, if my memory not betrays me, she was responsible for the simulation training program for pilots in the U. S. Armed Forces. Romiszowski, also from Syracuse University, is perhaps the best known of all, having done extensive work in the fields of instructional design, development and evaluation. He always interacted very much with Brazil. John Franklin has a doctorate in statistics and computer science from Toronto University and is an expert on Six Sigma at Texas University. Being an excellent mentor, he is also a generous and friendly person. Triggered by him, I developed the concept of network of synapses, much later identified on the basis of the idea of neural network. These great men, besides my own parents, educators par excellence, gave me the right philosophical, psychological and socio-cultural foundations in such manner that I should not get lost in the entanglement of mistakes that would be made later in Brazilian education as a whole, such as those which arose from the frequent precariousness of the techniques of evaluation / quality control.

Since the 1990s, the literature on distance education has been abundant, adding meritorious contributions in such works as those of Garrison (1990), Bracey (1992), Oblinger (2000), Garcia Aretio (2002), Soller (2004), Moore & Kearsley (2005), Tabor (2007) and Vaughan (2010), among many others. Despite much debate and effort, computer technology in Brazil had not coming truly to win education experts and educators, yet anchored to the conventional techniques of organization of instruction, until the advent of the Internet (1995/96). Once the Web came on scene, distance learning was introduced in the Brazilian educational system with the enactment of the *Lei de Diretrizes e Bases* (Law of Guidelines and Basis) as a mode of teaching, in which students receive lessons via television, telephone or Internet, without the obligation to go to school. It was the connection between computer networks that actually enabled, via protocol www (World Wide Web), the advancement of the teaching/learning beyond the confines of the classroom and beyond the context of the traditional relation student/teacher, creating opportunities for students to build knowledge in their own home environment. In regions previously inaccessible to the best of the civilization in terms of education, people burdened with daily chores and no prospect of higher professional training for economic reasons

saw in front of him a brand new horizon of possibilities to be unveiled. Despite this gain absolutely undeniable, the physical distance between teacher and student would drastically restrict the acquisition of intangible human values added to the interactive process even in face of the available methods of evaluation. In 2001, Bunge has already claimed about the electronic society that,

> *…la sociedad electrónica o virtual, en que solo nos comunicaríamos a través de la red global, es uma utopia irrealizable. Todos, com excepción de los pacientes aquejados de autismo, necesitamos ver a nuestros interlocutores, adivinar lo que nos dicen com el movimiento del cuerpo, estrecharles la mano, o aun que sea caminar juntos em silencio. Al fin y al cabo somos animales con sentimientos, no autómotas. La relación entre pantallas puede complementar a la relación cara a cara pero non reemplazarla.* (Bunge, 2001).

Things like the convincing by the posture, the gesture clarity, the general influence of the personality physically present, the pleasure of conversation and the possibility of banning the doubt almost immediately when it comes, would be lost and with them a considerable portion of all that matters to a well training in every way. Already in the late Eighties, it was defended a partitioned school learning, with regular classes on one side and computer interaction on the other, ensuring cyber and human both in harmony. In particular, I was always an advocate of this position, since I think that the main strength and the main weakness of distance education constitute simultaneously its greatest advantage: flexibility. Strictly speaking, this issue was really the center of my academic discussions with John Franklin, when we defined the core methodology of the statistical package in which we worked.

It is not that the ideal combination of old and new methodologies have been abandoned; the fact is that in practice more distance courses are offered with little or none intelligent interaction. However, it is also a fact that at certain levels of learning, i. e, which do not involve necessarily communication refinements, the tutor at distance supplies, in most cases, the functions of a teacher in class. In this case, I include the corporate training courses in some specific techniques or in the use of administrative software tools.

In 2004, according to studies by the Center for Applied Computation of the Getúlio Vargas Foundation, it was estimated that Brazil had about 40,000 students matriculated in higher education courses at distance, and of those, at least 39,000 took part to teach at distance. More than 2.5 million Brazilians studied in distance courses in 2007, according to a survey done by the Brazilian Statistical Yearbook of Open and Distance Education in its 2008 edition. Most of these students were in the graduation level. The difficulty in developing projects of distance learning at the basic level of education has at least one problem in legal matter. While graduate/undergraduate projects may be established in any state of the Federation after obtaining accreditation by the National Education Council (NEC), projects for basic and technical education need to gain accreditation in each state of the Federation in which it is intended to establish a distance course. As the criteria vary from state to state (permitted age, methodology and documentation required, type of course you may be allowed, etc.), this situation inhibits initiatives at that level, which has a growing demand in the country, mainly for technical courses.

Complementing the above information, in the first half of 2009, MEC — Ministry of Education — reported an estimated increase in the number of students and institutions of distance learning in 2008, based on a monitoring performed around the country. According to the data collected, there was 760,599 undergraduate students at distance in 2008 and 145 higher education institutions (HEI). Although I have no news about the current numbers, one would assume that there has been considerable increase in the offer judging by the growing of initiatives in this area and the mitigation of the trends by the emergence of federal projects such as the Open Technical School in Brazil (E-TEC), aimed at technical training schools. This growing can be a sign that the projects are being produced responsibly by competent persons in the area of teaching / learning. By the way, it would be interesting to include in the planning of global strategies of distance education a plan to implement metrics for assessing productivity of well trained human resources at the end of a certain period, anticipating possible innovations in the use of such human resources (Hazy & Ashley, 2011).

