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COMPLEX KNOWLEDGE AND EDUCATION COMPETENCES

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Complex knowledge and education competences

by

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Introduction

Far from being a natural phenomenon, the school and the school systems are social institutions developed at a certain time of history to satisfy concrete needs. School systems are, from their very start, the social device used to distribute "socially valid knowledge". These systems were organized as part of the emergence of the modernity with the aim to expand a secular worldview in the population in accordance to the development of a society based furthermore in the rational principles of science.

Though in Latin America its organization dates from between mid and end of XIX century, and in the central countries a bit earlier, the school—its basic institution—originated much earlier.[1] The subjacent conceptions which implicitly supported the school are basically related to three ambits: how learning is understood and how the student is defined; how teaching is understood and how the teacher and his/her role are defined; and which is the epistemological conception which defines the contents to be transmitted. The ways to define originally these three ambits are unavoidably embedded in the historic determinations at the moment of their emergence.

Throughout the XX century there has been great progress in the redefinition of the two first ambits, or pillars, of the didactic triangle, and that has allowed pedagogy and didactics great advances in terms of improvement in teaching. Today we acknowledge the fact that the student is not an object of teaching but a subject of learning, and we also know that "to teach" is to organize learning experiences for the student to advance in the process of construction of the object of learning. Still, little progress has been made and less has been discussed about the epistemological definitions that should characterize what society defines today as "valid knowledge". Within the theory of the curriculum, the updates of the approaches and the disciplinary contents are discussed but there is yet no deeper discussion in order to reach the different themes that relate to the epistemological aspects, which means those that reflect over the definition of knowledge, its types, etc.

The knowledge permeating the school system is not a "socially valid knowledge"

There is a clear conscience today that one of the dimensions of the crisis of education systems has to do with the crisis of the hegemonic models of how to teach and, above all, with the classic hegemonic definition of what to teach. There is also agreement about the fact that the great novelty of our times is that we are facing an education "revolution" which is of a totally different nature from the changes that education encountered previously. The problem is that expanding education is not enough[2], nor improve it; now the model has to be rethought and to do so the three pillars of the didactic triangle have to be redefined: what is understood for the subject of teaching, what is understood for the subject who teaches and what is understood for "valid" knowledge to transmit.

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[1] In the modern format, the convent schools of XIII century are generally accepted as the earlier schools (Brunner 2000).

[2] Throughout the XX century in Latin America the main problem was the expansion of the education system to include the populations that still did not attend school.

This discussion is in its infant stage and I think that not confronting it is very detrimental to it as it obstructs the development of the new education paradigms. My opinion is that one of the reasons for the unsolved crises in education is that our systems—and the great majority of education reforms proposed—are still based on a model of knowledge no longer pertinent, an obsolete knowledge, a model of knowledge applicable at the time education systems were created, but unable to mutate towards the new definitions. For some changes such as updates of the curriculum, modification of the structures of education, new training of teachers, had been proposed and implemented, but all these changes are based on an unquestioned supposition referring to the model of knowledge to be transmitted.

Education, and specifically school systems are institutional spaces of society for the generation and transmission of the knowledge society regards as "valid" for its growth and reproduction. The school is in charge of the transmission of complex knowledge, which means the ways of science not acquired by the interaction with other socializing groups. We argue that the present education changes ignore the latest developments of epistemology which are today redefining the knowledge in the ambits of academic discussion.

The crisis of the scientific model

The crisis of the conventional paradigm of science is each time more omnipresent and includes the redefinition of the foundations themselves which are understood as scientific knowledge. "Two decades ago, the unique arguments of Prigogine initiated a strong epistemological debate including today's notion of 'objectivity', the multiple shapes of the complexity, the new conceptions of rationality, the question of turbulence, and the relationship among science, values and politics." (Atilio Borón, prologue to Sotolongo and Delgado 2006). This means that there exists today a strong questioning that should affect the base of the sustainability of the education system, where knowledge is the "raw material" it distributes.

