CHALLENGES OF THE EDUCATION FOR SUSTAINABLE DEVELOPMENT WITH PARTICULAR FOCUS ON THE SUB-SAHARAN AFRICA CONTEXT

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Abstract

The education for sustainable development is one of the major challenges of our époque, because it is the key to make sustainable development possible by fostering informed, active and convinced participation from the public. It is also a novel type of challenge, because it needs to reach the public at large, and not only learners within the formal instruction systems, and it needs to promote responses in terms of sustainable behaviour patterns. Therefore, it needs to expand beyond science education and to incorporate and utilise additional types of information in order to design the best communication options for each type of audience. On the other hand, it requires a certain level of science literacy to offer adequate motivations on proposing sustainable behaviour patterns; therefore, it may also need to address the issue of science literacy when necessary, above all when targeting the general public.
After an introductory overview of the general features of these challenges, the paper focuses on the Sub Saharan Africa context and attempts to outline options for the integration of the new messages inherent in the sustainable development concept with relevant aspects of the local realities. Specific attention is given to the challenges common to science education and to sustainable development education (mostly stemming from historical reasons); to the challenges of education aimed at fostering sustainable patterns; to possible routes for the youths' active participation in the dissemination of information and in the design of viable sustainable options; and to the importance of connections with traditional systems of knowledge and values.
Key words: *education for sustainable development, formal and informal education, indigenous knowledge systems, language of instruction.*

Introduction

The education for sustainable development (ESD) is posing great challenges to educators worldwide. The novelty – in world history – of the situation that has prompted the necessity of ESD is by itself a major challenge. For the first time in history, the outcomes of human activities are affecting the equilibria of the entire planet, causing changes whose effects are increasingly detectable worldwide. It becomes necessary to shift to behaviour patterns that attempt to reduce or minimize the undesirable impacts of human activities on the environment. This, in turn, requires *ad hoc* education for individuals and communities to acquire adequate awareness of the situation and utilise the acquired information when making decisions.

ESD is the educational effort focusing on these objectives. Because of the nature of its objectives and the high variety of interplaying factors, ESD needs to articulate into several

directions and interconnect them into a comprehensive picture. It needs to build the awareness of the global impacts of specific aspects of current life styles and behaviour patterns. It needs to focus on local realities as the contexts offering more familiar examples of impacts, e.g., detectable effects of environmental pollution or detectable consequences of the climate change. The extent of the necessity to integrate global perspectives and attention to local realities, inherent in ESD, is unprecedented in history and constitutes a major challenge for educators.

Another major challenge stems from the fact that ESD requires basic science literacy for the background information to be grabbed and internalised up to the point that it can stimulate awareness and responses by individuals and communities. On the other hand, the increasing rate of certain phenomena of anthropogenic origin (e.g., climate change) determines considerable urgency for the adoption of sustainable behaviour patterns. This requires that ESD attains concrete effects in real time, without waiting for the new generation – currently in schools and in the progress of acquiring basic science literacy – to grow to adulthood; therefore, ESD needs to comprise extensive informal components to reach as many as possible of the current adult generations in the age-range that corresponds to decision-making at individual and community levels.

Managing to adequately communicate information is not enough. On the basis of this information, ESD needs to foster and build ethical attitudes, for which individuals and communities become intellectually and emotionally available to make sustainability-compatible choices. Conveying the meaning of sustainable development (WCED, 1987)

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs

implies convincing people that this message does not pertain to the category of political or philosophical movements generically inciting to build a better future for the forthcoming generations, but stems from the recognition that we are in the progress of building a much worse future for the forthcoming generations, unless we take effective measures to prevent further deteriorations. This immediately links with the ethical questions of why we should take care of preventing damages to the forthcoming generations. Ethics education – the distinction between good and evil, the motivations for which we should pursue good and prevent evil – becomes an essential component of ESD, as well as of the practical initiatives to reduce or prevent environmental damages (Gaie, 2002). The effectiveness with which ethical messages are communicated depends largely on adequate familiarity with each community's system of values.