INSTRUCTIONAL GAMES

For a long time, video games have been ignored by educators. This was primarily due to the fact that it was about the negative social consequences of gambling that we concentrate our concerns, ignoring the significant potential for teaching that the games offer. Due to the pervasive influence of video games on popular culture, many educators have expressed interest in studying what effects these games have on players, and some of its components as motivators can be used to facilitate learning, integrating them into the instructional design (Bowman, 1982, Bracey, 1992, Driskell & Dwyer, 1984). Bowman, for instance, suggests that educators can use video games as models for improving learning environments, providing clear objectives in a challenging context, enabling collaboration, giving to the students more control over the learning process, all under the operational evaluation criteria based on the phases of the game. Bowman adds that a good instructional design should involve students in what he called "flow states", i. e, continuous behavior that keeps learners focused on transposing the situations presented, pursuing meaningful goals for them.

The research on video games reveals many patterns of the way that humans interact with technology. Such patterns are very important for educational technologists that will become designers of digital environments. In addition, this research recovers the role of the act of playing in the intellectual activity. I have no doubt that the confrontation of problems without fear and with the spirit of fun not only leads to the solution of problems, but often to creative and innovative solutions. It goes hence the importance of the juvenile culture of comics to keep alive, well balanced with the systematic education, the flame of invention and of daydreams, after all, the first agent of human growth. In particular, in the late eighties, I emphasized the importance of playful learning from general observations made by Huizinga about the animal world (Serpa, 1989).

Using action instead of explanation, at the same time providing interactive and decision making contexts, modern educational games have been applied in teaching complex subjects since they promote high levels of motivation (Charles & McAlister, 2004; Sheffield, 2005). In addition, from the 1990s until now, a copious literature has established instructional theories to consubstantiate the design of educational games (Egenfeldt-Nielsen, 2005; O'Neil & Fisher, 2004; Squire, 2002, 2004; Li & Shresthova, 2002; Schank, Berman, & Macpherson, 1999). For instance, the so-called "Learning by Doing" instructional theory, from Schank, Berman, & Macpherson (1999), originated three games developed by Massachusetts Institute of Technology (MIT): the **Biohazard** (Squire, 2002) about medical emergency situations where players carry out medical practices responding to epidemic infectious diseases; the **Daedalus' End** (Li & Shresthova, 2002) giving simulations where players embody civil engineers to learn about the management of civil engineering projects and engineering ethics; the **La Jungla de Optica** (Squire, 2001) providing an adventurous environment where the players learn about basic concepts on optical physics. Accordingly Schank et *al.* (1999), there are seven instructional events to facilitate "Learning by Doing" process, says:

- Define goals;
- Set mission;
- Present cover story;
- Establish roles;
- Operate scenarios;
- Provide resources;
- Provide feedback.

However, despite the relative success of educational experiences with games, it is premature to assert a distinct qualitative differentiation of results comparing the use of games with other learning techniques in vogue. In a broad survey on the effectiveness of instructional games, Robert T. Hays, from the Naval Air Warfare Center Training Systems Division, concludes, among other results, which

> *The empirical research on the effectiveness of instructional games is fragmented. The literature includes research on different tasks, age groups, and types of games. The research literature is also filled with ill defined terms, and plagued with methodological flaws.[…] There is no evidence to indicate that games are the preferred instructional method in all situations.* (Hays, 2005).

Instructional games are a relatively unexplored niche in Brazil. Particularly on this focus, Leandro Serpa, my nephew, proposes that networks of synapses can take optical configuration through what he called "visual virtual intelligent agents" (VVIA), enhancing the emulation of the master with the introduction of facial expressions and animations in 3D, transforming data into actions (commands) that make a particular track of graphic moving. This track can branch into several others whose choices will be done on the probabilistic weight of previous tracks, ensuring the development of the state of knowledge of the student.

CONCLUSIONS

This treatise gave a clear overview of distance learning, pointing toward an advanced theoretical research, including principles of logical representation to modeling the emulation of intelligent teaching/learning processes, and correcting a major deficiency in the history of distance learning in Brazil. It also indicated the need of greater support to both research and development in the area of instructional games, still shy in modern academic culture at Brazil. The cyber-DL, the main idea developed here, is an option that still requires much work. It would be interesting that the UNIP, one of the great private Brazilian universities joined the practice of distance learning in recent times, formed a group of ongoing research in this area, offering places for undergraduate students wishing to pursue studies in artificial intelligence. Indeed, it would be reasonable to create a distance learning academic degree with a wide hybrid grid consisting of technology and philosophy. I remember that this initiative is fully consistent with the efforts of the House to obtain the highest score in the governmental evaluation of courses related to information technology. To achieve excellence in distance learning means that we are at the forefront of IT and social responsibility, teaching with quality and modernity. Paraphrasing Romiszowski, in full knowledge society I believe it is essential that educational institutions help people to develop proficiency to work with multiple skills that allow the use of existing knowledges to build new knowledge that can be useful to the solution of problems in face of the opportunities always present around us. Nothing is more appropriate to gain that proficiency than an apprenticeship with the help of distance learning and all its facilities and motivations to search new challenges.

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