Perhaps the paradigmatic point expressing the depth of this change is that, from the beginning of the XX century, science started to cease to be the observation of the world (and information) to become the creation of the world. This re-locates the place of man in the world since it questions aspects so accepted as is the distinction between to know and to do. The appearance of this "New Knowledge" is related, among other things, with a new type of problems and with the ethical urgencies which have brought about the increase of creation in science[3] and its insertion in everyday life.

This crisis is leading to profound redefinition of the ways to do science and, above all, of the place of science and of knowledge within society. Sotolongo and Delgado[4] present this issue starting from the idea that the changes taking place in contemporary scientific thinking modify both the perspective of knowledge and the ideals of rationality. From the standpoint of the change in knowledge there are two central changes: the predominant place of *creation* in contemporary science and the *non classic* character of the new scientific creations, objects and instruments included, because these new creations have a non-classic character. These are not creations as the usual ones. The non-classic instruments and objects carry elements inherent in uncertainty and autonomy. The effects of its functioning escape

[3] Here we refer, for instance, to the ethical connotation of cloning or the use of information provided by the human genome.

[4] In all this section, unless expressly stated, the positions of Sotolongo and Delgado (2006) are followed.

the capacity of prediction and control of its creators which makes it problematic to establish correlations of forecast and effective control in the long term.

As a consequence, science and everyday life have changed, new problems have been formulated and a revolution in knowledge is being produced although frequently unnoticed. The content of the "unnoticed revolution" is constituted by the revolution in the conception of man, the ways to conceive and produce knowledge and science itself. One of the substantial changes brought about by this revolution is the modification of the place of scientific knowledge within the system of human knowledge, which leads to the elaboration of a new knowledge advancing hand in hand with the innovative theoretical solutions such as the approach of "complexity"[5]. (Sotolongo and Delgado 2006)

The ideas of complexity challenge the classic ideal of rationality. Facing this, which is structured from the ideal of simplification proper of classic rationality, a new rationality is imposed which prioritizes the look of the complexity as an essential characteristic of the social and no social reality around us. There is a new understanding of the world in terms of dynamic systems where interactions between the constituents of the systems and their environments turn out to be as important as the analysis of the components themselves.

A new rationality: the systemic rationality

The approach of "complexity" proposes the overcoming of the classic ideal of rationality, centered in the supremacy of reason, the objectivity of knowledge, the method and notion of knowledge at the service of man to do well. Over three centuries the consolidation of science as an independent knowledge made it possible that the classic ideal of rationality surpass the boundaries of the disciplinary scientific cognition and project itself ideologically to the ordinary man and his daily life. This ordinary man placed science and its factual knowledge above all other kinds of knowledge. If science incorporated reason as ideal, daily life assumed it as ideology. This has been its major influence, and the essential means to achieve it has been the school.

Such problematic issues are still restricted to some groups of discussion. "The science of complexity have not yet become a topic of wide recognition within the academic and scientific communities and still less within society in general or within the spheres of the State, notwithstanding the fact that there is an academic and scientific community increasingly interested and working in complex systems, both at home and in the world. What still rules is what in terms of Khun can be designed as "normal science". The reasons for the predominance of normal science and the difficulties for the emergence and consolidation, in general, of new paradigms and, in particular, of the sciences of the complexity, can be, and have been, partly at least, explored by the philosophy of sciences (Khun 1962; Kitcher 2000; Machamer and Silberstein 2002), the sociology of science (Latour 1998) and the cultural studies on science and technology known as STS (Science, Technology and Society)." (Maldonado 2004). "The sciences of the complexity redefine from scratch the relationships between the sciences and the philosophy, as well as among the sciences themselves, and therefore, between science and society." (Maldonado 2003: 142).

[5] Sotolongo and Delgado also refer to others: the Global Bioethics, the Environmental Holism, and the New Epistemology.

