Knowledge and values in science textbooks concerning complexity in ecological systems and environmental problems: A cross-cultural study on secondary school manuals*

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Abstract: The study was carried out within the European research project "Biology, Health and Environmental Education for Better Citizenship" that joined 18 European and North-African countries. We report here the methodology and some of the conclusions drawn from an analysis of science textbooks that considered the topics ecology and environmental education (EEE). Grids were conceived with the aim of revealing value systems conveyed by the exposition of the content and by images. We concentrate on the explicit/implicit presence of two of the four conceptions that have been investigated: complex vs. linear and relation of humans respect to nature in relation to the sub-topics ecosystems and ecological cycles and pollution. Dogmatism, scientism, and non-historical approach were also checked. The findings from the analysis of the sample of seven Italian textbooks for lower and higher secondary school are illustrated and compared with those obtained in Morocco.

The outcomes of the analyses show that ecology is not oversimplified, and structural descriptions appear more articulate than the relational and the dynamical ones. The view of ecology communicated by most of the textbooks is rather superficial and incomplete under many respects that we specify. The topic pollution is treated in a fragmentary way, as a "call of attention" added to the description of the environmental components or in Cards included in the chapters concerning the human body. The higher secondary school manuals do not contain more and more articulate information nor they more deeply account concrete cases, familiar to students' experience. Regardless of cultural differences and the diversity in the environmental contexts, the examined topics

* Eighteen countries from Europe and Africa have participated in the Project BIOHEAD-CITIZEN CIT2-CT2004-506015 that took into account school manuals, in service teachers and teachers-to-be of biology and of humanities. Values and beliefs underlying knowledge content in topics that are critical for citizenship have been the targets of the investigation. We thank all the other partners for their contribution that made possible this report.

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are treated in a very similar way in the Italian and Moroccan textbooks, as if a globalized approach to EE prevails on the attention for the construction of students' environmental identity.

Key words: environmental education; textbooks; complexity; conceptions

1. Introduction

Today, by the unreasoned use and the wasting of the natural resources, by the diversity of pollution of the environment and by the negative impact of his multiple activities on the life of the other alive beings, the humankind undermines the alive one. So it is urgent to stop and reverse this process of environmental degradation. It would not be possible if it does not have a total management of the environment and an awakening of these problems by the populations.

Education in general, environmental education in particular, has a significant role in this awakening. It is also a factor of education to the citizenship. By its objects, its step, it tends to recreate proximity between the pupil, future citizen, considered as responsible subject and the choices which govern its everyday life. The school is thus, so an essential place for environmental education.

Ecology and environmental education (EEE) are one of six topics taken into account by the European research project "Biology, Health and Environmental Education for Better Citizenship".

This project aims to investigate value systems interacting with knowledge, either in teacher's beliefs in biology textbooks' content.

This report is a partial account of the findings drawn from the application of grids that have been conceived for analyzing samples of science school manuals in the countries joined in the project.

The targets of our analysis have been the conceptions that are conveyed by teaching together with information about facts, concepts, and science models. The French term conception defines the intertwining among scientific knowledge, values and social practices according to the model proposed by Clément and Hovart (2000). We will focus in particular on two sub-topics: ecosystems, ecological cycles and pollution treated in science manuals to report the results obtained from the analysis of a sample of Italian science textbooks for lower and higher secondary school. These outcomes will be compared with those produced by the application of the same grids by the colleagues in Morocco and they will also be discussed in relation to the conclusions drawn by the study carried out by the French team of IUFM, Montpellier (Berthou-Gueydan & Clément, 2008).

The Italian partners in the BIOHEAD project added a set of questions in the questionnaire conceived for investigating conceptions of student teachers and in-service teachers, these questions inquired about their class practices for environmental education. Two items were aimed to understand the role assigned to textbooks and to detect the teachers' sensitivity to the deficiencies of the manuals in view of some of the objectives of environmental education. The answers given by the Italian sample will be commented in relation to the results of our analysis of the textbooks.

1.1 Ecology and environmental education

"Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture and his biophysical surroundings. Environmental education also entails practice in decision-making and self-formulation of a code of behaviour about issues concerning environmental quality" (International Union for the Conservation of Nature and Natural Resources, 1970).

