Overcoming the underdevelopment of learning:

A transdisciplinary view

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Abstract

This paper serves as an introduction to the collection of papers prepared for the Symposium on *Overcoming the Underdevelopment of Learning* at the Annual Meeting of the American Educational Research Association, held in Montreal, Canada, from 19 to 23 April 1999. It will provide an integrative conceptual framework for the other papers, inspired by the following theses:

- Learning is an underdeveloped concept. It is increasingly necessary for humans to be able to adapt themselves to continuous and ever faster change and to conceive of the world as a complex environment. School-based learning, in many parts of the world, however, is often still largely based on the assumption that human intervention in the world is linear and that preparation for life is more important than preparation for learning during the lifespan. Fundamental change in the school system, attitudinal change in the actors within the school, and the conceptualization of more comprehensive learning environments of which the school is a part, are some of the urgent requirements.

- Learning is a transdisciplinary concept. It relates to such diverse issues and concerns as change and growth; community processes and development; complex adaptation; diversity and emergence; design of systems for knowledge construction; interaction with and building on existing knowledge bases; learning at different levels of organizational complexity; neuroscience; lifespan cognitive development; the connections and distinctions between data, information, knowledge and wisdom; technologies for learning; language, cognition, and meta-cognition. While much can be learned from looking at learning from the point of view of all these different perspectives as well as from their multiple interactions, there is also a need to transcend these different and separate views and to acquire a transdisciplinary and integrative vision of learning.

- Learning has to do with the capacity to interact creatively and constructively with problems. In much of the current educational practice such problems are at best concealed and at worst ignored. Learning therefore needs to be refocused on problems, including their historical and epistemological context.

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INTRODUCTION

The meaning and importance of learning are rapidly changing. It is argued in this paper that the way in which we should look at learning at the current juncture in time is markedly different from how it was commonly perceived until only a few decades ago. Nonetheless, and despite encouraging signs of change, much of current practice and related discourse is still heavily rooted in the conceptions and metaphors of the past. The central thought underlying the collection of papers to which the present paper provides the introduction is the concern that much still needs to be done in most circumstances to develop the conditions that promote and facilitate learning at large. Here I shall particularly attempt to sketch a broad vision of learning, providing a framework in which the remaining papers can be situated. At the outset it should be noted that learning is so multifaceted a concept that in no way this small collection of papers can be seen as anything more than a modest attempt to unveil a small, but hopefully significant, proportion of the questions that should be raised and to suggest directions for some of the strategies to overcome the underdevelopment of learning.

WHAT DO WE UNDERSTAND BY 'LEARNING'?

Merriam-Webster's dictionary, as included in the CD-ROM version of the Encyclopaedia Britannica (1999), relates the verb 'to learn' in its most common meanings to the gaining of knowledge or understanding, or the acquisition of a skill or behavioral tendency through study, instruction, or experience. An in-depth article on the *Philosophies of the branches of knowledge* included in the same encyclopaedia refers to the ability "to understand and manipulate symbols – verbal, mathematical, artistic, musical, and so on" as being of crucial importance to human learning. Nowadays one would certainly want to add to this list the symbol systems that relate to our technologically mediated communication environment, particularly those that pertain to the virtual spaces created through different uses of the Internet (see e.g. Taylor & Ward, 1998; also Burnett, in this collection). Symbolization allows human beings to deal in an abstract fashion with concepts and ideas, making it possible to handle them at levels that go beyond a given reality and thus to gain insight in and see connections between different realities. The power of symbolization, however, is also seen as a danger as "it can trap man into circling around at a high level of generality without ever feeling the need to tie his abstractions to concrete applications" (Encyclopaedia Britannica, 1999). Because of the recognition of the importance of symbolization in human learning, the tradition of schooling has put a particularly high value on it. To the extent that symbolization is indeed important, this should be seen as a