Though there are some groups of researchers and scholars interested in these topics and who work with them, this movement has not yet massively reached the pedagogy. Even though a detailed search allows finding some initial productions in this line, in the field of education the development of these viewpoints progresses slowly and faces serious difficulties. An example of this is the book by Antoni Colom (2002), whose critiques account for the still predominant classic thinking in this respect.[6]

An education system for the knowledge society

The society of the third millennium is defined as a knowledge society because of the characteristic of the role of (scientific) knowledge in it. It is not new that this type of knowledge has been for a while the engine of the (economic and social) development of humanity, but what is new of this age is precisely the fact that the type of knowledge used to drive this engine is, as we have already seen, of a very different kind from what it has been so far.

That is why the school system has at present lost its direction. It can no longer answer to the demands of society. The bases of the modernity have crumbled down and the meta-statement of the modernity based on the Enlightened Reason, which cohered and articulated the social whole, has been proved fake and no longer has legitimate capacity (Lyotard 1979). The education system has become "senseless" as a new account imposes itself from the development of the society of information and communication, carrying a new definition of knowledge, alien to its origins.

This new rationality is not based on the causative relation and on an explanation of reality which assumes that this is unchangeable and with laws that can be known. The age of knowledge is based on another type of knowledge, one that understands change not as a disruption of order but as a promising innovation. One where science is not only a description of "natural laws" and an explanation of the phenomena, but also entails the creation, the modification of nature, and therefore provides a new place to the human role. One in which the production of knowledge is not one thing and ethics another.

The challenge of the education reforms is not then what-school-for-the future but how the new society solves the need to distribute knowledge fairly; which characteristics must be inherent in such a knowledge to be "socially valid"; and how to organize the social environment to allow "lifelong learning". Today there are authors who, overcoming the idea of *reforming* education, refer to the *reinvention* (Elmore, 1990) of the school. The focus is always on the interaction between somebody (or something) that teaches and somebody that learns, but this reinvention is supported by a new organization of the teaching and learning process. As stated by the Forum in Toronto on Schooling for Tomorrow[7], "the school" is not necessarily an institution of the formal education system, because if it is reinvented it may refer to an amount of institutionalized arrangements through which organized and deliberate learning could take place. (OECD Secretariat 2008: 2)[8]

[6] For example, see the analysis of Fabio Chacon, Coordinator of the Area of Curriculum and Instructional Design of the Empire State College, Center for Distance Learning, Saratoga Springs, NY, at: http/edrev.asu.edu/reviews/revs 109.pdf.

[7] Toronto Schooling for Tomorrow Forum, June 2004.

[8] But it is necessary to be aware that the learning environments are not to be formatted according to the logic of the school, as it happens nowadays when an instance of learning is thought of, there is a usual appeal to the

I deem it necessary, together with Elmore (1990), to reinvent a new education model and its start should be the efforts to move forward in reaching agreements over how the new society understands what is learning, what is teaching, and what is "valid knowledge". This implies also to define which are the results (or the achievements) aimed at and how is the new society to organize the relationship between learning (how and where learning takes place) and knowledge (what knowledge should be distributed; which depth?). That is why I think it is foremost to talk about "competences" (differentiating them from the achievements of learning), and "learning environments"[9] and not just the school, which does not mean that the school cannot be one of those learning environments, or that the competences do not go beyond external actions and can be also understood as thinking operations.

What knowledge within the education system

The historic period of the emergence of the school and teaching was the transition between the Middle Age and the Modernity. Consequently, the paradigm of knowledge immersed in convent schools, still binding in the Magna Didactics by Comenius, is the product of this historic moment when a theological explanation of the world was being replaced by the knowledge of the modernity which imposed the enlightened ideal of rationality.

In ancient philosophy, in the Middle Age and even in the philosophy of the Modernity, the rationality was considered to be based on the ontological structure of human reason (caused by an Absolute Reason, a divine one, and structured in analogy to it). With the crisis of the Theo-centric paradigm and the loss of an absolute reference, for the modern post-enlightened man, the "rationality" not only loses its absolute foundation but also turns itself (in the logic of its self-referential resourcefulness) into something built in accordance to different environments or vital contexts. The procedural laws of thinking are, therefore, not unique, but emerge from those different contexts.

