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COMEST

World Commission on the Ethics of Scientific Knowledge and Technology

Nanotechnologies and Ethics

- Policies and Actions -

COMEST Policy Recommendations

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Nanotechnologies and Ethics

Policies and Actions

World Commission
on the Ethics of Scientific
Knowledge and Technology
(COMEST)

Contents

1 Introduction

Nanotechnologies currently are one of the most rapidly developing technologies with many promising applications in medicine, energy, manufacturing and communication. Like any new technology, they raise ethical issues; and the possible benefits and harms are increasingly discussed, as well as its implications for international relations in science and technology policies. UNESCO can take initiatives to map the ethical dimensions of nanotechnologies from a global perspective, and to explore implications for its Member States and possible actions for the Organization.

A first examination of the ethical dimensions was discussed in a special session on nanotechnologies during the 3rd Ordinary Session of COMEST in Rio de Janeiro in December 2003. It was also an issue presented in a number of debates during the 4th Ordinary Session of COMEST in Bangkok in March 2005. Following these meetings an ad-hoc group of experts was established to explore the ethical issues in relation to nanotechnologies. On the basis of the recommendations of the group of experts an outline of a policy document was drafted. This outline was discussed in the Extraordinary Session of COMEST in June 2006. After further expert consultation on 16-17 November 2006 in Paris, additional recommendations were taken into consideration during the 5th Ordinary Session of COMEST in Dakar in December 2006, resulting in the following COMEST Policy Recommendations on Nanotechnologies and Ethics.

Nanotechnologies can be used to enhance the lives of the privileged, as well as to address the concerns of the developing world, including the UN Millennium Development Goals (MDGs). UNESCO has an opportunity to advocate an ethical approach in the identification of fundamental purposes for the research, development and application of nanotechnologies. From a global perspective, ethical reflection needs to address the potential benefits and harms of nanotechnologies but even more important is assessing and publicly discussing the goals for which these technologies will be used, now that science and technology can be harnessed to solve the most pressing needs of humankind.

2 Methodology

In order to enhance the relevance of actions undertaken, three categories of stakeholders have been involved in exploring the ethical dimensions and international activities: philosophers and ethicists, scientists, and policy-makers. The involvement of these three categories of experts explains the scheduling of activities in three phases set out below:

2.1 First phase: identification of the moral dimensions

In the first phase, UNESCO established a multidisciplinary group of experts, whose mandate was:

- To review the state-of-the-art of ethical considerations of nanotechnologies; and
- To identify opportunities for international action.

The group of experts on the ethics of nanotechnologies met in UNESCO Headquarters in Paris on 5-6 July 2005 and 6-7 December 2005. Based on the papers submitted by the experts and the debates during these two meetings, proposals for international action have been identified.

As a first step in the awareness-raising process, the papers of the experts have been collected in a book "Nanotechnologies: science, ethics and policy issues" to be published in the "Ethics of science and technology" series of UNESCO.

2.2 Second phase: testing the relevance of potential international actions

It is important that the considerations of the experts address the moral concerns of the scientific community but also of society at large. In the second phase, representatives of the various sciences involved in the development and application of nanotechnologies have examined the strategies and options proposed. The consultation meeting of experts in November 2006 in Paris have been the first opportunity to test the recommendations.

2.3 Third phase: enhancing the political feasibility of potential actions

As soon as this COMEST report has been published, major significant stakeholders will be consulted and involved in the process regarding the political feasibility of potential actions identified in the two previous phases. This implies that the relevant stakeholders are identified at an early stage, and that they are consulted about possible and desirable actions in this area. On the basis of this consultation process, specific activities can be undertaken.

3 Central features of nanotechnologies

3.1 Interdisciplinary and cross-disciplinary dimensions

One way to characterize nanotechnologies is to refer to their interdisciplinary dimension. There is not one particular technology that should be called nanotechnology, but the word rather refers to several technologies and sciences. From the scientific point of view, nanotechnologies question the usual distinctions between scientific disciplines. Furthermore, the distinction between science and technology is very difficult to make in this field (scientists and engineers have to work in the same teams). Finally, the very boundaries of science and the humanities are disappearing as the nanoscale is being explored. Constructive interactions between science and the humanities must therefore be reinforced in order to avoid mutual distortions and misunderstandings.

3.2 Peculiarities of nanotechnologies

The following peculiarities of nanotechnologies give rise to specific ethical concerns:

a. **Invisibility**: the invisibility of nanotechnologies when applied makes it difficult to control and trace their effects (similar to nuclear technology).

b. **Rapid development**: the rapid pace of development in nanotechnologies creates difficulties in the identification of and response to potential impacts, especially long-term impacts.

c. **Military and security use**: military and security applications of nanotechnologies could potentially result in conflicts with human rights.

d. **Global impact**: potential impacts on countries and societies even if they are not participating in the development of nanotechnologies.

e. **Risk of "nano-divide"**: potential deepening of inequalities between developing and developed countries.