benefit of the schooling tradition. To the extent that the above-referred fear is justified, it should equally be seen as its downside. Due to the general recognition of the importance of symbolization and the emphasis attributed to it in the school context, school-based learning has become a dominant dimension, if not an exclusive focus, both in the public opinion and in the concerns of planners and policymakers, of how learning is being viewed. So dominant is this thinking that most of the alternative pathways to learning, such as much of the distance education practice, are based on the same kind of assumptions as those that underlie the schooling practice. There is clearly a need to rethink what is going on in the school environment and to do so from a perspective that looks at learning as much wider than the focus of the school and its implicit definition through mainstream instructional practice. Such rethinking should no doubt focus, among other concerns, on the role and value of abstract reasoning *vis-à-vis* concrete manipulation (Papert, 1993; Resnick, 1998; Turkle & Papert, 1990; Wilensky, 1991) and be itself a thinking process that finds expression, as Resnick shows, in concrete manipulatives.

WHAT DO WE KNOW ABOUT LEARNING?

The educational research literature does little to give us insight into the meaning of learning. What it actually is remains largely undefined. Often it is simply seen as the taken-for-granted consequence of instruction, an intermediary between our efforts to instruct and the behavioral changes in the subjects we study. We know that it has taken place through observable learning outcomes. Such learning outcomes can be measured to inform us about the amount of learning that has occurred. However, the tools used to observe and measure, as well as the choice of what to measure, do not only help to increase our knowledge about learning and thus to shape the conditions of learning, they also determine how we see the world. They may therefore restrain our view. They serve, to quote Salomon and Perkins (1998), both "to act upon the world and as scaffolds to facilitate such action" (p. 11). In addition to aiding us to understand and transform the world, they determine our perspective of the world. Similarly, in an analysis of how scientists' tools have shaped our visions of mind, Gigerenzer (1991) refers in particular to how "methods of statistical inference have turned into metaphors of mind" (p. 254).

Our knowledge about what it is to know and how we get to know, i.e. what it is to learn, is a social construction. It is based on agreed procedures of asking questions and probing the world, as well as on shared discourse and modes of interpretation and argument among a community of interest. This observation applies as much to the study of learning as it does to any other field of human intellectual endeavor. The study of the sociology of science (e.g. Bloor, 1991, discussed also in O'Connor, 1998) is of interest in this regard, and so is the study of the

history of science[2] (e.g. Koestler, 1959), as are accounts of the processes of scientific discovery as seen from the perspective of scientists' life history (e.g. Lederman & Teresi, 1993). Such studies show not only the great achievements that these processes of social construction of knowledge can lead to, they also reveal how scientific progress can stall – for periods of as long as two millennia even, as argued by Koestler – not just because of ignorance, but rather because of what, at a particular point in time, we think we know, but in retrospect often must recognize to have misunderstood, i.e. as a consequence of what Boorstin (1983) calls the illusion of knowledge.

THE NEED TO BROADEN OUR PERSPECTIVE ON LEARNING

Trying to understand learning exclusively from the perspective of what we know through the bulk of educational research may thus lead us to acquire too limited a vision. The learning outcomes that receive the attention of researchers typically relate to relatively short timeframes, as do the instructional metaphors (e.g. Wilson, 1995, March) to which they pertain. Moreover, they represent intellectual, motor and attitudinal capabilities of limited scope, largely developed in isolation of one another. Typically, the development of wisdom, and of what Nicolescu calls in this collection "the study of the universal" – as opposed to more narrowly specialized interests and ways of knowing – are not supported by their pursuit. We may thus fall short of attaining "the 'universal truth' of our time," namely "a systemic consciousness in which the consequences of events and actions are understood to be causally related and to have long-term effects for the survival of human life and for the environment that sustains it" (Csikszentmihalyi and Rathunde, 1990, p. 32). Little does the traditional focus on learning outcomes also reveal about the long-term dynamics of the development of learning in both individuals and communities. Nor does it take account of the complexity of experience that underlies learning. Anthropological studies, such as the one by Lansing (1991) of the Balinese culture of water management, reveal that these crucial dimensions of learning are often much better reflected in the local knowledge systems of so-called traditional societies than in the learning systems of western society. Overlooking them, as Lansing shows, can lead to disaster. Schank and Cleave (1995) observe in this connection that "the method people naturally employ to acquire knowledge is largely unsupported by traditional classroom practice" (p. 175). To bridge the gap between how people naturally learn and much of the current instructional practice, they propose that natural teaching be based on "goal-based scenarios" (p. 188). Such goal-based scenarios should meet four requirements, namely (i) that