Finally, ESD vividly re-proposes fundamental questions about the meaning, routes and objectives of education. The need to convey a global picture as motivation for selecting sustainable behaviour patterns makes ESD incompatible with fragmentation approaches (increasingly frequent in some contexts in the last decades), for which formal education turns into the transmission – or, in better cases, the analysis – of selected individual issues, without building a comprehensive picture of a discipline (of its conceptual frameworks, its threads etc.), and without training learners to seek and identify connections between different pieces of information or different aspects. The comprehensiveness extent required by ESD is unprecedented and pedagogical options need to respond to it by avoiding fragmentation and compartmentalization.

The challenges facing ESD, although global in their essence, take different characterizations in different contexts. This study devotes specific attention to some characterizations of the Sub Saharan Africa context.

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Objectives and Approaches of the Study

The study presented here is a qualitative study carried out throughout several years and aimed at spotting out challenges and possible viable options for ESD. The information that constitutes the basis for the presented reflections was collected through the direct experience of incorporating ESD components into chemistry teaching at the tertiary level and through interactions with students, colleagues and members of the community. The more immediate objectives of the study comprise the gathering of information to utilise in the design of ways for refining the presentation of ESD components within chemistry courses, so as to enhance its extent and effectiveness, and the purpose of attaining an as-complete-as-possible background overall picture in view of a project aimed at promoting shifts to sustainable patterns for a specific issue (biomass burning, Mammino 1998).

Because the major source of information pertains to chemistry teaching within formal instruction, the study largely utilises science education (SE) as reference, with the assumption that identifying similarities and differences between the challenges facing SE and those facing ESD may contribute to a better understanding of their possible interfaces and synergies.

After an outline of the challenges from a more typically educational point of view, the paper: highlights the challenges of educational interventions aimed at fostering sustainable behaviour patterns, illustrating them through selected concrete examples; outlines the prospectively important roles of resources like extensive active engagement of the youth and the search for interfaces with indigenous knowledge systems; and presents two issues that could be selected for effective cutting-edge roles in EDS, i.e., green chemistry and climate change.

Educational Challenges Ensuing from Contextual Realities

The major challenges facing SE in Sub-Saharan Africa extend to the ESD, where their impact is often enhanced because of the importance that ESD messages attain adequate internalisation levels. The challenges include the difficulties inherent in the use of a language of instruction different from the learners' mother tongue, the inadequate number of qualified secondary school science teachers, the inadequacies in the general public science literacy, and the currently inadequate number of teachers and communicators who can effectively carry out ESD.

Second language instruction (a historical inheritance from colonialism) is acknowledged as a major obstacle to effective science learning (Mammino, 2010-a, and references therein). It also has an impact on learners' and public's deeper perceptions because, as long as science is presented only through someone else's language, there is scarce possibility of *acquisition* of the scientific discourse in the full meaning of the terms, i.e., "coming to own" it, to perceive it as part of one's own overall cultural belongings (Mammino, 2006). A drawback of this type would be fatal to the objectives of ESD, because ESD is meant to foster sustainable behaviour patterns and, therefore, it needs to be perceived as something pertaining to the learners and their communities, not as something pertaining essentially to someone else. The use of the learners' mother tongue becomes *conditio sine qua non* not only to convey the technical information effectively, but also to stimulate personal responses that can impact on behaviour patterns. The importance of the use of people's language for development (Prah, 1993 & 1995) extends to ESD, to ensure the acquisition of the relevant knowledge and the stimulation of the mental availability to make choices based on this knowledge. The general importance of informed decisions and the relevance of ESD-based knowledge for decision-making turn the use of people's language into a key democracy factor (Mendes, 2003).

