



Training of Science Teachers: the Perspective of Education for Sustainability

Antonella Bachiorri¹, Alessandra Puglisi²

Abstract

In recent years, the debate on sustainability has become even more important within school curricula especially within scientific subjects.

It is widely acknowledged, that teaching sustainability needs to focus not only on the cognitive aspects related to sustainability but also on the personal dimension, involving values, attitudes and behaviours of each individual, in the perspective of education for sustainability (EfS).

The teacher's role becomes truly strategic if we look at the principles and concepts that frame the sustainability debate (i.e. system, complexity, limit, uncertainty, diversity). In fact, they need to be translated into curricula and pedagogical practices that will promote the engagement of students in exploring their own values and visions of the world, supporting a deep and meaningful understanding. Teachers consequently, need to be able to approach their discipline from these standpoints, requiring a new pedagogy of transformative education/learning in way to rethink their model of teaching.

Our experience in pre-service and in-service science teachers' training courses, within the context of a University center (CIREA - Centro Italiano di Ricerca ed Educazione Ambientale), suggested that teachers need to reflect critically, both individually and as a group, on their roles and actions coherent to the aims of EfS. This means that training must become a way to analyze teaching methodologies and strategies: it requires a new form of inquiry teaching in alternative to the traditional strongly disciplinary approach. Consequently, there must be support for educational models that go beyond teaching based on "what" (transfer of information) to models that emphasize "how", through more interactive and collaborative learning processes. EfS science teachers training, in addition, needs to include concepts related to social equity, quality of life, etc., that strongly support an interdisciplinary approach by drawing together both the environmental, social and economic dimensions of sustainability, with cultural and methodological contributions of different school subjects.

Starting from these remarks and from our experience that will be discussed in detail, the support to science teachers in understanding and rethinking the conceptual and practical constraints of their work needs to be considered essential in science teachers' training for sustainability.

Keywords: Education for sustainability, teacher, training

1. Introduction

Different international conferences and events (the 1992 Earth Summit in Rio de Janeiro, for instance) catalysed the attention of the world to the urgency of rethinking the idea of development, turning around the paradigm of sustainability. This new perspective, requiring to face old themes and to deal with new problems (climate change, loss of biological and cultural diversity, for instance), has become even more important within society, involving also education, educational systems and curricula of different school levels. Complexity, system, holism, interactions, limits, uncertainty and changes, some of the founding concepts of the ecological debate, appeared as some of the key words that characterized the challenge of sustainability in our society, included education. The development of ecological thinking and ecological awareness, then, wrongly became for many educators, the main goals attributed to Education for Sustainability (EfS). In this perspective, EfS at school, became as an extension of naturalistic/ecological education and consequently involved especially scientific subjects and their cognitive domain.

¹CIREA - Centro Italiano di Ricerca ed Educazione Ambientale, Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, Italy

²CIREA - Centro Italiano di Ricerca ed Educazione Ambientale, Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, Italy



2. The perspective of Education for Sustainability

It is widely acknowledged, that the environmental dimension is only one of the three pillars of sustainability, together with the social and the economic ones, and that the cognitive domain is only one of the domains of learning. EfS, in fact:

... "can promote a shift in people's mindsets and in so doing enable them to make our world safer, healthier and more prosperous, thereby improving the quality of life. Education... can provide critical reflection and greater awareness and empowerment so that new visions and concepts can be explored and new methods and tools developed" [1].

In addition to knowledge, also principles that frame the sustainability discourse (such inter-generational equity) need to be translated into curriculum and pedagogical practices that will intellectually and emotionally engage students in developing deep meaningful understandings, but this is not a simple or easy task for teachers. In fact, this requires to focus not only on the cognitive aspects related to sustainability but also on the personal dimension, encompassing values, attitudinal changes, people's behavior and lifestyles, giving sense to the perspective of EfS and to the need of an approach at a systemic level [2], [3]. In this perspective, teachers' role becomes truly strategic. Teachers, in fact, need to translate the principles and concepts (the key words mentioned above) into curricula and pedagogical practices and to promote the engagement of students in exploring their own values and visions of the world, supporting the perspective of a sustainable future.

Research, teaching and training in EfS (from an environmental, social and economic perspective) characterize our experience (CIREA - Centro Italiano di Ricerca ed Educazione Ambientale, Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma) in pre-service and in-service science teachers' training courses.

