learning development institute

Concept Paper
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THE SCIENTIFIC MIND IN CONTEXT

Introduction

This concept paper is about the complex combination of skills, thought processes, attitudes, ethical concerns and aesthetic considerations that can be associated with the scientific mind. It is also about the conditions that allow or impede the scientific mind to develop and flourish in a perspective of lifelong human development. It proposes, as part of an overall effort to contribute to fundamental change of the learning landscape, a symposium on the scientific mind, for which it seeks to generate financial and substantial partnership. It also aims at speaking to the interests of the potential invitees of the symposium, whose intellectual commitment and engagement it seeks to obtain.

The scientific mind: The need to broaden the perspective

The creation of a scientific mindset has traditionally been seen as the domain of science educators. This is too narrow a view. Science educators no doubt contribute considerably to the process, but they are not – and should not be considered – the only ones responsible for doing so. Neither should it be taken for granted that the perspective imposed on the large majority of science educators, for instance through existing curriculum models, is the most propitious one, nor should it be assumed that the approaches applied by them are the most effective ones to promote and foster the continual development of a scientific mindset that can usefully be employed to tackle the problems of our time. Such problems are almost invariably of a nature that transcends the narrow focus on science *per se*. What is needed now more than ever is the development of the scientific mind in context.

This paper serves as a brief conceptual sketch to outline the problem area. It seeks to raise questions that can motivate new thinking, research, policy and action. It is particularly intended to inspire a three-day symposium that will bring together a small group of people (approximately 20, maximum 30) from as wide a variety of disciplinary

backgrounds as possible. This group will include, among others, scientists, artists, philosophers, writers, thinkers about learning and human development, cognitive scientists, brain researchers, and managers and designers of learning environments. They will be carefully selected to represent creativity and wisdom in deviating from the trodden paths. Particular attention will also be paid to inventiveness in the use of all currently available technologies and depth of insight into the meaning of learning. Considering the global importance of the scientific mind, due consideration will be given to the need for this symposium to rise above the biases of one or a few particular cultures.

Purpose of the symposium

The above symposium is designed to be the first step in a comprehensive effort to rethink the conditions for lifelong learning as they pertain to the development of the scientific mind. The initiative originates from discussions that took place in conjunction with the international symposium on *Overcoming the Underdevelopment of Learning*, organized by UNESCO's Learning Without Frontiers unit in collaboration with the Learning Development Institute at the Annual Meeting of the American Educational Research Association, held from April 19-23, 1999, in Montreal, Canada. The need to link theory and discourse on the one hand, and policy and practice on the other, stood out in those discussions. Thus, the aims of the symposium are

- to raise the level of understanding of what the scientific mind entails and how it relates to, and is relevant for, multiple aspects of human endeavor, including, but not limited to, the advancement of scientific knowledge, insight, and know-how;
- to generate ideas and strategies about what the key conditions are that promote and facilitate the continual development of a scientific mindset as an essential ingredient – but not an isolated or exclusive component – of the human capability to deal with complex problems in context;
- to lay the basis for a publication of the proceedings and conclusions of the symposium, aiming to inform and inspire policy, research and practice, regarding the learning environment at large, i.e. including such areas as the broadcast media, the school, the family, museums, and the Internet;
- to lay the groundwork for follow-up activities aiming at creating propitious conditions for the development of the scientific mind in a lifelong and life-wide learning perspective.[1]

[1] Examples of follow-up activities are: A radio science story telling project with global outreach, focusing on awakening the motivational conditions for the development of the scientific mind, possibly using direct digital satellite broadcast technology, such as provided through the WorldSpace system, in combination with the Internet; creating a capacity building and exchange network to inspire reform in school-based learning; expansion of the network of science museums/clubhouses and similar venues for exploration and free-choice learning in science and technology to parts of the world where such facilities do not exist, complementing the effort with the creation of related virtual spaces for exploration. ('Free-choice learning' is defined at http://www.ilinet.org/freechoicelearning.html. Information about the WorldSpace technology and its applications can be found at http://www.worldspace.org and http://www.worldspace.com. A potential partner in expanding the science museum experience to Africa is the Pathfinder Foundation for Education and Development, information about which is available at http://www.cmdfoundation.org).