The issue of the inadequate number of qualified secondary school science teachers constitutes a huge challenge, as science teachers are the most apt to take charge of ESD within

formal instruction. On the other hand, only a science teacher who is sufficiently confident of his/her content knowledge may be available to undertake the task and to utilise pedagogical approaches that can make it effective. ESD requires a teacher's active engagement in all stages: in searching for sufficiently complete information about the sustainable development concept and its motivations (also because such information is not yet adequately present in several syllabi and corresponding prescribed textbooks); in organising the information so as to present it in the way that is more suitable for the given group of learners; in utilising pedagogical approaches that engage the learners actively, because this is essential to stimulate conviction. Teachers who are not sufficiently confident of their content knowledge usually refrain from in-class interactions or from other active learning options, while these are crucial for ESD, which cannot be reduced to a set of recipes or rules to memorize, but requires learners' participation and intellectual involvement. Finally, ESD would require the ability of the science teacher to interface with other areas and disciplines, first of all ethics; and the availability and ability to interface with other knowledge areas depends largely on the teacher's self-confidence in his/her content knowledge and mastery.

ESD through informal education is extremely important in order to reach the current adult generations. The major challenge is the inadequate science literacy in the general public. Since ESD cannot *wait* for science literacy to be built by other interventions, it needs to incorporate the provision of the minimum required science information as an integral component of its approaches. This, in turn, poses a number of challenges: the challenge to design diversified novel approaches, suitably tuned to the specific characteristics of different learners' groups; and the challenges inherent in the search for reasonable balances between the need to simplify the presentation of the information up to making it accessible to persons with scarce science literacy and the need to ensure effective communication of the essential information. These challenges are methodologically parallel to those that SE encounters on presenting the basis of advanced materials to pupils or junior students (e.g., atomic and molecular orbitals at secondary school level), with the additional component that groups of adult learners are not institutionally "learners" (being learners is not their dominant status) and, therefore, require more on-an-equal-basis approaches from the teacher.

The Challenges of Education Aimed at Fostering Sustainable Behaviour Patterns

The major objective of ESD is that of fostering sustainable behaviour patterns, and this reflects and impacts on the design of educational approaches.

Experience in all contexts shows the difficulties of fostering behaviour patterns conducive for objectives like protecting health or pursuing sustainability. The difficulties experienced by the campaigns aimed at discouraging people from smoking offer a telling example, as smoking is something that affects the health of individuals, something whose consequences are known to be serious in terms of premature weakening of certain body functions, and with the always luring risk of a fatal disease; yet, in some contexts, after a previous decline following thorough campaigns, the proportion of smokers appears to start increasing again in recent years. The difficulties are unavoidably greater for behaviour patterns that do not affect the health and well-being of the individual with a clearly perceivable cause-effect relationship, but mostly refer to general concepts like the situation of the planet or the well-being of the future generations. Manifest symptoms in "developed" countries may be the still inadequate use of bicycles in place of cars in all those situations (short distances, nice weather, etc.) in which a bicycle would be an optimal choice, devoid of any discomfort; or the increasing spreading and excessive use of air-conditioning in countries in which it was not so customary until maybe a decade ago, despite its high energy-demands and the uncertainty of some impacts on health.

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Educational interventions aimed at fostering sustainable behaviour patterns need to be tuned to the characteristics of a given context. These characteristics comprise traditional heritage and inherited practices as well as presently changing social patterns and the directions of such changes.

In Sub-Saharan Africa, traditional patterns are more often associated with poorer and/or rural situations, like communities mostly or solely depending on subsistence agriculture. The patterns may include practices like extensive biomass burning (burning of grass and bushes to clear areas), whose incidence is by far greater in Sub-Saharan Africa than in other continents. Fostering changes regarding this specific practice will require finely-tuned and broad-range interventions and the proposition of alternative patterns that may bring easily perceivable benefits (Mammino, 2008).

Changing social patterns are often associated with efforts to get out of poverty. They comprise phenomena like the migration to urban suburbs, often giving rise to informal settlements, and the actual economic improvement of some groups. The characteristics of informal settlements make ESD particularly difficult: practical external interventions, like the provision of clean water and sanitation, become pre-requisite to any ESD attempt.

In the case of social groups that are emerging or have emerged from poverty, ESD needs to target the dominance of the system of symbols perceived as markers of the changed social status, and the ways in which they determine behaviour patterns. Examples are offered by the attitude toward the use of bicycles or toward saving. Using a bicycle is viewed as a marker of poverty, a sign informing that a person cannot afford a car; a pattern like in Europe's developed countries, where persons across most or all social classes may choose to use bicycles, is still unconceivable; ESD could foster an attitude for which those who own a car may also feel comfortable at choosing to use a bicycle when practicable, by convincingly highlighting its environmental and health advantages.