Prior to the modernity there existed three orders of truth: the theological truth based on the faith that ruled the cosmos and society; the philosophical truth based on the reason that accounted for the world, and the truth of tradition based on experience. To this tripartite scheme the modernity adds the truth of science based on the evidence which contrasts with reality. This is the look of the modernity which defines a model of how to think and what, immersed in the school systems, allowed these to collaborate with the need to secularize society, with the attempt to impose the model of knowledge of the modernity.

The school systems therefore based their contents in the new epistemological conception emerging. This approach, traditionally known as *scientific knowledge*, defines science as a human activity that describes and explains phenomena (social and natural) to acknowledge the laws of the functioning of reality, which have to be organized into theories. The aim of this knowledge is to describe and understand reality and wears out in the enunciation of theories.

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traditional frontal model. There already exist other formats of learning environments which are not invented from education but from other contexts, basically from the entrepreneurs. The management of knowledge and the learning outside the school throughout their lives already has a place in that media (Aguerrondo, 2008)

[9] This concept is being developed in the Project Alternative Models of Learning (AML), in the framework of OECD-CERI Schooling for Tomorrow.

As mentioned, in the knowledge society this approach has been redefined adding to it an active connotation. The classic conception, contemplative, considering science as the human activity that describes and explains phenomena to create laws and to enunciate theories, still remains to be the basis from where to define what knowledge is, but its ultimate aim is not only to enunciate theories. Today it is also expected to operate on reality, to solve problems. The objective is not only to enunciate theories but also to incorporate the possibility of acting on reality to enhance it. And this, which appears to be just a detail, modifies completely the relationship among man, knowledge and the world. It is what Sotolongo and Delgado refer to as the change of "the place of creation".

Furthermore, according to that first conception, the school made by itself the division of sciences into disciplinary languages and designed the curricula in terms of "disciplines" with well defined boundaries; instituted also the difference between "hard" science and "soft" one thus establishing the models of some as superior to others; accepted the scale of knowledge where the "scientific" becomes more precious (mathematics, physics, history) and the non scientific (music, art, physical education) play a secondary role in spite of the fact that it declares in the objectives of education the need of an "integral development" of the person.

In other words, when we speak of a redefinition of knowledge it does not mean that academic knowledge does not exist, or is not needed. What it means is that the knowledge society is reviewing the old antinomies and does not longer acknowledge any opposition between academic knowledge and applied one.

Models of Knowledge

Traditional Paradigm	**Third Millennium Paradigm**
Its objective is to develop theory	Its objective is to solve problems (using theory)
The new knowledge reverts itself in the scientific community	The new knowledge reverts itself in the society
Faces problems of reality segmenting them, develop 'disciplines'	Approaches problems from the need of its resolution, mixing disciplines
It does not commit itself to action	It commits itself to action
The criterion of verification is the logic of experimentation (does it explain the problem?)	The criterion of verification is the logic of effectivity (does it solve the problem?)

"The sciences of the complexity install effectively a new form of rationality, different from the ones already known to western history, and where there are no longer oppositions between the theoretical and practical levels**,** or philosophical and scientific, or theoretical and social, which have marked the bulk of the history of science as well as the history of philosophy". (Maldonado 2003: 153)

This redefinition of the model of knowledge is the basis for understanding the new discourses of education centered not only in the need of training thought but also in the commitment to develop the competences of the student. The competences imply precisely another kind of knowledge, beyond the traditional knowledge of the modernity, a knowledge that combines knowing and doing.

The education competences as fulfillment of complex thinking

The present debates on education fully agree on the diagnosis but not on the solutions. The strong agreement of conceiving education as a process centered in the learning of whoever learns, instead of a process of transmission of knowledge, is found today in a bottle-neck since it fails to agree on which are the reforms to achieve it.