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[2] A rich source on the history of science is the WWW Virtual Library for the History of Science, Technology & Medicine.

instruction coincide with each individual student's desire to learn; (ii) that the learner be involved, through exploration, in the pursuit of learning goals; (iii) that instruction be delivered on demand, preferably in the form of stories; and (iv) that failure be positively recognized as a driving force for learning. This proposal underscores the need for educational practice to take problems seriously and to explore their pedagogical value as they relate to students' real-life experience. Lederman, in this collection, thus points to a search for "educational processes that will strive for the capability of adapting, and even thriving in areas of new problems and new opportunities," requiring schools to "look across disciplines, across the knowledge base of the sciences, across the wisdom of the humanities, the verities and explorations of the arts, for the ingredients that will enable our students to continually interact with a world in change, with the imminence of changes bringing essentially unforeseeable consequences."

THE NEED FOR MULTIPLICITY OF PERSPECTIVES ON LEARNING

In addition to broadening our outlook on learning, there is also a need for multiple perspectives on learning, in other words, to explore diversity of views. Such different perspectives should not be seen as opposing each other, requiring choices to be made, but rather as a mosaic of complementary visions, each revealing part of the truth, not necessarily allowing one reality to be visible while another one is being explored. Failing to tolerate multiplicity of views leads to sectarianism, as seen for instance in the debate on constructivism (Phillips, 1995), failure to look beyond – or even recognize – one's own presuppositions (Greeno, 1997), and may, unnecessarily, encourage taking up unproductive single track positions (Sfard, 1998). I would add to this that it also reflects disrespect for the historical roots of our knowledge in past visions and approaches that worked in circumstances different from our own. Again, to draw a parallel with physical science, there is, despite our more refined current relativistic visions, still a lot of value in Newtonian mechanics as long as one is aware of its underlying assumptions.

The idea of complementary descriptions of the same phenomenon has long been known to physicists, since it was first formulated by Niels Bohr in 1928 (see Heisenberg, 1930). It is closely related to the notion that we are ultimately always ourselves part of the world we try to know. While the complementarity principle resolved important paradoxes of its time, related to the interpretation of quantum phenomena, its roots can be found, as Heisenberg points out, in the centuries old fundamental discussions, "so important for epistemology, of the difficulty of separating the subjective and the objective" (p. 65).

It is important to recognize that learning is a complex and multifaceted phenomenon and so is the world with which learning individuals and communities interact. Learning pervades the

lifespan and impacts on human life across multiple fields of interest. Available knowledge about learning, however, is scattered across a large variety of fields of disciplinary inquiry and traditions of practice, such as psychology, cognitive science, linguistics, neurophysiology, computer science, the study of complex adaptive systems, anthropology, instructional design, cultural studies, epistemology, economics, communications, management, to name but a few. They all work mostly within the boundaries of their own traditions.

To come to a better understanding of what learning is and how it can best be facilitated, there is a need to explore the interconnections between the above mentioned disciplinary contributions to our knowledge about learning. It is particularly necessary to develop visions of learning that go beyond the simple sum total of these different areas of research, i.e. to approach the challenge of exploring the meaning of learning at a transdisciplinary level[3]. This requires synergy between contributory disciplines and collaboration among scientists who recognize the importance of diversity of perspectives on the study of complex phenomena. At the Symposium on Transdiciplinarity, held in May 1998 in Royaumont Abbey, France, McMichael noted in this regard that "synergy, and the resultant emergent properties of the scientific discourse and conceptualization, are most likely to occur when a diverse mix of scientists cooperatively tackle research questions that are embedded in large, complex and dynamic systems" (UNESCO, 1998, p. 27).