3.3 Nanotechnologies as an opportunity

Nanotechnologies are enabling technologies. Therefore nanotechnologies require a holistic approach, which implies a truly interdisciplinary dialogue. This applies to any of the actions proposed here: debate, education, research and policy. Reciprocally, the development of nanotechnologies may be an opportunity to develop

interdisciplinary cooperation in the sciences as well as transnational cooperation, helping to address one of the most basic demands of ethics of science and technology.

4 Articulating the ethical framework

4.1 Ethical principles guiding the development of nanotechnologies

UNESCO should pursue further reflections on nanotechnologies, with the purpose of examining and elaborating ethical principles that could guide the development of nanotechnologies.

4.2 Public accountability and transparency

The principles of public accountability and transparency in decision-making regarding nanotechnologies investment, research and development should be highlighted, paying particular attention to the implications and risks of military interests. Models on how these principles are to be applied within society could also be developed. The importance of concepts within organizational ethics such as corporate social responsibility should be noted. Decision-making on nanotechnologies should also include benefit-sharing considerations, with emphasis on the furthering of peace and conflict resolution.

4.3 Capacity building on ethical issues

UNESCO should facilitate capacity building for Member States and the general public to deal with ethical issues in nanotechnologies by developing an initial database on existing policies, codes of conduct and guidelines of professional organizations, policy bodies and research institutes, and transforming it into an observatory for action in the future.

4.4 Public participation

Public participation in the formulation of nanotechnologies policy should be strengthened, reinforcing the need to involve civil society groups, including those concerned with the environment, health, labor unions, and public safety. The need to stimulate further development of models for public debate in nanotechnologies policy should be highlighted. Member States' capacity for public participation should also be strengthened, especially in developing countries. UNESCO should participate in existing public forums on nanotechnologies to ensure an inter-disciplinary, inter-opinion, and balanced dialogue. Dialogues on nanotechnologies policy should also be promoted on a regional level, taking into account the different development and social concerns of each region.

4.5 Media outreach on ethical issues

Media outreach on the ethical issues of nanotechnologies is necessary, and respected media personalities should be identified and engaged to assist in enlightening the public on these issues.

4.6 International cooperation

UNESCO should cooperate closely with other international organizations working in the area of nanotechnologies, such as the OECD and ISO, in the elaboration of a comprehensive ethical framework for nanotechnologies.

4.7 International Commission for Nanotechnologies and Ethics

Recognizing that nanotechnologies are developing at a very fast pace, UNESCO should establish an International Commission for Nanotechnologies and Ethics to continuously monitor and respond in a timely manner to emerging and evolving ethical issues in this field.

5 Need for awareness-raising and debate on nanotechnologies

5.1 The need for balanced, informed and interdisciplinary public debate

In order to have a balanced, informed and interdisciplinary public debate, it should be recognized that nanotechnologies are raising many expectations and anxieties that can influence the ethical dialogue in positive and negative directions. Realistic and informed debate based on careful considerations of all data as nanotechnologies are developing should be promoted, avoiding positive or negative conclusions without the necessary evidence. More nuanced, objective and accurate information needs to be provided in order to enlighten the public as well as policy-makers.

UNESCO should raise awareness on both the risks *and* benefits of nanotechnologies, especially amongst Member States with little or no capacity in nanotechnologies; on public accountability of scientists and engineers to ensure responsible development of nanotechnologies; on the public's responsibility to seek out accurate knowledge and participate in the generation of public policy related to nanotechnologies; and on the need to manage potentially disruptive effects to communities in social transformations induced by nanotechnologies. This debate should take into account the Millennium Development Goals.

5.2 Environmental impact and health issues

An early, informed and interdisciplinary public debate could focus on the environmental impact and health issues in order to maximize the benefits that can be expected from nanotechnologies. The opportunities and risks of nanotechnologies in products and applications that involve human contact or that may affect the environment must be balanced against each other.

The difficulty is that the potential toxicity of nano-engineered materials is subject to scientific uncertainty in a very fundamental way. Indeed the very definition of the toxicity of these materials is problematic. Furthermore, there are no clear views on how this toxicity, if defined, could be scientifically and indisputably tested. Finally, there are no systematic scientific studies on the toxicity of many materials. One of the issues could be that such toxicity may be slow to manifest itself, as was the case for asbestos in a different context. Therefore, the question of the applicability of the precautionary principle would need to be studied and discussed, and scientific uncertainty should not circumvent or delay the necessary debate (see also 7.1 and 7.3).