I believe we still have to move forward in the area of what results are expected from the learner, and as to that I think it is totally pertinent to bring to the discussion the approach of the competences. Such a concept, born as part of the reflection on vocational training in the past two decades of the previous century, has generated many controversies in the education field. The education and the training based on competences have increased quite unexpectedly around the world, especially in those countries committed to offer a pertinent, effective and efficient education.

The concept refers to the idea of significant learning, where the notion of competence has multiple connotations (the capacity, expressed through the knowledge, the abilities and the attitudes required to carry out an assignment in an intelligent way, in a real environment or in another context), all of which have four common characteristics: the competence takes the context into account, is the result of a process of integration, is associated with criteria of execution or performance, and implies responsibility.

By their nature and the way they are obtained or developed, the competences are usually classified into academic, labour, and professional. As to the academic competences, they foster the development of the human capabilities to solve problems, to weigh risks, to make decisions, to work in a team, to take the lead, to relate with others, to communicate (listen, talk, read, write), to use a computer, to understand other cultures and, even if it sounds redundant, to learn to learn. Unavoidable competences in the same sense are to incorporate learning to undertake something to be achieved, according to each type of education, to learn to search, to learn to learn, to learn to study and to learn to research, and which in terms of a prospective vision of education, have to apply the seven complex lessons in education for the future that Edgar Morin (1999a) proposes.

Tobón (2007) argues that there are different approaches to the competences due to the multiple sources, perspectives and epistemologies which have been implied in the development of this concept as well as in the application both on education and in the organizations. The most outstanding approaches today are: the conductivist, the functionalist, the constructivist and the complexity approach (see below).

Perspective	**Description**	**Approach**
Conductivist	Assumes the competences as key behavior of the individuals for the competitiveness of organizations	Empirical-analytical Neo-positivist
Functionalist	Assumes the competences as a set of values that individuals must have to fulfill the purposes of the labour processes—professionals devoted to specific functions	Functionalism
Constructivist	Assumes the competences as abilities, knowledges and skills to solve difficulties in the labour-professional processes within the organizational frame	Constructivism
Complexity	Assumes the competences as complex processes of performance in activities and problems with qualification and ethics, seeking individual achievement, quality of life and a sustained social and economic development in balance with the environment	Complex thought

Note: Personal elaboration from Tobón (2007).

This author resumes from the research line in complexity and competences several of the elements stated in these definitions, such as performance, qualification, flexibility and global achievement, and from there he proposes to conceive the competences as:

> "Complex processes of achievement with qualification in certain contexts, integrating different kinds of knowledge (knowing to be, knowing to do, knowing to know and knowing to co-live), in order to carry out activities and/or solve problems as a challenge, motivation, flexibility, creativity, understanding and undertaking, within a perspective of meta-cognitive processing, on-going improvement and ethical commitment, aiming at contributing to personal development, construction and strengthening of the social network, the permanent search of a sustained economic-entrepreneurial development, and the concern and protection of the environment and the living species." (Tobón, 2007)

According to Tobón, this definition reveals six essential aspects of the concept of competences from the complex approach: processes, complexity, achievement, qualification, meta-cognition and ethics. This means that in each competence there is an analysis of each

one of these six central aspects to guide learning and evaluation; this has implications in the didactics, as well as in the strategies and instruments of evaluation.

The aspects of achievement and ethical commitment correspond to one of the most distinctive characteristics of the new knowledge—its capacity to revert itself in society because it aims at generating competences for the solution of problems.

Thus, the teaching and learning proposals within the frame of the knowledge society should integrate an education system whose objective must be the operations of thinking, not within the frame of traditional logical thinking, but within a model where the operations of thinking can be expressed by competences of action that are complex competences where abstract knowledge is mixed with experience. We define this type of thinking as *technological thinking*.