A solid base of knowledge is necessary for understanding the scientific ways of modeling the interdependence of ecological relationships and processes that shape any environment, particularly when humans and their activities are included in the system. This aim can hardly be achieved by the students if the information that they receive deals with ideal, de-contextualized scenarios, when it does not examine specific cases of altered ecological relationships and the multiple consequences arising from these conditions, and when it does not take into account issues that are familiar in the experience of the students. Ethical reflection engaging personal beliefs and agency is the other important component of the cultural transmission. The relationship between values and environmental attitudes has been pointed out by several studies (Schultz & Zelenzy, 1999) and the clarification of values has proven to be a crucial element in the construction of scientific knowledge (Thelen, 1987).

When EE was first introduced in the school education, it tended to be identified with ecology teaching in most countries; as the partners in the BIOHED project could check, EE is presently recommended in the national syllabi as a transversal concern with different aspects infused in various subjects across the content of the curriculum, and sustainability is one of its scopes in perspective. Natural sciences, geography, history, technical education are the subject matters more frequently involved in EE. The decade 2004-2014 that has been proclaimed by IUCN “decade for sustainability” is promoting collaboration between schools and territorial agencies.

Teachers’ competences are seriously challenged by EE for sustainability and often they rely on the collaboration with other partners for engaging their students in educational programs. Since EE is not a subject matter, didactical aids and documents have to be retrieved from a variety of sources but not all teachers take the time to do so. Very likely, the textbooks are still the most handy resource and the main reference in most classrooms, where they often represent the actual curriculum since they may determine the selection and sequencing of topics to be taught, besides influencing even the teaching approach.

It is important to underline that textbooks convey ideological and epistemological values either in explicit or implicit ways and incorporate a lot of obvious or hidden messages in the textual exposition and in the images (Jacob, 1988).

1.2 The construct of conception

Many theoretical and empirical studies have been carried out within different scientific fields to highlight the personal, social, cultural representations of nature and of environment (Götschl, 1990; Graumann & Kruse, 1990; Benvenuto, 1995; Mortari, 1999; Stern, 2000; Clément & Forissier, 2001; Clément, 2004). Values pertinent to EE belong to many domains: moral, political, social, epistemological, aesthetical and spiritual. They influence the attitudes and beliefs concerning:

(1) Nature (spiritualism, materialism);

(2) The relationship between humans and nature or environment (anthropo- or eco-centrism, socio-centrism, utilitarianism, pragmatism, idealism);

(3) The ecological and environmental dynamics (reductionism, determinism, mechanism and evolutionism);

(4) The image of science and technology (scientism, dogmatism, relativism, precautionary attitude).

The theoretical construct of conception elaborated by Clemént and Hovart (2000) has been applied to ecology to investigate teachers and student-teachers representations (Clément & Forissier, 2001; Clément, et al., in press). The challenging aspect of this construct lies in its endeavor of non-disentangling the informational from the emotional and the practical content of social representations. Actually, conceptions originate from the mutual interaction of scientific knowledge, values and social practices that instantiate the specific knowledge in cultural contexts. Multidisciplinary and un-stabilized knowledge, such as EE implies, is particularly object of debate in

contexts that are characterized by ideologies, when the search of practical solutions and decisions to be taken is carried out in associations, political and professional groups. Beliefs and knowledge work together and their separation can only be the eventual outcome of a meta-cognitive process.

1.3 The presuppositions that justify a cross-cultural study

The possibility offered by the European project of comparing countries that are representative of differences in cultural context has been considered an added value of our investigations for the reasons that are pointed out here below. Societies differ in their social representations of the environment and environmental risk (poisoned food, nuclear risk, dying forests are risks differently perceived and assessed, as it has been pointed out by Grauman & Kruse, 1990).

The main goal of EE is to develop the capacity of citizens to understand, support and project policies that may result to be sustainable for the environment and the human communities. Therefore, EE ought to be grounded on the awareness of the environment where the students live, it should coach the comprehension of the complexity that emerges from exploring and interpreting specific contexts and cases, which implies the ability of relating the emerging problems with the factors, conditions and processes that are acting on a small and a large scale, short-term and long-term.

On the other hand, we witness a deep change in the relationship that the individuals entertain with the environment, the "natural" one in particular, because of the growing rigidity of the routines in everyday life, because of the transformations produced by the industrialization and urbanization of territories that tend to delete their environmental identity in a process of globalization. The influence of media communication rather than direct experience becomes the prevalent factor in the construction of cultural and individual representations concerning nature and the life environments. Moreover, media communication promotes the globalization of such representations. An understated consequence of these phenomena is that the social rather than the individual construction prevails and people risk to loose that part of their cultural identity that has its roots in the specific environmental identity (geographic, historical, social), where they grow up and in the multiple forms of interaction in which the specific environmental features eventually engage the people (Sauvé, 2005; Giuliani, 1995; Schultz & Tabanico, 2007).