Rationale

The scientific mind comprises attitudes and skills – cognitive and meta-cognitive ones – that disposition people to question the facts and critically challenge the 'givenness' of any a priori knowledge and authority. It also represents a high level of aesthetic and moral conscience. Development of a true scientific spirit is important not only to create a scientifically literate population, but particularly also to create a citizenry that can creatively and constructively respond to the challenges of the world of the 21st century. So many of these challenges being of a global nature, it is particularly important to stimulate the development of the scientific mind in the context of learning communities that are not restrained by geo-political boundaries. Computer networking is a technology that has, if well designed and applied, important potential for such development, but other processes of global exchange should also be explored.

The call to focus on the scientific mind as a dimension of human capability that has relevance beyond its application in the advancement of science *per se* comes from scientists themselves. Lederman (1999) refers to the "ability to function in entirely unpredictable situations" not only as an essential component of the make-up of scientists, but as an important condition of life in general in today's world. He thus calls on schools to "look across all disciplines, across the knowledge base of the sciences, across the wisdom of the humanities, the verities and explorations of the arts" to find the ingredients of educational processes that "will enable ... students to continually interact with a world in change." Penzias (cited by Visser, 1999) notes that children cease to ask questions – a key element of scientific pursuit – as soon as they go to school. In a time in which knowledge becomes obsolete various times in a lifetime, this is a frightening situation. Penzias thus emphasizes "learning to learn" as an essential ability to be acquired and maintained.

Asking questions, and the refinement of the ability to do so, should be a process of permanent renewal. Pais (1997), in a retrospective analysis of how the world has changed over the past decades, points to two time scales that have dramatically gone out of sync. One is expressed in the roughly 20-year timeframe that marks the leadership of a particular human generation before it passes on to the next one. The other one is "the period after which existing information and technology become obsolete. A critical point is reached when the second period becomes shorter than the first one." Then, according to Pais, "the experience of the older generation is no longer all that helpful." If ever there has been a reason for critical inquiry to be a lifelong endeavor, it is now.

The development of the scientific mind should not take place in isolation. It is part of the broader make-up of the balanced development of human beings. Perkins and Grotzer (2000) show that dealing with science in isolation from the consideration of its epistemological underpinnings adversely affects student performance and may lead to gross misconceptions. Their study suggests that such a treatment inhibits the development of the skills and attitudes so crucial in science to continually challenge one's own assumptions and theories.

Science and technology have become important dimensions of everyday life. Without a basic understanding of the principles governing the way human beings think, feel and act scientifically, a critical assessment of today's problems – and intelligent and constructive participation in responding to such problems – will be impossible. However, it is important to recognize that such understanding of the principles of science is a situated understanding. Wilson (1998) notes that "most of the issues that vex humanity daily...cannot be solved without integrating knowledge from the natural sciences with that of the social sciences and humanities." Lederman (1999), addressing the issue of school science, calls for increased dialogue among the disciplines, not only the scientific ones, but including the social sciences, arts and humanities as well. Nicolescu (1999), arguing that integration of disciplines should also lead to the development of visions that transcend the simple sum total of each of them separately, recommends "to devote 10% of the teaching time in each discipline to transdisciplinarity." In the same vein, the Declaration on Science and the Use of Scientific Knowledge (1999), adopted by the World Conference on Science, held in Budapest, Hungary, from June 26 to July 1, 1999, emphasizes in its preamble the urgency to "seek active collaboration across all the fields of scientific endeavour, that is the natural sciences such as the physical, earth and biological sciences, the biomedical and engineering sciences, *and the social and human sciences*" (emphasis added).

Call for debate and action

The above considerations provide a strong argument to take a fresh look at what is required to foster the development of the scientific mind in a lifelong and life-wide perspective. Such reassessment touches not only upon existing practice. Questions must equally be raised about the narrowness and rigidity of established discourse that underlies such practice and tends to see it as restricted to the instructional environment. Moreover, a constructively critical look is required at the research agendas built to inform, but also causing to last, established discourse. Put differently, there is a need to break open the vicious circle of too narrowly defined research that informs too narrowly situated discourse that, in turn, supports and reflects too limited practice. After all, that same limited practice is quite generally recognized to be failing.