Traditional Paradigm ***Logical Thinking***	**Third Millennium Paradigm** ***Technological Thinking***
From the construction of theory →	→ to the solution of problems
From operations of thinking →	→ to the capacity to act on reality
Operations of thinking: Watch Describe Compare Reason	Operations of thinking plus: Competences of action Find a problem (define it) Diagnose it (explain it) Create the solution Solve the problem

The traditional logical lineal thinking is redefined in the frame of the technological thinking, which includes operations of thinking but places them in competences of action. Finally this commitment supposes not only the development of personal competences for the solution of their own problems but also the development of competences demanded by today's job life as well as the competences for participation and for civilian life.

Thus, it focuses problems from the need of their solution, mixing disciplines, discovering new emerging fields, since the look is placed on the problem and the problem is never to discipline it, the problem contains effects of the different disciplines. The school valid for the knowledge society will be that capable of organizing its teaching task in order to help students developing the capacity to solve problems. Bearing in mind the complexity of today's problems, this requires skills in the use of theoretical knowledge.

When we mention the need of an education for XXI century, we mean an integral education, capable of fostering in the students a set of achievements and knowledge(s) such as the skills, the knowledge and the necessary competences to be successful both in their personal lives as well as in their jobs. In the present century, these are:

- Basic curricular subjects and topics of XXI century
- Learning and innovation competences
- Competence in the handling of information, media and technology of information and ICT communication

- Skills for their personal and professional lives

Thus, from the school system perspective, important consequences are displayed. The new knowledge implies to accustom the students, the teachers, our communities, to the fact that what is expected as the outcome of education is people who think how to solve problems, and who are trained to solve them (or endeavor the solution). This means that there exists inside the school a potential to help the community, that it can help to solve problems in its immediate community, social problems or individual ones, concrete, real, which could turn out to be the essence from where the school would be enabled to work to train complex competences in its students.

A force-idea of such kind helps to produce deep changes because it redefines the work of the school overcoming the commitment of teaching to think by the commitment of teaching to think-to-know-how-to-do. This, again, is the challenge of the competences, which are in reality a know-how-to-do.

Systemic thinking is the basis of complex competences

Systemic thinking implies a vision of the complex reality in its multiple elements and with its diverse interrelationships. It is simply the acknowledgement of the systemic nature of the world. It watches its objects as *complex phenomena*.

The style of thinking known as "systems thinking" distinguishes itself from other ways of thinking because of various characteristics (Senge 1990). The essence of this way of thinking is a change of approach from the previous style of scientific thought, oriented to explanation by the causes, and is characterized by:

- Observe the problems in a **"holistic" vision**—just on the opposite side of the methodological reductionism—truly revealing the characteristics of the field studied without reducing inadequately its complexity.
- Observe **dynamic relationships** (networks of…) instead of looking for lineal chains of causes-effects.
- Overlook simple snapshots—static vision—to the follow-up of dynamic **processes**.
- Replace the one-dimensional consideration for **multidisciplinary** statements.
- Complete the analytical treatment of the quantitative aspects for the consideration in synthetic vision of the **qualitative** aspects.
- Substitute the determinist, deductivist and closed statement, for **open** statements, in circular **reversion** and supported in the creativity that enables **innovation.**
- Abandon the paradigm of the calculatory rationality, which presupposes an ontology of the stable, well regulated and manageable (with adequate techniques) to enter the paradigm of uncertainty and insecurity ("the society of risk"; philosophy of the complexity).
- Moving from the statement in models of the "trivial machine" to the models of the **no trivial machine.**

This global approach cannot be supported by the mere intuition or improvisation. To deal adequately with complex problems it is necessary to adopt methods which allow working from the holistic perspective. This is the vast field of theoretical and practical reflection and construction of a pedagogy and didactics which account for these new perspectives and which enable to generate new tools at hand for the teachers, tools which can solve the great current uneasiness of our schools and our school systems where the new generations do not find the adequate answers to their requests and needs, answers which will not be provided if the paradigm will not change.

Bibliography

Aguerrondo, I. 1994. *Planificación de la educación hoy en América Latina: ¿crisis o redefinición?* Ponencia presentada en la VI Reunión Técnica de REPLAD-OEA (mayo 1994). Documento Técnico Nº 1. Brasil: Universidad de Campinhas.