THE WHOLE LEARNING

Learning almost never seems to be what it is intended to be by those – be they teachers, educational planners, instructional designers, school architects or the designers of virtual spaces of learning – who attempt to create the conditions for its emergence. Burnett, in this collection, speaks about the "wonderful phantasmagoria of emotions, experiences, thoughts, daydreams and projections" that often interfere with the well-intended educational communication process a classroom teacher may engage in. Both Singer (1988) and Edelman (1992), from different research perspectives, point towards the fascinating complexity of the workings of our neural make-up at any time, including while we learn – because we learn all the time. Even more complex is what happens when different individuals start interacting with each other to form communities of learning that interact collectively with a world in continuous change. Trying to understand learning, or to facilitate it through instructional practice or through the setting of

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[3] At the time of writing, a research project is being conceived that will aim at the social construction on the Meaning of Learning (MOL), using web-based technologies to generate synergy among a community of collaborating scholars and practitioners (see http://www.learndev.org. Interested individuals, institutions, and funding agencies are invited to contact ldi@ibm.net so as to clarify what and how they could contribute to this project.

appropriate motivational conditions, therefore requires that such complexity and wholeness be taken into account (see also Berenfeld, in this collection; and Burnett, in this collection).

LEARNING COMMUNITIES

Learning is essentially a social process (e.g. Salomon and Perkins, 1998). Nonetheless, much of what goes on in the schooling/training context is premised on the assumption that learning is primarily an individual act. This is most strongly reflected in the practice of assessment of learning outcomes. There are probably good reasons why this is so. After all, management processes that relate to the use of human competence – i.e. the job market and the educational systems that serve it – look at the individual human being as their most convenient unit of analysis and management. Those same individuals, however, function socially both within the schooling and training contexts referred to above and in most work related environments, as well as in multiple other settings to which they contribute through what they have learned and are learning. The Report to UNESCO of the International Commission on Education for the Twenty-first Century (Delors, *et al.*, 1996) identifies 'learning to live together' as an essential pillar among a total of four – the other ones being 'learning to know', 'learning to do', and 'learning to be' – on which the educational edifice of our world should rest.

At the conceptual level it is relevant to relate 'learning to live together' to Bereiter's (in progress) ideas on "deep understanding" as fundamentally a relational disposition. "Understanding implies abilities and dispositions with respect to an object of knowledge sufficient to support intelligent behavior." Bereiter considers in this context that "teaching for understanding is a matter of cultivating the learner's relationship to objects of knowledge, developing it into a relationship capable of supporting intelligent action." In this view, our capability to understand is particularly challenged in the everyday context of living together with other people. Again, to quote Bereiter: "High on the list of things we try to understand in our daily lives are other people – not people in general, but the particular people who matter to us, each one of whom presents a distinctive problem of understanding." This resonates with the words of the report by Delors *et al.* (1996) that "learning to live together, learning to live with others…is probably one of the major issues in education today"(p.91). "Encountering others through dialogue and debate is one of the tools needed by twenty-first-century education" (p. 93).

Similarly, and with reference to the social constructionist literature, Shotter (1997) emphasizes the relational nature of our knowing ourselves and each other and thus the dialogical nature of our 'inner selves.' "The 'things' supposedly in our 'inner' lives are not to be found within us as individuals, but 'in' the momentary relational spaces occurring between ourselves

and an other or otherness in our surroundings." He quotes in this connection Volosinov (1973), who argues that "the processes that basically define the content of the psyche occur not inside but outside the individual organism, although they involve its participation" (p. 25).

These views have profound implications for how the environments in which learning takes place should be envisioned. There is little doubt that the learning individual is an entity to count with. However, the almost exclusive focus on the individual in the traditional conception of the school is detrimental to the development of the kind of disposition Bereiter (in progress)refers to. It is also counter to the dialogical practice of knowing stressed by Shotter (1997) and Volosinov (1973). There is therefore a need to visualize the individual learner as an integral part of learning communities. Such communities are, by nature of the fact that they are learning, open. Individuals normally participate in different learning communities – e.g. the school, the family, the media context, community-based settings, etc. – at one and the same time. It is important to distinguish between the concepts of 'learning community' and 'collective of learning individuals.' Learning communities demonstrate as such learning behavior, i.e. as a whole they have the ability to constructively interact with change at a level that transcends the simple sum of the various individuals who constitute the community. Internally they are the dialogical basis for the construction of knowledge among the participating individuals. They are an essential condition for deep understanding among them.