People's experience makes them perceive saving as a necessity imposed by poverty. Consequently, it is also perceived as something whose relevance ceases when emerging from poverty. This perception turns into a sort of general paradigm determining practices. A most critical example regards energy saving. Electricity supply is inadequate in several Sub-Saharan Africa countries, including South Africa, and power outages are frequent (Wines, 2007); yet, when the electricity is on, attempts to save it are scarce, both by individuals and by companies. ESD needs to educate to resource-saving attitudes, by showing the economic and environmental value of saving.

The Youth – a Key Resource for the Education for Sustainable Development

The youths can constitute an optimal resource to link formal and informal instruction. For junior (pre-university) levels, it is natural that the pupils spontaneously communicate the information acquired at school − and their perceptions on it − to their families and communities, thus transmitting messages beyond the enclosure of formal instruction. If ESD at school succeeds in engaging pupils intellectually and emotionally, they will communicate ESD messages to their communities in modes capable of reaching considerable impacts. In this way, they can also significantly contribute to foster shifts toward sustainable behaviour patterns. The quality of ESD at school determines the levels at which pupils understand the messages and, therefore, largely determines the extent of the impact that the youths may have in their communities.

Tertiary level students can play active roles in extending ESD to their communities. Direct experience at the University of Venda (a historically black university located in a rural area of South Africa) has shown keen interest by several students searching for ways to personally communicate ESD messages in the secondary schools in the area. The advantages of such option include the greater immediateness of youth-to-youth communication and the benefits from the

potential role-model of university students for secondary school pupils. Since tertiary students' conviction of the importance of sustainable development arises within science learning, they are also particularly apt to communicate the science-based motivations of ESD messages in ways accessible both to secondary school pupils and to their communities of origin.

Youths' involvement can prospectively be extended to the search for sustainable patterns alternative to current non-sustainable ones. This search requires active engagement of the persons and communities concerned, for the alternative proposals to be convincing. The youths can play important roles if they are engaged in this search both within formal education and within the informal education involving their communities: they are more apt than outside experts to communicate information to their communities effectively, and the general availability of the youth towards changes increases the value of their potential contributions.

Indigenous Knowledge Systems – Resources Deserving Explorations

Sub-Saharan Africa has a wealth of indigenous knowledge systems (IKS). Many aspects of this cultural heritage may be interesting for ESD, e.g., in the roles of familiar references for proposed concepts or suggested options.

An easy example may be offered by architecture. The traditional African rondavel was capable of maintaining a comfortable indoor temperature throughout the day and the seasons. This is something well known to people, although now many of them live in modern western-style buildings. It can thus constitute an optimal reference on searching for, or proposing, architecture options that minimize energy consumption to keep indoor temperature within comfortable levels. Such architecture would be designed *de novo* for different geographic and climate contexts, to better respond to the characteristics of each geographic area. The architectural proposals may thus be new, but the concept that a building may be able to keep a comfortable indoor temperature pertains to familiar knowledge. ESD can aptly utilise the familiar knowledge, appreciate its validity, and link it to new proposals for practical implementations.

General aspects of the cultural heritage can also be valuable for interfaces with ESD. These include aspects like the relationships between human communities and their environment, which can constitute familiar reference to communicate the importance of environmental protection. In this way, ESD can constructively interface with IKS research, with mutual benefits.

Cutting-edge Issues?

Although ESD is by itself a comprehensive endeavour, responding to a global picture of the effects of anthropogenic activities on the planet equilibria, there may be selected issues that can be utilized as cutting edge components. Two of them will be briefly considered here: climate change and green chemistry.

Phenomena related to climate change are already perceivable in many areas of the planet and, therefore, a discourse on them will not have abstract character, but will refer to something that people have already started wondering about. The behaviour patterns that could tend to oppose the climate change likely constitute a good proportion of sustainable behaviour patterns. Basic level ESD (both formal and informal) may focus on three fundamental messages, whose combination is capable of making a significant difference: reducing combustions, saving energy and planting trees. Their motivations and their expected benefits can be illustrated through visualization and other tools apt for communicating basic science concepts in an immediate way.