The concerns referred to earlier in this concept paper are felt around the world, as much in highly industrialized nations as in those countries customarily referred to as 'developing nations.' Common sense dictates that it would be dangerous to limit the concern with the scientific mind to only certain parts of the world. Indeed, some of the most pressing problems facing humanity today not only affect us all, what's more, they can only be solved on a global level and through the involvement of citizens worldwide. The acute imbalance in opportunities among nations to develop the values, attitudes, thinking habits and skills pertaining to the scientific mind is thus not just a great injustice; it is also a threat to peace, equity and sustainable development. The preamble to the aforementioned Declaration on Science and the Use of Scientific Knowledge (1999) therefore calls for a "new commitment," urging that "the role of the sciences...be collectively defined and pursued." Similarly, a UNESCO (1999) analysis made of the "Principles and commitments contained in the documents of the World Conference on

Science" as a "basis for follow-up activities" identifies among the principles contained in the Declaration the notion that "science education at all levels and without discrimination is a fundamental requisite for democracy. Equality in access to science is not only a social and ethical requirement: it is a necessity for realizing the full human intellectual potential."

Partnership

The Learning Development Institute has taken the initiative for the international symposium proposed in this concept paper cognizant that, in order for the debate to result in sustained action, a strong partnership is required. Currently that partnership is made up of the following institutions/organizations:

- Learning Development Institute (LDI), which sees the initiative as an important lever to forge fundamental change in the way societies promote and facilitate learning;
- United Nations Educational, Scientific and Cultural Organization (UNESCO);
- International Council for Science, Program for Capacity Building in Science (ICSU/PCBS);
- Centre International de Recherches et Etudes Transdisciplinaires (CIRET);
- Forum. International des Sciences Humaines (FISH).

It is expected that, while the idea continues to take shape, others will join. Interested parties are encouraged to contact ldi@learndev.org.

Scope of the debate

By nature of the problem area under consideration, the scope of the debate envisaged for the three-day symposium will necessarily be wide. The overall question to be tackled is the following one:

> *If there is such a thing as the scientific mind, what exactly is it? What pertains to it and what not? What is counter to it? If it is, as this paper suggests, something worth caring for, why should society value it and what should society do to allow the scientific mind to develop and flourish in the perspective of lifespan human development and the practice of learning[2] throughout life?*

Many other questions can be derived from the above one. Some of them are listed below as an illustration of the amplitude and importance of the discussion envisaged. By no means should that list be seen as exhaustive or closed.

- How does what we think to know about the scientific mind, intersect with what we know about such domains as learning; cognitive development; creativity and critical thinking; pedagogy/andragogy; instructional design; the workings of the brain; the processes involved in experiencing and appreciating beauty; our sense

[2] 'Learning' is meant to refer here to all those processes that allow humans, on an ongoing basis, to engage in the development of intelligent behavior – both individual and social – that supports humanity's constructive interaction with change.

of belonging and solidarity; the social role of the media; the nature of the public debate in different parts of the world involving questions about the meaning of science and the meaning of learning?

- What implications can be derived from answers to the above questions for
  - the diverse school systems in different parts of the world;
  - the role played by the broadcast media;
  - science museums/centers/science clubhouses/science travel;
  - the family as a learning environment and the way that environment can be helped to function adequately;
  - the role and nature of science writing and other ways of science communication among the public at large (e.g. science journalism, book publishing, Web publishing), particularly as regards questions such as choice of topics and approaches; integrity; mystification *vs.* clarification of issues; science/science fiction/science adventure/science storytelling;
  - the place and role of libraries/media centers in the community;
  - Internet-enabled processes to become involved in scientific exploration;
  - the role of the producers of scientific knowledge, such as major laboratories, and their responsibility to open themselves up to the community;
  - the place and relevance of the contemplation of nature in a world in which it becomes increasingly unnatural to stand face-to-face with nature?

- What is the importance in the above context of reviving (in many societies/cultures where the practice has died out or diminished) philosophical debate and inquiry, raising consciousness of the painful and often courageous history of the development of knowledge, and generating insight into how little we know and how fragile, yet at the same time wonderfully beautiful, our theoretical constructions are?

Notes on the multidimensionality of the scientific mind

The scientific mind is a complex mindset. The following suggestions are offered as a starting point for the description of its multidimensional character:

- The spirit of inquiry
- The spirit of collaboration
- The quest for beauty (harmony, parsimony, wholeness)
- The desire to understand and do so profoundly
- The creative spirit
- The urge to be critical
- The spirit to transcend
- The spirit of building on prior knowledge
- The search for unity
- The building of the story of human knowledge and ability
- The spirit of construction

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