Applying the above notions to the conventional teaching/learning situation cannot but lead to rethinking the roles of both teachers and learners, and indeed other actors as well, within the overall context of the learning community and, I should emphasize, *in relation to each other*. Driscoll (in this collection) thus rejects the either/or alternatives of focusing on only one set of actors present in the learning environment, arguing that "viewing instruction from either a teacher-centered or a student-centered lens" in both cases leads to "perspectives [that] are myopic." She thus proposes a view that focuses on the – dialogical – learning process itself. While the conditions in many traditional classroom settings may not be particularly inviting to lead to the kind of changes envisioned, it is a lucky circumstance that many learning situations are no longer solely conditioned by the characteristics of closed spaces. Visser and Jain (1996) argue that particularly the emerging information and communication technologies, if adequately taken advantage of, offer opportunities for these changes to occur with far less effort. Berenfeld (in this collection) describes technology-facilitated learning communities that exemplify these notions. UNESCO's work in the area of *Learning Without Frontiers* (online) is another source of documentation of these processes.

TOWARDS AN ECOLOGY OF LEARNING

On various earlier occasions (e.g. Visser, 1996; 1998; in print) I have advanced the idea of the learning environment as the overall setting in which learning communities come into being, evolve, die, regenerate, transform. This is a different conception of 'learning environment' than the one usually encountered in the literature, defined, for instance, as "a place where learners may work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities" (Wilson, 1995, p. 27). Definitions such as Wilson's emphasize the need to conceive of spaces of learning in conformity with the principles of collaborative learning, particularly as seen by the constructivist school of thought. While recognizing this need, I argue in addition for a broader meaning of the term 'learning environment.' It is useful to interpret that broader meaning with reference to an ecological-biological metaphor – to be further explained below – and thus to conceive of an ecology of learning. In this broader sense, the idea of learning environment comprises different levels of organizational complexity, ranging from low to high. It includes, but is not limited to, the notion of learning environment covered by the above-cited definition by Wilson.

The learning environment, then, may be compared with the biosphere. In other words, what the learning environment is to learning is what the biosphere is to life. The Encyclopaedia Britannica (1999) refers to the biosphere as the "extremely thin, life-supporting layer between the upper troposphere and the superficial layers of porous rocks and sediments" that cover the Earth. The term biosphere is used in two ways, i.e. to refer to the part of the world in which life can exist as well as to indicate the collection of living beings together with the environment of which they are an integral part. Both meanings refer to the full range of conditions and organisms existing on the planet Earth. The second meaning draws specific attention to the notion that organisms co-exist and that the life of one organism is conditioned by the life of all other organisms present in the environment. To put it differently, organisms interact and exchange resources with the environment that they 'see' around them, but they are at the same time part of the environment as other organisms 'see' it. In yet another words, they use the resources they find in their environment and are themselves also perceived as a resource by others. At a higher level of organizational complexity we see species interact with each other to form biological communities. As they compete for shared resources, they adapt to the physical parameters and the flora and fauna within the community, thus carving out their specific niche by developing specialized features. This gives rise to the development within communities of such structures as food chains, food webs, guilds, and other interactive webs. Over time the relationships within these structures evolve as the different species co-evolve. The result is a rich diversity of life

forms that co-exist thanks to the presence of nested frameworks of organizational complexity to which different time scales and spatial frameworks apply.

There is much similarity between the ways that life forms co-exist and co-evolve in the biosphere and what happens in the learning environment. Just like life exists at different levels of organizational complexity – from the cellular, or even molecular, level upwards to the level of highly complex biological communities – so does learning manifest itself at a similarly rich diversity of levels in the learning environment. The notion of learning community, as referred to above, is key to this ecological interpretation of the learning environment. Learning entities range from the level of learning individuals to that of very complex webs of interconnected people who share a common interest and who – either implicitly or explicitly – work together in a continuous process of creating new meanings. Such learning communities may be intentionally and/or formally structured, requiring deliberate steps to be taken to become a member. In other cases becoming a member of a learning community may be a far less conscious process.