5.3 The need for risk assessment

Issues of risk analysis and standardization require in-depth ethical, and not only scientific, consideration. It is necessary for UNESCO to cooperate with organisations such as OECD that are currently developing standards for risk assessment. The need for risk assessment and the concept of probabilities in risk assessment should be introduced to scientists and engineers working on nanotechnologies through awareness-raising and ethics education activities. This could also be achieved by promoting the use of risk identification and management requirements in nanotechnologies-related grant application processes.

5.4 Nanomedicine

Nanotechnologies applied to medicine gives rise to several issues that need to be discussed in an early, informed, interdisciplinary and public debate. The easy availability of new diagnostic methods is one issue (e.g. susceptibility to diseases could be measured); there is another set of issues related to prospects of enhancement of the human body (e.g. what is a genuine part of the body? What is an enhancement and who defines it?). UNESCO can initiate the application of the bioethical principles adopted in the *Universal Declaration on Bioethics and Human Rights* to the area of nanomedicine, and examine the specifications needed to take into account the ethical questions raised by nanotechnologies in health care.

5.5 Privacy and confidentiality

An early, informed and interdisciplinary public debate could also focus on the basic ethical and legal notions of privacy and confidentiality. Indeed nanotechnologies allow for unprecedented surveillance devices (ranging from nanocameras to nanotracers locatable by GPS), and the question of the acceptability and conditions of use of such devices would need to be considered.

5.6 Intellectual property

An early, informed and interdisciplinary public debate could furthermore focus on intellectual property related to nanotechnologies. One reason is that nanotechnologies intersect with biotechnology, and the patentability of living organisms and of genes is thus relevant to the ethical consideration of nanotechnologies. Another reason is the blurring of boundaries between science and technology induced by nanotechnologies: while scientific knowledge is a common good, technological practices often are not. Furthermore, the risk of over-patenting could increase the risk of "nano-divide." Therefore, the patentability of nanotechnologies related innovations could be expected to be more and more controversial and should be addressed in terms of risk-benefit assessment (see also 7.6).

6 Need for ethics education

6.1 General need for ethics education reinforced in nanotechnologies

Public engagement and educational strategies for nanotechnologies are necessary. The need for adequate ethics education of scientists and engineers is commonly emphasized. It is a consequence of the ethical demands for interdisciplinarity and a holistic view on science and its implications for society in the broadest sense. The interdisciplinarity of nanotechnologies therefore strengthens the need for explicit ethics teaching at all levels of education for scientists and engineers involved in nanotechnologies. Particularly, it also strengthens the need for science education for professionals in social and human sciences fields involved in ethical, legal and social issues of nanotechnologies. The role of NGOs is central for awareness-raising, monitoring, and due to their participation in the decision making process. Governments should also be involved in public debate on nanotechnologies, as they play a determining role for investments and for possible legal actions. Identifying interested groups is particularly important, and different professional viewpoints need to be factored in. Attitudes towards nanoethics education may differ according to cultural background. To the extent possible, education to encourage critical thinking should be favoured.

6.2 Specific additions to content of the programmes

The demand for ethics education for scientists and engineers is addressed by UNESCO through its Ethics Education Programme (EEP). In this framework, the consideration of nanotechnologies will have implications for the content of ethics education (e.g. issues mentioned in 3 and 5, e.g. the questioning of usual physical and philosophical rules when it comes to the nanoscale; the implementation of the precautionary principle). UNESCO can therefore map existing programmes in ethics education, specifically focused on nanotechnologies, can promote the development and introduction of such programmes in science and engineering curricula. UNESCO can also develop a proposal for a basic course in ethics and nanotechnologies. The challenges that cultural diversity represent for the development of such a core programme should be taken into account.

6.3 Guidelines

In addition to a general core programme on ethics education that could be adopted for different regions, specific ethical guidelines could also be elaborated as an indicative basis (*voluntary compliance guidelines*) and be incorporated in the education programmes (see also 7.7) along with other education materials produced by UNESCO. The elaboration of such guidelines would require an extensive consultation process and could take place in the framework of the ongoing reflection of UNESCO on science ethics.

The objective of the guidelines would be to provide practical guidance not only to individual researchers, but also to UNESCO Member States in their implementation of the progressive realization of the ethical recommendations regarding nanotechnologies, especially in the national and regional context. The guidelines would represent a first attempt by UNESCO to propose a harmonization of ethical principles related to nanotechnologies and to recommend actions to be undertaken for research and applications in this field.