——. 2008. *La escuela inteligente en el marco de la gestión del conocimiento*. Seminario Administración del Conocimiento y la Información (abril a diciembre 2008). México: Instituto Politécnico Nacional, Centro de Formación e Innovación Educativa.

Brunner, J. J. 2000. *Educación y escenarios del futuro. Nuevas Tecnologías y Sociedad de la Información*. Documento Nº 16. Santiago de Chile: PREAL.

Colom, A. 2002. *La (de) construcción del conocimiento pedagógico. Nuevas perspectivas en teorías de la educación*. Madrid: Paidós.

Denis, B. 2006. *La participation politique, crise ou mutation ?* Paris: Ed. La Documentation Française.

Domínguez, G. 2001. "La Sociedad del conocimiento y las organizaciones educativas como generadoras de conocimiento: el nuevo 'continuum' cultural y sus repercusiones en las dimensiones de una organización." *Revista Complutense de Educación* 12(2): 485-528.

Dubet, F. 2002. *Le déclin de l'institution*. Paris: Editions du Seuil.

——. 2004. *¿Mutaciones institucionales y/o neoliberalismo?* Conferencia inaugural, Seminario Internacional sobre 'Gobernabilidad de los sistemas educativos en América Latina', 24 y 25 de Noviembre de 2004. Buenos Aires: UNESCO-IIPE.

Elmore, R. 1990. *La reestructuración de las escuelas, la siguiente generación de la reforma educativa*. México: Fondo de Cultura Económica.

Hargreaves, A. 2003. *Teaching in the knowledge society: Education in the age of insecurity*. New York: Teacher's College Press.

Khun, T. 1962. *La estructura de las revoluciones científicas*. México: Fondo de Cultura Económica.

Kitcher, P. 2000. *El avance de la ciencia*. México: UNAM.

Latour, B. 1998. *La esperanza de Pandora. Ensayo sobre la realidad de los estudios de la ciencia*. Barcelona: Gedisa. (Citado por Maldonado 2003).

Lyotard, J.F. 1979. *La condition postmoderne : rapport sur le savoir*. Paris: Editions de Minuit.

Machamer, P. y Silberstein, M. (eds.). 2002. *The Blackwell Guide to the Philosophy of Science*. Oxford UK: Blackwell Publishers. (Quoted by Maldonado 2003).

Maldonado, C.E. 2003. "Marco teórico del trabajo en ciencias de la complejidad y siete tesis sobre la complejidad." *Revista Colombiana de Filosofía de la Ciencia* (Universidad del Bosque, Bogotá) año/vol. 4, Nº 8-9.

——. 2004. *CTS + P. Ciencia y Tecnología como política pública y política social*. Bogotá: Universidad Externado de Colombia. (Quoted by Maldonado 2003).

Morin, E. 1990. *Introducción al pensamiento complejo*. Madrid: Editorial Gedisa.

——. 1999a. *Seven complex lessons in education for the future*. Paris: UNESCO.

——. 1999b. *La cabeza bien puesta. Repensar la reforma. Reformar el pensamiento*. Buenos Aires: Nueva Visión.

OECD (Organisation for Economic Co-operation and Development) Secretariat. 2008. *Alternative Models of Learning – Building on insights from recent OECD-CERI analyses*. Paris: OECD.

Rodríguez Moreno, M.M. 2003. *La metamorfosis del cambio educativo*. Madrid: AKAL.

Sarason, S.B. 2003. *El predecible fracaso de la reforma educativa*. Barcelona: Octaedro.

Senge, P.M. 1990. *The Fifth Discipline*. Londres.

Sotolongo Codina, P. y Delgado Díaz, C. 2006. *La revolución contemporánea del saber y la complejidad social. Hacia unas ciencias sociales de nuevo tipo*. Buenos Aires: CLACSO.

Tobón, S. 2007. "El enfoque complejo de las competencias y el diseño curricular por ciclos propedéuticos." *Acción Pedagógica* 16: 14-28.