LEARNING WITH THE ARTIFICIAL SCIENCES
A Paradigmatic Shift

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Abstract: In what follows, we look into the intellectual history of Distance Education. We study the *methodological, political* and *epistemological* aspects of the shift of paradigms in the scientific thought used to construct distance learning objects. A global (not meaning exhaustive) coverage of the various ways in which instructional communication has been mediated is given. We consider e-learning's objects to be socio-technical in nature and thus that their history stems from the very beginnings of Artificial Intelligence.

Key words: Change; Artificial Intelligence; Policy Writing; CSCL; Otherhood

1. INTRODUCTION

According to P. Moeglin (2000), expert on cultural industrialisation and the computerisation of society at a Parisian University, we have totally lost track of the objects we learned with in the past, and more generally, communication in education. This has had its long-term consequences in Science: "the fragmentation and differentiation of sciences in the 20th century have reached a point where specialists working in different areas of what used to be a unified field of science no longer understand one another" (Kinelev 2003). Moeglin wonders: "what were the precursors to our present multimedia learning techniques?" We shall argue that the early technologies that sprang from Man's thought at the intersection of mathematics, physically manipulating objects, and human intelligence itself constitute the foundations of today's new world of education. What is the nature of these obsolete educational entities and how might they influence current research

in the science of Distance Learning? Whatever the means might have been the problem in any pedagogical activity is to instill in one's students the *will* to acquire knowledge and thus the *desire* to communicate. The effectiveness of problem-solving is the main factor in the appraisal of progress in any science. In the same grain of thought, L. Laudan (1977) points out that it is important to explore the *intellectual history* of a domain of thought for two reasons, to write sound history and to make rational choices. The intellectual history of Artificial Intelligence (AI) — the core area of research used in modern Distance Learning — must be a "non-eliminable ingredient" in choosing between alternative actions for future work in such uses of AI.

Though computers are not the only technical objects we learn with, our intention here is not to establish an exhaustive history but to concentrate on the aspects having to do with the automation of Man's intellect and the methodology of evaluating distance learning systems. Even since the beginning of the new millennium, there have been quite a few changes in the role computing has had in educating people. Despite its trials and tribulations, more people are accepting this mode of learning. So be it. But when comparing with the precursors of 15-25 years ago we feel right at home in speaking about a paradigmatic shift in the use of Machine-Assisted Learning. Today, it would seem that Open and Distance Learning communities have allowed "libertarian pedagogical attitudes" to flourish. Up until the very end of the 20^{th} century, studies concentrating on the relationship between humans and machines would check up on the *effects* of the demands of the public on the institution or on the *effects* of computers on individuals. But studying these well-defined activities is no longer *à la mode.* Why not?

2. SOME HISTORICAL BEGINNINGS OF DISTANCE LEARNING

In order to answer this and other questions, we will need to establish an historical setting and talk about some of the personalities involved in Artificial Intelligence, education, and related fields. Kinelev (2003) and Moeglin (2000) recall that the coming of printing to educational institutions was as great a revolution in teaching as was the advent of recent technologies like the Internet; one may attempt to say that Distance Education today only *makes use* of printing in a novel way; however that would be somewhat false as it also employs sound and images, a multimedia delivery which could well be calling out for multi-modal definitions of optimal learning activity and what the word "literacy" should now really mean.

Instructional radio and television were little more than simple reproductions of "boring" professors giving a lecture. Despite the failure of radio (1930s) to become a noticeable precursor to modern Distance Education, television gathered 400,000 students in 6500 public school classrooms in and around Indiana thanks to the Midwest Program on Airborne Television Instruction (MPATI) of the Ford Foundation (1960s); later spin-offs of this were Educational Television (ETV), Closed Circuit Television (CCTV) and Instructional Fixed Television Service (ITFS). In the late 1960s, Universities started reaching out to both on-campus and off-campus populations (Jeffreys, 2004).

As few people knew about computers then, speaking about the idea of converging television and computers would certainly have seemed a preposterous thing to do. But the Internet did come to be, and we could state that one of the prototypical versions of it was Campus Wide Information Systems — "online repositories for public-domain information generated on university campuses" (CBI). In the 1980s and 1990s the CWIS was envisioned as an information space where university students, faculty, and staff could engage in electronic self-publishing, retrieval of course information, and have access to e-mail, online library catalogue facilities, the campus phone book, and other remote facilities. […] Credit for the earliest CWIS is usually given to CUinfo, deployed on October 10, 1982, by Steven L. Worona and others on an IBM mainframe." The information contained therein had the goal of encouraging uniformity and the building of inter-collegiate information system relationships but was "invariably obsolete even before reaching its users' hands". It did not really represent education but it is an important precursor to modern *textual* information flow within educational institutions (intranet/extranet).