The comparison among countries offers the opportunities to verify these tendencies and to strengthen the conclusions that can be drawn from more limited observations. Italy and Morocco differ under many aspects, presumably relevant for the development of ecological culture. Geographic, historical, economic and cultural features, including religion, characterize each country. It may be debatable how the religious beliefs in an increasingly secularized world may influence the "official" culture of a country, but there is no doubt that the authors of textbooks are situated within a culture from which they absorb values on fundamental issues, such as the attitude towards the natural world, which has always been a source of questions for humankind about itself and about its ethical relationship with a transcending reality.

2. Objectives of the study

Many questions therefore underlie our study: It aims at checking the place that ecology and EE have in science textbooks, at assessing how the exposition of the contents reflects the development of ecological sciences, mainly whether they take into account the widely shared recommendations to the educational systems that are stated in the documents of international conferences and organizations, such as the Agenda 21

(http://www.un.org/esa/sustdev/documents/agenda21/) and that are backed by scientific arguments in the literature (Sauvé, 1997; Goffin, 1998; Mortari, 1998; Falchetti & Caravita, 2005).

The group of BIOHEAD partners designed grids for the analysis of text and images of the textbooks to find out to which extent:

(1) The complexity of the ecosystems and their working is simplified in the exposition and schematizations;

(2) The textbooks support the development of a systemic approach to and a dynamic interpretation of local and global cases dealing with polluting agents and related environmental problems;

(3) The implicit conceptions are instantiated in the images that illustrate the environments and in the exposition of emblematic examples of environmental issues;

(4) The authors are sensitive to ideas of environmental identity, promote reflexive thinking on the specific nature of the human relationship with the environment;

(5) The approach to the complexity of environmental issues is dogmatic, non-historical, scientist and relies on linear causality.

Obviously, the educational practices in the school classes are in the teachers': they decide the role of textbooks in the learning environments. Anyway, textbooks are one possible "look-out" for gaining information on teaching, also considering that they reflect the kind of didactical transposition of science to which the prevalent culture of the country gives credit (Chevallard, 1989).

3. Sampling of the textbooks

At least three specimens for each school level was suggested to the partners of the BIOHEAD project as a minimum sample per country for carrying out the analysis of the science manuals, but this was not possible in all the countries. In Italy, the publishers are free to produce school textbooks, but these ones must get an imprinting from the Ministry of Education before circulating in the schools. The schools choose the textbooks among a great variety of options received by different publishers either on request or on delivery. The choice is discussed among the teachers and has to be approved by the council of the school institute.

In Italy, the manuals that we have chosen for our analysis appeared in top positions in the national lists of titles for lower and higher secondary school ranked by frequency of selection by schools in 2004. We have included in the sample textbooks from different publishers.

In Morocco, the publication of textbooks is under the control of a committee of experts appointed by the Ministry of Education. From two to four books are selected for publication among the many projects submitted by publishers. The textbooks are written in Arabic language, but their design follows the French educational framework and style. The sample examined in Morocco included two science textbooks, one for lower and one for higher secondary school, and one history and geography textbook for higher secondary school (Textbook 2 in Table 3).

4. Tools and methods for the analysis

The design and construction of the grids for the analysis of textbooks has been a collaborative endeavor of the BIOHEAD partners and it is illustrated in a separate paper (Caravita, 2008). Four sub-topics had been identified (ecosystem and cycles, pollution, use of resources, biodiversity) for checking conceptions about the topic ecology and EE. This paper focuses on ecosystems and cycles (EC) and pollution (Po) and it will report only

the data about the presence of two out of four conceptions that have been targeted by the entire analyses, that is: Complex vs. linear and relationship of humans in respect to nature.

The complex vs. linear view was characterized as follows when instantiated in EC or in Po:

(1) Webs vs. chains of ecological components;

(2) High number and diversity of components of the ecological webs vs. stereotyped simplification of their components;

(3) Functional vs. structural description. A functional perspective highlights factors, variables, constraints;

(4) Inter-dependence among the components vs. one-way relationships;

(5) Presence vs. absence of feedbacks, retroactions, cycles;

(6) Time scales consideration, reversibility of processes vs. "here and now" descriptions;

(7) Interpretation of events as emergent from systems of co-factors, from parallel processing vs. description/explanation of events deterministically caused, results of linear chains of causes.