7 Need for research and development policies

7.1 Scientific and technical knowledge

There is a lack of knowledge in many issues pertaining to nanotechnologies, which requires more scientific research. This lack of knowledge should be acknowledged, and further research is needed to address many issues pertaining to nanotechnologies (e.g. environmental and health impact, fundamental properties of nanoparticles, disposal of nanomaterials, labelling of consumer goods). This research (as mentioned in 3.1) should be interdisciplinary.

7.2 Social sciences research to guide policy

Strengthening current social science research would also be necessary to determine the social and economic contexts where nanotechnologies develop, as well as the associated impacts, in order to guide appropriate research and industrial development policies (see 7.6). This research would need to be interdisciplinary (see 3.1 for issues that should be addressed).

7.3 Ethical research and ethics in connection with legal issues

Research in ethics needs to be developed in association with nanotechnologies. Ethical considerations are still insufficient within the vast financial effort devoted to nanotechnologies. Ethicists should be encouraged to address nanotechnologies and nanotechnologies teams in sciences should endeavour to be in close interaction with ethicists and philosophers. The ethics programme of UNESCO can play a role here in providing an international platform for the ethics of nanotechnologies, in acting as a clearing house for information regarding ethical issues, and in establishing a database of relevant information concerning ethics and policies (as part of the Global Ethics Observatory). It is also important to address the legal context (e.g. consumer legislation, occupational health legislation, criminal negligence claims against corporations, laws regarding technology development, production and dissemination). This research would need to be interdisciplinary (see 3.1 for issues that should be addressed).

7.4 Social science research and innovation in research methodology

There is a need to conduct social science research on how different cultures envision, define and problematize nanotechnologies, and consequently how related ethical issues are constructed. In this context, the development of innovative methods in framing nanotechnologies research questions, priorities and policies, as well as methods in conducting research should be encouraged.

7.5 Promotion of Ethical, Legal and Social Issues (ELSI) research

UNESCO should promote ELSI research as an important tool within the national technology research frameworks of countries, recommending that a certain percentage of the nanotechnologies research budget should be allocated for ELSI research, as is currently the case for human genome research.

7.6 Nanotechnologies and development

Even being interdisciplinary, scientific research alone cannot solve value problems regarding nanotechnologies. Social science research (7.2), more debate and awareness, as well as explicit examination and articulation of the ethical principles involved are needed. Therefore UNESCO could assist countries in identifying technologies that are most appropriate and relevant for development. It is necessary to distinguish the actions to be

undertaken at an international level and issues that need to be addressed from a national or local perspective. Countries whose national resources may be replaced by nano-engineered materials, for example, should rather look for the best use of their resources and for specific nanotechnologies research.

In this debate the following topics should be considered:

- The utility of particular nanotechnologies for development.
- The comparative advantages and disadvantages of a given nanotechnology for a given country.
- The ability to turn research effort into applications that are useful for development.
- The possible environmental risk; risk assessment and management.
- The impact of the intellectual property regime in terms of risk-benefit assessment (see 5.6).
- Sharing of benefits (similar to the provisions of the *Universal Declaration on Bioethics and Human Rights*).
- International cooperation between developing and developed countries (similar to the provisions of the *Universal Declaration on Bioethics and Human Rights*).
- Cost-benefit analysis of alternative technologies and actions versus those offered by nanotechnologies.
- Management of social transformations resulting from structural changes in the global economic system due to nanotechnologies.

7.7 Voluntary guidelines

Early assessment of ethical, legal and social implications of nanotechnologies will create opportunities to develop a normative framework in this field. Therefore, voluntary guidelines on science ethics and nanotechnologies as mentioned in 6.3 (particularly in regard to safety issues) could be elaborated in a consultative process and proposed as an indicative ethical framework for countries, corporations or scientific organizations. Such guidelines could also inspire national regulations.

7.8 Institutionalisation

Creation of National Committees on Ethics of Science and Technology (as equivalents of COMEST on national and regional levels) dealing with nanotechnologies should be encouraged. Such committees could also act as a more permanent platform for public debates and public communication.

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Division of Ethics of Science and Technology of UNESCO

The Division of Ethics of Science and Technology reflects the priority UNESCO gives to ethics of science and technology, with emphasis on bioethics. One objective of the medium-term strategy of the Organization is to "promote principles and ethical norms to guide scientific and technological development and social transformation".

Activities of the Division include providing support for Member States of UNESCO that are planning to develop activities in the field of ethics of science and technology, such as teaching programmes, national ethics committees, conferences and UNESCO Chairs.

The Division also ensures the executive secretariat for three international ethics bodies, namely the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), the International Bioethics Committee (IBC) and the Intergovernmental Bioethics Committee (IGBC).

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