Green chemistry is mostly related to the chemical industry (Anastas & Farris, 1994; Anastas & Warner, 1998; Tundo & Anastas, 2000). But, by taking care of the overall life of produced substances, it may also be referred to the use of chemicals in everyday activities.

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Then, its twelve principles (Anastas & Warner, 1988) can be presented from the point of view of good housekeeping, and the ensuing recommendations on the correct use of chemicals like fertilizers, pesticides or detergents may be valuable for pollution prevention (e.g., by counteracting the "the more the better" uninformed preconception). Although requiring at least basic chemistry literacy, the challenges and features of green chemistry education (Tundo & Patti, 2001; Mammino, 2002) are mostly common to those of ESD: the need for the design of options apt for different learners' groups; the importance of communicating information to enable citizens to make informed decisions; the need to foster paradigm shifts in attitudes and practices (Mammino, 2009); the importance of cross-discipline perspectives (Mammino, 2010-b); the importance of ethics and ethics education (Gaie, 2002). Thus, green chemistry education can become a component of ESD, whose extent varies according to the characteristics of the learners' groups and is expectedly larger within formal instruction. The examples from industries which have adopted some green chemistry (cleaner production) options can contribute to underline the importance of ESD messages; e.g., the information that each of the 16 production facilities participating in the DANIDA-supported *Cleaner Textiles Production Project* in South Africa achieved 1.2 million rand annual savings from the combination of saving water, energy, and chemicals (as documented in the October 2003 post-project survey) may contribute to underline the general importance of saving resources. The significance of green chemistry education to foster awareness of the importance of sustainable development is highlighted, e.g., by the responses from several third year chemistry students at the University of Venda (in various academic years) to active-involvement assignments aimed at guiding them to gradually "discover" green chemistry: the "discovery" prompted the wish to communicate to others, and first of all to secondary school pupils, "such important information that is so little known".

Conclusions

The previous sections have attempted to outline a basic overview of the challenges of ESD in Sub-Saharan Africa, both in terms of typically educational approaches and in terms of contextual features. It is concluded that ESD needs to design novel approaches, tuned to the characteristics of the different learners' groups, in order to pursue its main objectives and to simultaneously attempt to overcome contextual difficulties.

Comparison with the challenges of SE shows relevant common patterns, suggesting prospective benefits from synergic efforts aimed at overcoming the impacts of identified difficulties like those inherent in the use of a language of instruction different from the learners' mother tongue, or those related to the scarcity of qualified secondary school science teachers. Explorations of incorporation of ESD information into selected tertiary-level chemistry courses showed interesting responses by students, hinting to the opportunity of expanding the incorporation to other courses.

The promotion of sustainable behaviour patterns is the core objective of ESD. The active engagement of the youths within formal instruction, and of communities at large, in the search for sustainable options in the various everyday life and micro or small production activities, is the key to success, as conviction is a prerequisite to the adoption of sustainable behaviour patterns and participation in the search for the options is apt to generate conviction. All this highlights the importance of active learning options and general active engagements of the learners and, consequently, the importance of extensively familiarising teachers with active learning options.

The attention to IKS and its inclusion in ESD approaches are expected to provide links between familiar concepts and ESD messages, thus strengthening the latter through the recognition of the former. This also requires active learners' engagement, as IKS belongs to the communities and only the communities' active engagement can enable the identification

of links with the ESD messages and facilitate the search for sustainable patterns that can be acceptable to the communities.

Collaboration on ESD across the continent can be expected to bring a variety of benefits. It can enhance the perception of the global nature of environmental problems and of sustainable development through the information about experiences in the other countries in the continent. It can decrease the impact of the scarcity of ESD specialists by sharing the expertise of the existing ones across the continent, above all for particularly challenging endeavours like the design of educational approaches and the design of suitable teaching/learning materials. It can be particularly attractive for the youths, as it would combine a continental effort based on modern science information with continent-wide references to the IKS of individual cultures.

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