The conception of the relationship of humans in respect to nature was characterized in terms of viewing humans as owners of nature and environment in opposition with humans as guests of the Earth together with other living beings. We outlined it as follows:

(1) Humans as part of nature vs. humans as observers;

(2) Planet as a resource for humankind vs. planet as a resource shared with other living beings;

(3) Emphasis on the attainment of economical aims vs. social, cultural, ethical, aesthetical aims;

(4) Humans only considered to be an external source of pressures, pollution and destruction vs. humans as users and responsible managers of resources;

(5) Human benefits vs. ecological benefits considered in the evaluation of the impact, costs, priorities;

(6) Emphasis on risks, catastrophes, problems vs. balanced information about problems and about possible solutions;

(7) Unlimited trust in science and technology solutions vs. principle of precaution, on one side, and citizen's participation, on another side.

The grids were composed of several forms each one having with lists of items to be checked. The whole set of grids had to be applied to each examined volume of textbook. One set of grids was common to all the topics. A selection of the items relevant for the data considered in this paper follows:

C-1 General information of textbook

C-1.0 Number of pages devoted to chapters concerning … (the specific sub-topic)

C-1.1 List the titles and sub-titles of all chapters concerning … (the specific sub-topic)

C-2 Grid - Proportion of text and images for … (the specific sub-topic)

C-2.2 Grid - Kind of images for … (the specific sub-topic)

C-2.3 Grid - Classification of images: Nature with or without human (Two entry-table)

C-3 Grid-Classification of diagrams: linear causal determinism *versus* retroaction(s), cyclic or systemic representations for … (the specific sub-topic)

C-4 Socio-economic and ethical dimensions for … (the specific sub-topic)

C-5 Grid-Historical approach for … (the specific sub-topic)

C-6 Grid-Epistemological approach for… (the specific sub-topic)

Another set of grids was specific for each topic and sub-topic and it was differentiated for each conception. The items included in these grids were checklists of indicators, which are of concepts that were considered

pertinent for each sub-topic and adequate for revealing the explicit or, to some extent, implicit presence of a conception. The occurrence of the indicators in the exposition (captions of images included) was checked by marking the page number where the concepts were treated in the text and the page and figure number of the related images.

Subjective interpretation is certainly the main drawback of this kind of qualitative analysis. This problem was partially controlled by having two analysts separately applying the grids and crosschecking their findings afterwards. Table 1 reproduces one of the specific grids designed for the sub-topic ecosystems and cycles.

Table 1 Grid for checking the conception: Complex vs linear

Content (Themes, topics)	Indicators	Page number of images	Figure number of images	Text page
Description of ecosystems (If present in the book, select the best articulated description of an ecosystem. If not, make reference to the general description)	(Specify here which description of ecosystem you have selected for the analysis of structural and functional indicators) Ecosystem: (e.g. pond) Biome: (e.g. tropical forests)			
	Structural			
	Variety and plurality in the abiotic components (geological, chemical, climatic)			
	Variety and plurality in the biotic components (more than just one representative of each kind)			
	Mutual influence of biotic and abiotic factors			
	Humans are mentioned among the components			
	Relational			
	Plurality of *ecological relationships* that link species to their environment:			
	• A—alimentary *(Food, webs …)*			
	• B—alimentary plus other relationships *(life cycle, rate of birth, nesting, spatial distribution, home range, etc.)*			
	Interspecific and intraspecific relationships:			
	A—only trophic *(e.g. predation)*			
	B—trophic plus other kind of interactions *(e.g. symbiosis, parasitism, competition, social, etc.)*			
	Ecological roles of biotic components *(producers, consumers, decomposers)*			
	Populations of species are mentioned			
Urban environment				
	Description as ecosystem			
	Variety of urban fauna and flora			
	Positive human interventions			
Ecosystemic dynamics				

(to be continued)