Examples of learning communities abound. They occur in schools, in the market place, the work place, places of worship, the home, the extended environment of family and friends, etc. They are equally generated through the media, such as exemplified by the experience of community radio, local TV stations serving small communities, village video, rural and local press, but also increasingly in the context of larger media networks that attract global audiences, particularly now that such audiences develop the capacity to talk back via, for instance, the Internet. The Internet itself has generated a great variety of mechanisms through which people become members of communities that derive great learning benefit from their interaction. The designation of such communities as 'virtual' is unhelpful to transmit the very real and deep sense of togetherness, shared purpose or commonality of interest experienced by its members, even in such cases where membership is only ephemeral. Spaces such as museums, and other manifestations of art, music, dance, and in general the celebration of cultural identity and diversity, are other opportunities to bring people together in processes that lead to the collaborative creation of new meanings. Street children require less sophisticated means to do the same for the purposes that serve their interests. Other examples are the various scientific communities; corporate environments, particularly those that have chosen to become learning organizations; clubs; associations; and one could go on and on and on. The picture becomes even more interesting if one starts considering how all those different communities interact, if alone because individual human beings move across the permeable boundaries that surround each of them. This is perhaps most concretely expressed in the notion of learning cities (Jain and Jain,

1998; Longworth, in print), but the idea is equally present in such less well operationalized notions as the learning society and the learning world.

LEARNING COMMUNITIES AS COMPLEX ADAPTIVE SYSTEMS

Learning communities, as referred to here, should be conceived of as complex adaptive systems. Holland (1995) identifies the following characteristics common to all complex adaptive systems:

- They consist of multiple interacting agents.
- They represent an aggregate behavior that is not the same as the simple sum-total of the behavior of each of the constituting agents considered in isolation.
- Such more complex aggregate behavior is the result of nonlinear interaction among agents.
- Diversity is a key characteristic of how numerous agents fit into a complex adaptive system and interact among themselves in that context.
- Complex adaptive systems are capable of self-(re)organization, a capability that fosters the evolution of diversity.
- The aggregate behavior of the system exhibits perpetual novelty thanks to the evolution of diversity.
- Agents in complex adaptive systems employ internal models of anticipation.

It is not difficult to see how these principles apply to the behavior of learning communities, nor is it difficult to see the connection between learning and growth if learning is seen as what complex aggregates of human beings do in a wide variety of different sets of interrelationships. Interpreting learning this way has important implications for how we visualize the ways in which the different structures in the society should (or should not) intervene in creating the conditions of learning. As Holland states: "The combination of internal models with a diversity of agents, along with the attendant nonlinearities, undercuts most traditional approaches to system dynamics" (p.46). This conclusion highlights to what extent the notion of educational planning is being challenged if we admit that the learning behavior of complex adaptive systems produces "perpetual novelty" (p. 46) rather than the stale traditions, the inability to change, and repetitious patterns of behavior inherent is so many of our education systems.

THE WHOLE LEARNING ENVIRONMENT

I thus conclude that it is of crucial importance to attend to the learning environment as a whole. Learning entities (individual/social) at diverse levels of organizational complexity live in that environment. They use its resources and are themselves part of the resources that make up

the environment. They are organized, and should be allowed to self-(re)organize themselves perpetually, in a complex web of nested frameworks relevant to human learning behavior as it relates to different timeframes and spatial contexts. A separate paper would be required to fully elaborate the idea of how learning needs in human society are differentially reflected in the levels of organization of complex adaptive learning systems. Often, their analysis would be the object of anthropological inquiry rather than that of the more regular educational research tradition. One example was given earlier in this paper with reference to the work of Lansing (1991).

This paper started of by being critical of the interpretation of learning as being mainly what is being done in the school and similar contexts. Those contexts emphasize relatively short-term temporal concerns and, but admittedly to a lesser extent, limited spatial frames of relevance. The world being what it is, dangerously close to reaching the limits of what it has to offer to those who inhabit it, there is an important need to redefine what it means to be learning on one planet, in one solar system, of one galaxy in a universe of fascinating complexity that, in the course of its evolution, has produced the neural matter of our individual and collective minds.

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