Well before the early CWIS history, Martiel Vivet was already into more advanced educational content in down-to-earth situations. Vivet (later known for his "pedagogical micro-robotics") was one of the pioneers in using technology for genuine learning in industrial settings. His struggle to obtain the appropriate computing equipment and bring mathematics teachers in France to recognise the merits of automatically demonstrating theorems and the inherent pedagogical problem-solving nightmares that produced preliminary thinking material for his later experiences with employees in micro-worlds that needed training (Vivet, 2000). The "battle" with the mathematics teachers corresponds to the period between his discovery of the experiences in High Schools using wooden computers for students to study the effects on students' acquisition processes and that of Papert's LOGO, thus between 1973 and 1977. LOGO enabled Vivet to demonstrate the pedagogical merits of manipulating objects at a distance. We are convinced he put the spotlight on the difficulty in many problem-solving situations:

their resolution is first fully conceptual, which hinders the planning of actions as one has trouble 'seeing' the real world deployment, extension or it's application. Vivet seemed to be drawing nigh to Dreyfus' position in *What Computers Still Can't Do* (1972) that software, not having (human) corporal existence, needs to convey one if it is to help us understand what the computer is actually doing. Vivet demonstrated that, by using real physical objects, actions, and environments, or by representing them at a distance, learning becomes easier.

Another major pioneer in the field was J. Self, known for his "automatic teaching" in the late 1970s and his student modeling for Intelligent Tutor Systems (ITS) in the late 1980s. Going from automatic teaching to student modeling constitutes a major shift in focus. His ambition was to escape from the empiricism of ITS research by admitting that the building of an ITS system that works implies adopting a theoretical stance taking into account the fact that knowledge cannot be treated as information (Self, 1990). His life-long 'slide' from the computational towards the concerns in Educational Sciences influenced a domain of study that shifted from machine-centred to human-centred design. As other informed writers in the mid 1990s, he wrote simply of AI *in* education and no longer of education in AI.

In mentioning "libertarian pedagogical attitudes" earlier, we meant that with computer networks for learning the in-class learning process is not only vanishing, but learning is becoming less *teacher-driven* as there is no physical classroom in which to *'contain'* students. *Activity-directed study* has enabled giving more consideration to self-initiated action on the part of the student. In exploring the various stages involved in acquiring this, we wish to establish a prospective epistemology meant to encapsulate the redefinition process with regards to suitable learning procedures for the current workforce and to envisage renewing the meaning of what it means to be literate/illiterate. This is all the more necessary in a field that has barely identified itself (Shale, 1988). There are really three aspects to the paradigmatic shift we wish to discuss. In this sense, we could even speak about *three* paradigmatic shifts, namely methodological (Shift no. 1), political (Shift no. 2) and epistemological (Shift no. 3).

3. SHIFT NO 1: METHODOLOGY FOR ANALYSIS AND EVALUATION OF THE EXISTING

Computer-mediated distance learning as we know it today has existed for about a quarter of a century. In the early days, the community focused on the best possible computerisation of the system with an aim to *replacing* the teacher, as can be done with television. This initial approach had limited

success. Little by little, the community started to reintegrate the (human) individual into the heart of the system. From simply technically-oriented, the system became "socio-technical", and the goal has shifted from replacing human activity to *assisting* human activity. A major reason for the methodological paradigmatic shift in question is the social acceptance of the World Wide Web. Its appropriation allows users with their own technical and cognitive skills to make the step towards using computerised learning environments. It would thus seem that the birth of the Internet has rendered e-learning tools familiar for transforming the nature of interactions from *1*/person-machine to *2*/person(s)-person(s) with, and through, machines.

Knowing what the user is doing with the machine is compulsory to studying the effects of the machine. J. Self's experience shows that we have been leading the learner away from the heuristic self-initiated learning of the past to contexts in which learning becomes a full-fledged social activity (1995). The knowledge being handled in the former situation was static (*objectivism),* and in the latter situation, it is becoming increasingly dynamic. The "paradigmatic appellations" that J. Self assigns here are *constructivism* or even *situationism* (1995). Others would say that we have entered the era of *interactionism* (Caelen, 2003) in which the likeness of artificial and natural agents play similar — or even identical — roles in communication. Current learning tools being developed and tested include neo-ITS, Computer-supported Collaborative Learning (CSCL), Dialogue Systems (D. Luzzati *et al,* 1992) and Collective Activities in a Learning Context (CALC, *cf.* P. Tchounikine *et al,* 2003). This latter type of application *environment* merely provides the learner with a whole line of communication spaces and a complete toolbox for learning. Its advocates purposefully to use this *minimalist directivity* to encourage learner integration into group projects.