	Functional description of ecosystems			
	Flow of energy through ecosystem			
	Energy dissipation through trophic levels			
	Flow of matter			
	Cycles of chemical elements (*O2,C02, N2,*…) and water:			
	• A—Single linear paths			
	• B—Multiple paths			
	• C—Links among paths			
	Ecological changes			
	Equilibrium described as a dynamic condition of ecosystems			
	Concept of climax is explained in dynamic terms			
	Regulatory factors and processes (*feed-backs*) are mentioned *(specify)*			
	Daily and seasonal changes are considered as variables in ecosystems			
	Anthropic factor			
	Description of negative human impact			
	Description of positive human intervention			
	Catastrophic changes:			
	• A—natural			
	• B—of human responsibility (specify)			
	Ecological dynamics of biosphere are considered *(specify)*			

5. Results

We cannot account here for all the data that have been gathered by the application of the grids. We summarize the main findings.

5.1 Space of the sub-topics EC and Po in the examined textbooks

The number of pages and of images (and their ratio) found in the textbooks examined in Italy and in Morocco are reported in Table 2 and Table 3. In the Italian textbooks, the number of pages dedicated to the two sub-topics and the ratio images/text varies across the textbooks. The smaller space that Po has in the books appears as a common trend.

Table 2 Number of pages, number of images (and their ratio) dedicated to the topics ecosystems and cycles, pollution in the sample of examined textbooks for lower secondary school

	EC	EC	EC	Po	Po	Po
	N° p.	N° Img.	Ratio	N° p.	N° Img.	Ratio
Textbook 1 Morocco	15	84	5.6	2	3	1.5
Textbook 1 Italy	32	82	2.6	16.7	32	1.9
Textbook 2 Italy	32	107	1.7	20.5	37	1.8
Textbook 3 Italy	15.5	30	1.9	12.5	15	1.2

Table 3 Number of pages, number of images (and their ratio) dedicated to the topics ecosystems and cycles, pollution in the sample of examined textbooks for higher secondary school

	EC	EC	EC	Po	Po	Po
	N° p.	N° Img.	Ratio	N° p.	N° Img.	Ratio
Textbook 1 Morocco	64	147	2.3	5	16	3.2
Textbook 2 Morocco	22	50	2.7	37	45	1.2
Textbook 1 Italy	39	65	1.7	20.5	37	1.8
Text B 2 Italy	16.5	29	1.8	3	5	1.7
Text B 3 Italy	31	45	1.5	6.5	7	1.1
Text B 4 Italy	34	65	1.9	4	8	2

Textbook 1 for Technical Higher Secondary School deviates from this tendency.

Comparing lower and higher secondary school Italian textbooks we do not find great differences in the average number of pages dedicated to EC. The ratio images/text is higher in the lower secondary school textbooks. As average, they assign more space to Po.

Comparing Italian and Moroccan textbooks, we do not notice great differences in lower secondary school, except for the ratio images/text that is higher than in the Italian books. The science manual for higher secondary school has almost double number of pages dedicated to EC. The history and geography textbook (T. 2 in Table 3) dedicates to Po a number of pages higher than any of the Italian science textbook.

5.2 Main types of images in the textbooks

We classified the images that we found in the examined textbooks in 8 categories; the most frequent ones and meaningful for the aims of our analysis belonged to figurative images from macroscopic observations, figurative images communicating conceptualizations, figures reporting empirical data (e.g., measures, statistic distributions, diagrams). Table 4 and Table 5 report the frequency as percentages on the total number of images and the distribution of these categories in relation to the sub-topics EC and Po.

Table 4 Percentages of the main categories of images found in the sample of examined textbooks for lower secondary school: Figurative images, images containing empirical data, images illustrating conceptualizations in a figurative way

	EC	EC	EC	Po	Po	Po
	Fig. Im.	Emp. data	Fig. concept	Fig. Im.	Emp. data	Fig. concept
Textbook 1 Morocco	46.4	3.6	20.2	100	0	0
Textbook 1 Italy	70	1.2	30.5	81.3	0	9.4
Textbook 2 Italy	90.7	0	9.3	75	5	10
Text B 3 Italy	56.7	0	30	75	6.3	18.7

Table 5 Percentages of the main categories of images found in the sample of examined textbooks for higher secondary school: Figurative images, images containing empirical data, images illustrating conceptualizations in a figurative way

	EC	EC	EC	Po	Po	Po
	Fig. Im.	Emp. data	Fig. concept	Fig. Im.	Emp. data	Fig. concept
Text B 1 Morocco	57.8	15.6	6.8	43.8	0	37.8
Text B 2 Morocco	30	30	22	28.9	15.6	22.2
Text B 1 Italy	52.3	7.7	33.8	83.8	5.4	2.7
Text B 2 Italy	10.3	13.8	37.9	80	0	20
Text B 3 Italy	71.1	0	24.4	42.9	0	29.6
Text B 4 Italy	52.3	10.8	27.7	62.5	37.5	0

Figurative images (photos and drawings) make the largest percentage of the images found in the Italian

textbooks, with the exception of one textbook for higher secondary school (Table 2). Images showing conceptualizations follow in the ranking. The images that report empirical data are very few or absent.