3. Training courses for Science teachers

Our ideas of training are found on the assumption (based on data collected during our practices) that unfortunately, very often within the Italian schools, sustainability is considered only a "new concept/knowledge" that needs to be included into the curriculum of different disciplines but that doesn't modify their educational approaches. It's very often forgotten that the biggest school's impact on sustainability is related to its role in educating professionals/citizen to understand, to position themselves, to act and to participate in building the future. To reduce their considerable impact, then, schools have to ensure that students don't acquire only knowledge but also values, competences and skills to apply sustainability principles in their future life and workplace. A reflection about teacher pre-service training, clearly show that in spite of these tasks, most teachers have not been assisted in them because the academic communities have maintained a focus on the development of environment/science-related goals and have neglected to probe deeply enough into their pedagogy and educational approaches. In Italian University system, in fact, competences, don't receive attention compared to disciplinary contents, such as biology, physics, geography and so teaching can be often conceived as the transmission of a mixture of different unconnected knowledge.

In our vision, teachers need to reflect critically, both individually and as a group, on their roles and actions coherent to the aims of EfS and this is the basis of our teachers' training proposals. In fact, they need to deal with the scientific perspective of the different themes but at the mean time, have to put the attention on their interrelations with issues as social equity, quality of life, economic impacts. In our proposals, then, an interdisciplinary approach which draws together both the three dimensions of sustainability is stimulating, together with the attention to values, attitudes and behavior.

Teachers' approach to EfS, in our idea, require also a new pedagogy of transformative education/learning in way to rethink the model of teaching and to support interdisciplinarity, active/transformative learning, problem - based approaches, starting from the cultural and methodological contributions of each discipline. This is the reason why during our training for science teachers, we are used to analyze with them their teaching methodologies and strategies, supporting a new form of inquiry based teaching, different from the approach traditionally used. In our experiences, in particular, we try to support educational proposals that go beyond teaching based on "what" (transfer of information) to models that emphasize "how", through more interactive and collaborative learning processes. In this perspective, during training courses, CIREA used a teaching/learning approach which is not only based on transmission of knowledge but on the practice/discussion of methodologies that teachers should use with their students (as an example, see our contribution to the project Sustain, supporting the interaction between IBSE and ESD approach [4]). We would like to change the idea of teachers: from instructors to individuals who are in relationship with their students, their colleagues and are involved in the dynamics of a society that is approaching the challenge of



sustainability. It is within the context based on these relationships, that the conditions that enable genuine learning to develop can be supported.

These general ideas of teachers training are put into practice by CIREA during the training activities thanks to a specific focus on competences. In fact, a continuous updating of competences represents a significant component of EfS and consequently is fundamental put the attention of teachers to the their development in order to promote new paths for a better future. Recently, coherently with the guidelines set at international level from UNECE [1] and UNESCO in the framework of the Decade for Sustainable Development (2005-2014) [5] and as response to recent Ministry guidelines [6], in the Italian Education System a strong methodological competences requirement for designing training actions in the field of sustainability has emerged. However, in spite of the position of competences at the core of the idea of teaching supported by the Italian Ministry of Education, the majority of Italian teachers' practices are essentially knowledge-based and so training in this perspective is particularly important.

Finally, thanks to some activities in group, sometimes organized putting together teachers of the same school level, some others times merging teachers of different school levels in a vertical curriculum perspective, alternative futures are explored, envisioning and promoting a change in the way people learn and in the systems that support learning.

4. Conclusive remarks

In synthesis, the perspective of EfS in science teachers training, asks to deal with different domains of competences [7], [8] that CIREA has pointed out in its training courses:

Knowledge; Even if, obviously, knowledge are fundamental, their acquisition is not conceived as the goal of the training activities for teachers but as a "pretext/opportunity" to experiment a new way to approach with the different issues. Knowledge needs to consider the interdisciplinary dimension of sustainability and needs to be connected with the dimension of time (past, present and future) and space (local – global).

Systems thinking; a reductionist and linear approach cannot help to envision a sustainable future. A holistic approach which emphasizes the complexity, uncertainty, inter-connection and systemic view of today's world, needs to be supported during training courses.

Emotions; emotional competences and the feeling of inter-connection with the living and not living world need to be supported during courses, because they are fundamental for EfS-commitment and processes.

Ethics and Values; teachers need to consider during their activities with students, that values, attitudes, beliefs and assumptions guid their perception, their thinking, their decisions and actions.

Actions; the analysis of actions is fundamental because allows to explicit and emphasize the points of view, the approach with conflicts, the coherence/incoherence, experiencing the change of behaviour. In other words, it enables to think about the deepest impact of teaching as contribute to the development of an individual.

Starting from our experience and from these remarks, we are convinced that the support to science teachers in understanding and rethinking the conceptual and practical constraints of their work needs to be considered essential in science teachers' training for sustainability.

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