A CONSTRUCTIVIST APPROACH TO INTEGRATED SCIENCE EDUCATION: TEACHING PROSPECTIVE TEACHERS TO DO SCIENCE

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Learner-centered approaches to teaching and schooling require supportive policies for preparing effective educators. Moving from constructivist philosophy, psychology and epistemology to the characterization of constructivist teaching and learning environments presents a challenge. Constructivist philosophy does not dictate how one should teach; however, it does make it incumbent upon the teacher to deal with each learner as an individual, to value diversity of perspective, and to recognize that the learner's behavior is a direct reflection of his / her life experiences. Bandura (1977, 1986, 1995, 1997), Fullan (1993), and other self-efficacy researchers have concluded that the catalyst for educational reform is the individual teacher and that a teacher's behaviors, values, beliefs, and ambition to act may be enhanced or suppressed during student teaching.

Constructivist science teacher preparation programs are intentionally designed to be transformational, not just informational. Preservice teachers are constantly given opportunities to make new connections in a setting focusing on personal empowerment and critical reflection. The programs challenge preservice teachers to move toward self-directed life-long learning (Ronald J. Bonnstetter, 1998).

The main mission for students in preparing to become educators is to learn procedures for proper education, the basics of teaching science, and the skill of conducting the process whereby students obtain knowledge. Young educators must be well familiar with teaching procedures, methods and methodical steps so as to be able to utiline tiese successfully in his or her work in various classes and under various conditions. When studying at university, students must not only become familiar with the theoretical foundations of science methodology, but also with their practical applications (Keirans, 2002).

Natural science competence of basic school teachers is one of the constituent parts of general professional competence. It is obvious that the students, prospective (would-be) teachers should receive considerably high education in the field of natural science education in the process of studies.

Educational literature distinguishes the coming crucial moments:

- science teachers have to learn knowledge of the content of science, general psycho pedagogical knowledge, and theoretical knowledge of science education (Mellado, Blanco, Ruiz, 1999);
- science is an increasingly important component of school curriculum across much of the world; teachers` lack of subject knowledge in science has been documented and frequently identified as a barrier to implementation of curriculum reform and to pupil progress (Asoko, 2000, p.79);
- the content of school science must change. Its conceptual content must be more selective, and taught in a manner that gives these powerful ideas coherence and linkage (Fensham, 2000, p.161);

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- a basic prerequisite for change is teachers` "*self-development*' or "*self-cultivation*" (Terhart, 1999).

"Teachers, as professionals, should have historical and philosophical knowledge of their subject matter quite independently of whether this knowledge is directly used in classrooms: teachers ought to know more about their subject than they are required to teach" (Matthews, 2000, p.334).

Systemic, integral natural science training of teachers is extremely important to the process of natural science competence development. On the other hand, competence has to be examined in a general cohesive system:

Natural science background standards –natural science competence of the teacher – the mastership (pedagogic) of activity – the results of natural science education

The competence of natural sciences teachers should be perceived as a system every component of which is fundamental. Natural science literacy is a core that is basically acquired in comprehensive school (*natural science education as a component of general education*). An appropriate natural science qualification and the level of competence are obtained in higher school. A decisive moment is a permanent improvement of competence during practical activities of the teacher.

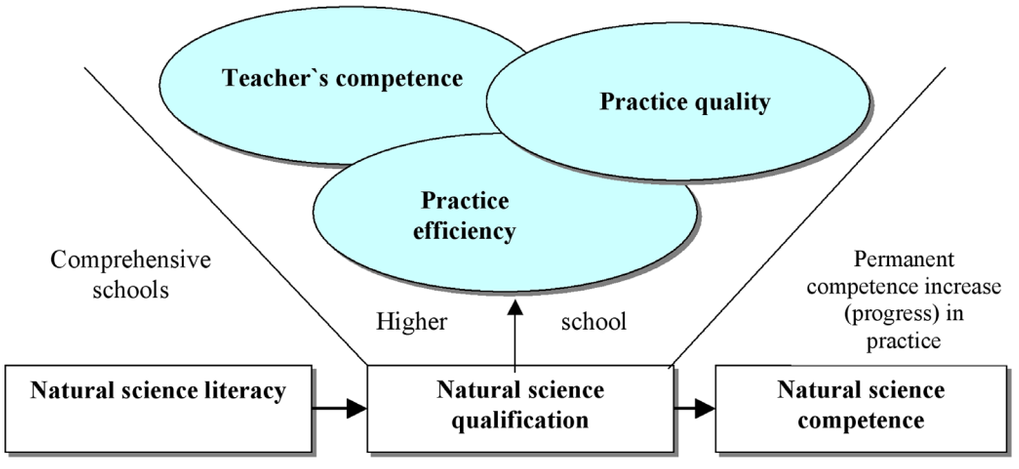

Figure 1: The competence of natural sciences' teachers as a system.