Some variation for sub-topics and across the examined textbooks can be observed: the images of conceptualizations are less in relation to Po than to EC, the percentage of figurative images is higher in Lower than in Higher Secondary School textbooks.

The comparison with Moroccan textbooks mainly highlights that the percentage of images reporting empirical data is much higher than in the Italian textbooks.

5.3 Contextualization of the topics in the content of the textbooks

The Italian science manuals are made of a set of separate volumes, and each volume is partitioned into Modules. We can underline the fact that the exposition of content makes a clear distinction between ecology (i.e., the description of the ecological components, their relationships and processes of the "natural" world) and environmental issues (i.e., the description of the effects produced on the natural world by the presence of humans). This separation of content appears to be less marked in the Moroccan science textbooks, in which the topics are in different chapters but in the same volume and also module. In the textbook of geography, though, the topics are included in two distinct modules.

But in both countries, particularly in lower secondary school textbooks, the environmental issues are treated as bits of inserted extra-information. Ecology and environmental education (EE) are conceived as contents belonging to separate domains and EE does not seem to aim at knowledge construction about conceptually relevant contents but only to increase the awareness of students about emergent problems.

The dichotomy between humans and nature, which is largely overcome in the scientific and philosophical debate, seems to resist in the school culture regardless of cultural differences.

5.4 Conception complex vs. linear

5.4.1 Sub-topic ecosystem and cycles (EC)

We cannot claim that the descriptions of ecosystems is presented in an oversimplified way in the exposition of textbooks, either in the Italian or in the Moroccan books, but we can certainly state that the structural aspects are more articulated than the relational and the dynamical ones, either in the text or in the images.

Most importantly, the textbooks' view of ecology is rather superficial and incomplete. What we did not find treated in the content of the manuals is a long list that mainly points out the absence of detailed illustration of concrete, contextualized examples of ecological phenomena that avoids simplistic treatment of facts. We will underline in particular some of the deficiencies that have negative consequences on the construction of "scientific" citizenship. Very rarely are mentioned or described: processes of regulation that take place at the ecosystems or at micro-ecosystems level as a consequence of natural (even cyclic) perturbing factors; ecosystems at life limits that can well illustrate the interplay between ecological and biological factors; variables and conditions that modify and modulate the ecological events. Discussion on the role that ecosystems' size and level of complexity may have, but also time, severity and persistence of perturbing factors are an important content. The concepts of resilience, of robustness of ecosystems should be defined. The "balance of natural system" should be treated as a metaphor, a model rather than a fact (Zimmerman & Cuddington, 2007).

The illustration of emblematic concrete (successful and unsuccessful) cases of management of ecosystems, of wildlife conservation might improve the comprehension of the controversial control of anthropic factors. Different kinds of empirical data produced by scientific studies, the use and meaning of statistical analysis, the possibilities offered by the application of new methodologies like simulation, should be essential components of the

information conveyed by the manuals to make more intelligible the role of ecology as science in the interpretation of ecosystems' changes and in the management of the environment.

Introducing the concept of landscape, considering the human shaping of the environment under an historical perspective implies a shift that the natural science contained in textbooks has not been made. Though ecological sciences have a robust tradition within the domain of life sciences, most of the ecological problems situated in specific contexts demand a multi and often cross-disciplinary approach through synergy between scientific and humanistic types of expertise.

5.4.2 Sub-topic pollution (Po)

In the majority of the examined textbooks, the issue of pollution is treated in a fragmentary way, as an added "call of attention" often in relation to the description of the environmental components or to human body affected by dangerous agents. An organic exposition, that highlights and defines concepts necessary for a deep understanding of the phenomena and relevant for facilitating generalizations, is lacking.

Surprisingly, in higher respect to lower secondary school, the exposition of the environmental issues does not attain higher levels of information and does not consider their complexity in a more articulated way.