Obviously, accessibility to information catapulted distance education into a new age, but the appropriation of technologies by society can be accelerated if we learn about the needs of a learning group. Getting to know the user and his needs, or having an idea of what he is doing is not always possible with today's lesser defined learning activities. Inversely, we have to be able to predict the use of certain techniques on the computing side of the equation. The advancement of computing techniques also yields many combinations of tools in CALC learning environments. The first corroboration we could make between the technological and sociological dimensions concerned is that the causal-type analysis of the *behaviourist project* has taken a huge blow. As a matter of fact, it has been watered down to mere theoretical posturing on the impact of machines on society and *vice versa.*

E-learning research evolved in light of the results obtained. The effects linked to the functional vision of the machine slowly gave way to the

difficulty of isolating variables in a causal relation. The question that is now leading the investigation is epidemiological in nature. What are learners really doing within their learning environment? Of the many devices they have at hand for learning, which ones are they using and how? And thus, on the technology side of the relationship, which types of tools are being promoted by developers and why? Our historical analysis up to the introduction of CALCs paints the context in which pedagogical diversification has since set in. Help menus, FAQs, chats, forums etc. and other generally good "excuses-for-not-getting-down-to-it" have been integrated into the task of learning *because* we wanted learning to become collective once again. We believe that the theoretical evolutions in the use of computers in education and their methodological implications come from society's propensity to learn differently in different epochs.

Qualifying group experience is becoming urgent. When one looks at the process starting in the 1970s, it is clear that there has been a general paradigmatic swing from "hey, look at what the computer can do!" to "what is the learner up to?" The question of the proper methodological analysis to employ must account for the socio-technical configuration of the system and work towards one that is optimal for the learning community. The fact that we currently use computerised group learning environments shows that we should not rely on causal analysis approaches any longer — those aimed at measuring single learners' performances — especially when using CALCs.

4. SHIFT NO. 2: DECISION-MAKING PROCESSES FOR COMPUTERISATION

In 1995 J. Self asked questions about the nature of knowledge that presuppose an operational definition of computer literacy. He also states that, over and beyond AI in Education's goal to promote computerisation in the knowledge society, it should have "broader aims: to develop ethical and moral values, to improve attitudes, to nurture better citizens, and so on". He might have been indicating a general societal problem linked to education itself.

Could there be something wrong with State-prescribed learning programmes? People do not only wish to have more control over *how* they learn but *what* they learn. They have had a taste of *direct control* with the Internet, i.e. serendipity, or the educational virtue found in freely wondering from text to text as pointed out by S. Papert (1993) of the MIT *Epistemology and Learning Group.* This opens the doors to change which means breaking away from the traditional institutional values of learning, but this change is slow in coming. Papert writes about the *design of school* and states that "the

possibility of freely exploring worlds of knowledge calls into question the very idea of an administered curriculum" (a typically strong American proposition). *Literacy for all* types of programmes have generally implied reading, writing, and arithmetic; but the new surge, with the help of computers, multimedia applications and networks should eventually modify the very definition of literacy. Vladimir Kinelev recently spoke of creating a new educational content to combat anti-individualistic attitudes and of the necessity of *New Literacy* due to new social demands and the new world around us, without really being able to say what "New Literacy" meant (*cf.* the UNESCO Summit, December 2003). Nonetheless, his idea of promoting transversal educational content by putting the emphasis on the less materially specialised disciplines (History, Arts, Law, Philosophy, etc.) in order to enhance the social nature of the human being and augment the inner balance of the individual comes as a change in attitude ten years after Papert accused the pundits of the *Educational Establishment* of not wanting to recognise the consequences of the progress of technology.

The big corporate players in America followed by those in England were the first to understand both that technology was sprinting ahead and that there was an important need for the internal e-learning training for their employees. Starting in the late 1980s with Motorola University (MU) in the United States, Lloyds Bank, Hilton Hotels, Rolls-Royce and IBM used "trained career coaches" to help employees establish their own "clear career progression pathways". A form of "watched freedom" that represents *direct control* nonetheless. The public services are catching onto the idea now: Arizona Government University (AzGU), British Telecom Academy (2001) and the National Health Service University (NHSU, 2004) just to mention a few, the last of which will be the largest in England (Cottee, 2003). In France, the National Centre for Distance Education (CNED) has been highly implicated along with the Ministry of Education in developing e-learning in the public sector with the creation of "digital campuses" (CNED, 2002).

Although it would be to the detriment of mastering reading etc., combat anti-individualistic attitudes could be a good pretext to adapt the recent proposals from the AI community, that is to increase development of learning through (multi-player) *game-playing techniques.* For the time being, this approach has a rather commercial flavour as it targets high-level corporate decision-makers, but we feel it is worth public assessment procedures as it does encourage the remedy of socialising.