Analyses of the factors, the drawbacks that influence the success of concrete interventions for controlling or preventing pollution are lacking. The relation between potential solutions and contextual features is never highlighted.

The participation of people and the role of local expertise are never mentioned.

The limits of available knowledge, the new frontiers of research and the arguments raised in the scientific debate are never or rarely considered.

Reference to plurality of perspectives and theoretical frames, to their consequences on the choice of methodological approaches, argumentation about the origin of the disagreements in interpretation and in the design of solutions, instantiate epistemological values that are crucial in EE to prevent dogmatic attitudes and to make citizens more aware of what Herbert Simon calls "procedural rationality" opposed to "substantive rationality", more acceptant of the approximation to satisfying solutions when many trade-offs have to be evaluated in the complex problems that characterize most of the ecological issues.

The conclusions that we have illustrated are consistent with the outcomes reported by the French team who took into account the life and the Earth sciences manuals for secondary school on which the teachers who presently start their professional career have studied (Berthou-Gueydan & Clément, 2008).

5.5 Conception relation of humans respect to nature

We can only summarize some general conclusions and comments about the implicit conception of human-environment relationship that is conveyed by the Italian manuals. The conflict of interests between humankind and nature takes the shades of a philosophical dilemma. The difficulty of finding a compromise between the protection/preservation of environmental "integrity" and the demands of the development of human economy is stated in terms of a stereotyped complaint about the destructive presence of humans on the Earth.

The attitudes conveyed by the Italian textbooks might be classified into the following types: fatalistic, blaming ("Man is guilty!"), responsibilizing, objectivizing ("interest of environment are also the interest of the human species"), optimistic and mainly based on trust in the progress of science and technology. Thus, the appeal to a generic responsibility of humans substitutes the identification of real cases, the pointing out of specific responsibilities of agents, the highlighting of concrete policies that might be explored at different levels in the organization of a society: economic, social and political.

In higher secondary school textbooks, the role that individuals can take in limiting pollution is almost disregarded or it is treated in the same way as in lower secondary, that is ignoring that the students are in a more adult age, have hopefully developed higher competences, have more autonomy of decision and action as consumers, as customers of services, as people who are planning their life as adults.

The neutral informative style of the exposition buries any emotional implication under a veil of neutral, reassuring and pretended rationality.

6. Perspectives of Italian teachers on EE in textbooks

We have interviewed Italian student teachers and in-service teachers through a questionnaire on many pedagogical aspects concerning environmental education. 602 valid questionnaires have been collected. The composition of the sample: 52% were student teachers and 48% were in-service teachers of primary and secondary school (primary teachers were slightly under-represented respect to secondary teachers). 88% were women, 40% had between 20 and 30 years of age. We briefly report only data drawn from the answers that inquired about the use of sources of information in their school classes, the evaluation of some deficiencies of textbooks. 69.3% of the teachers considered the use of a plurality of sources of information by far a more effective practice than the use of a “good textbook” (only 21.5% expresses a preference for this aid). The lack of situatedness of problems in environmental contexts that are close to students’ life experience was highlighted as a fault in the manuals’ content by 47.1% of the teachers. The weak emphasis on change in individual behaviors and responsibility was indicated by 45.1%. The un-relatedness between local and global problems was highlighted by 39.6%. The absence in text exposition of a multi-perspective approach was considered a “very serious” fault by 32.5% of the interviewed teachers, and 52.6% of them considered this fault “serious”. Finally, 67.8% considered “very serious” or “serious” the understatement of citizens’ participation in the search for solutions concerning environmental issues.

7. Conclusions about the comparison between Italy and Morocco

What can we gain from the comparison between the outcomes of the textbooks’ analysis in these two countries? Slight differences can be pointed out. The most outstanding conclusion is that, regardless of obvious cultural differences and differences in the environmental contexts, the topics of ecology and pollution are treated in a very similar way. We have also observed that the types of pollution, the kind of events that are considered and the accidents that are illustrated are often the same in the Moroccan and in the Italian textbooks. Even images and schematizations tend to be similar. In both countries the majority of the figurative images point out the “bad deeds” of humans. Some of the images that show a less aggressive interaction of humans with their environment concern cases in foreign, and sometimes exotic countries.

We must conclude that a globalized approach to EE is prevailing on the attention to the construction of students’ environmental identity and this approach is in contrast with the aim of EE.

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