Look at the historical process of innovations coming to support Distance Learning. We went from audio text flow on the radio (failure) through TV — mainly visual and audio text flow (success) — to multimedia multi-text convergence, meaning visual, audio, plain text plus animations, etc. (strong technical integrative progress and very high acceptance). What has this to

say about the nature of the instructional text today? And the type of literacy we are demanding of our students? There are perhaps other changes not too far down the road.

5. SHIFT NO. 3: AI AND THE IDENTITY OF THE LEARNER

Hard AI constitutes the earliest plausible premise for ITS, CSCL and CALC. The diverse aspects of Herbert Simon's intellectual life may have been meant to come together to form 3rd Millennium Distance Education. In any event, he was a "heavy-better" with his 'big' predictions. The period of 1952 to 1958 was a fast one for H. Simon: he met A. Newell at the Rand Corporation in Santa Monica California and focused his attention on the theory of games; in August 1956 he automated, along with Shaw and Newell, the very first theorem proving process using an example from Whitehead & Russell's *Principia Mathematica*; he studied A. de Groot's theories on the psychology of chess playing (Gobet, 2002) and, by 1958, Newell, Shaw and Simon had written the first computer program to play chess. In his 1958 *Operations Research* article with Newell, he predicted that in ten years time a computer would become the world chess champion. This did not happen actually until 40 years later.

While waiting for the triumph of IBM's *Deep Blue* over Kasparov in 1997, IA diversified. In the 70s, R. Schank was implementing "scripts" — frames for stereotypical social activities — to manipulate language in special purpose micro-worlds to deal with common sense knowledge (i.e. ordering food in a restaurant). However, the goal was still like that of Simon's, *teaching machines to "reason" like humans*; one could say his scripts described game-world scenarios. Presently, the quick evolution of work on pre-set fictive situations has caused important AI figures to climb back on the game-playing band-wagon. In the Introduction to Prensky's book (2001), one will notice that Papert goes along with this idea, though he would have done so already in 1993 (*cf.* Shift no. 2). And Schank's 35 year-long endeavours in prescriptive scenarisation have also been reconverted over to... yes, Distance Learning through Playing Games (2002).

Today's workforce is changing due to the ubiquitous nature of the digital. The idea in this new "*ludic AI* for acquisition purposes" is to make use of the newer non-conformist mind-sets we find in liberal enterprise in a lucrative way. Company CEO's are unaccustomed to the nature of the skills and knowledge of today's youth as they do not generally have a high literacy rate —according to the traditional definition. Human Resource managers have nevertheless realised they present the specific potential of becoming the

future strategy-builders of their firms. Could the current emphasis of turning corporate e-learning environments into tools for socialisation and fun be due to Simon? He was involved in administrative behaviour, decision-making, human psychology and the first game-playing applications of AI. He was known for saying "play with your knowledge and explore the unexpected connections". Even if he did make his own unexpected connection on the *ampleur* games would attain in distance education and 'forget' to make the prediction, AI as the foundation of e-learning owes a lot to his advancing knowledge in a topic of interest that has stimulated research for half a century.

6. CONCLUSION

In light of these three shifts in the history of computers in education, future perspectives in this young field of research should focus on inter-learner relations now that learning whilst exploring Otherhood has become paramount. The first shift shows that it has become blatantly impossible to link all the effects to their corresponding causes in high-functionality environments; new methods are necessary for CSCL applications (*cf.* Cottier & Schmidt). The second shift demonstrates that new dynamism in promoting transversal knowledge acquisition has found a place in international policy writing. One question may rest unanswered for the reader, particularly with respect to the third shift. Can we maintain the idea of paradigmatic shift if playing games started and ended the historical process of the AI Sciences in education? Or has AI taken us round full swing from chess-playing through emulating serious-toned courses on the Internet and back to playful activities in virtual classes (i.e. two shifts)? We believe we can maintain it because there is a fundamental issue when it comes to the pedagogical objective: *who* is acquiring the knowledge? *Humans teaching machines to play games has given way to using networked machines to teach humans.* But this should not come as a surprise as, halfway down the road to the New Millennium Distance Education initiatives discussed herein, a Socio-Psychologist from Harvard sent out a "tremor signal" to specialists in AI trying to teach machines to 'think'. In speaking of the computer's physical opacity in 1984, S. Turkle states that "the computer brings out thinking more than it determines it. [...] The computer has become 'an object we think with'". This corresponds roughly to the period of the beginnings of ITS. Since then, we have learned to think *through* this technical object in order to play and communicate with others. And most importantly, since the days of radio- and television-supported distance learning, our intellectual history has taught us that, whatever the distance, learning must be made fun.

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