Considering the changes of paradigms (for example, learning is in the prior position to teaching), the following ***objectives of natural science education*** can be raised in higher school:

- to ascertain the correlation between knowledge of nature and the phenomena important to society (for example ecology, environment protection, economics, healthy way of life, etc.);
- to extend and improve knowledge of the closest environment, to spark interest in the animate world;
- to demonstrate knowledge of the macro, mezzo and micro world as a tune of the three correlating systems and the place of human being in nature and his/her impact on it (anthropogenic aspect);
- to develop active students' relations with an environment, respect for nature (nature appreciation) and responsibility for it;

- to promote interest in the latest strategies of natural science education in the foreign countries;
- to become familiar with a world of modern technologies, to develop abilities in order to share natural science experience;
- to enhance students' understanding of the interaction and intercourse between animate and inanimate nature;
- to deepen comprehension of the most important natural science ideas and phenomena;
- to prove students' competence in natural sciences, to strengthen the cognitive interaction with nature etc.;

Objectives of methodical training (readiness):

- to learn to coordinate and concretize practical pupils' work considering the specificity of school (environment, resources, etc.);
- to perceive and realize the specificity of the integrated teaching/learning courses, to master to decide on the teaching material corresponding to pupils' experience;
- to find out and understand an individual and pedagogic-psychological readiness to teach the subject (teaching process establishment and control) in lower and upper secondary school;
- to manage to equip a material-technical facilities for the science classes;
- to succeed in applying professional and pedagogic-psychologic knowledge, to be able to plan classes and extra curricular activities;
- to establish conditions for students to develop abilities necessary to explain pupils the importance of natural science knowledge to their individual lives;
- to encourage to understand and to apply the significance of research activity methods, to develop abilities to obtain, receive and present information using the latest technologies of information (for example, natural science education database development, etc.)
- to set out conditions for students to work self-sufficiently (particularly with projects), etc.

Social training objectives are also important, and therefore cannot be forgotten. Thus, we have:

- to enhance understanding that the emphasis of value-based attitudes is an important striving of education;
- to acknowledge, perceive and respect human freedoms, rights and duties of every person as well as of the whole democratic society;
- to explore individual possibilities and ways to be involved into public life, to accept responsibility for the future of the nation;
- to realize the preconditions, possibilities and responsibility for the participation in the ruling on the contemporary democratic state and its institutions;
- to reveal contemporary tendencies of democracy evolution in the world;
- to enhance understanding that personal solutions to concrete situations most frequently are governed by value-based attitudes;
- to enrich comprehension that individual activities are very important to abilities development and value-based attitudes fostering;
- to appreciate ability to communicate and contribute, to seek and receive an answer to tricky questions;
- to manage to shape a personal opinion, to critically evaluate individual competence, to continually search for alternative decisions;
- to succeed in applying acquired knowledge in every day life.

Shulman (1986) also suggests that teachers can learn the knowledge needed during practice

through stories or cases. It is clear that teachers` training programs has to be in accordance with the following fundamental principles (Kokkotas, 2003):

- the aim of teachers` in-service training is by using teachers` views and practices to achieve appropriation of knowledge and competencies in some important teaching and learning aspects of science;
- in-service science teachers following a professional development program are learners who actively construct their own theories about teaching and learning. This is achieved through their personal teaching experience and determined by their attitudes and beliefs;
- the quality, breadth, and flexibility of teachers` practices they use in the classroom are tightly connected with their professional development;
- the teaching and learning processes receive continuously support from teachers who attend professional development programs, and offer opportunities allowing them to interact with colleagues and exchange experience on these processes.

In general, excellent science teacher preparation and professional development programs have some common characteristics. In such programs, prospective and practicing science teachers (The Association for Science Teacher Education, 2008):

- participate in collaborative professional settings with peers, expert science teachers, science teacher educators, and pure and applied scientists.
- engage in activities that promote their understanding of science concepts and the history and nature of science;
- experience strategies for effective science teaching and inquiry including meaningful laboratory and simulation activities using contemporary technology tools;
- question and evaluate evidence and justify assertions scientifically;
- develop science-specific pedagogical knowledge grounded in contemporary scholarship;
- engage in substantive clinical experiences where they develop and implement lesson plans appropriate for students from diverse backgrounds, assess their success on student learning, and plan next steps to improve their teaching;
- find and use credible information about the safe and effective use of laboratory activities, independent science projects, science fairs, field trips, simulations, computer tools, and curriculum resources.

For pre-service science teachers is very important to understand how secondary school students interact in the classroom; to understand how secondary school students respond to different teaching techniques; to gain experience in classroom teaching under the guidance of experienced teachers; to practice teaching in their own discipline and other subject areas; to gain experience in planning thematic units and understanding how a teaching team functions. A teacher is the key of the teaching process. Along the organization of integrated teaching the teacher has a big influence on schoolchildren. The awareness and assessment of the format of this influence helps the teacher to reveal what should be changed and improved in the process of integrated teaching. Competent science teachers have a direct, positive effect on students' learning. Science teachers must have a deep understanding of how people learn science as well as skills and dispositions grounded in that knowledge that enables them to promote meaningful learning at their levels of science teaching. It is clear, that new teachers at schools need special science-specific teaching support during their first years of teaching to enable them to apply their science and pedagogical knowledge and skills successfully. Such a system of support need to be developed. Also science teachers must be prepared to meet the needs of their students and communities, grow by participating with others in the science education community, and participate in the development of science education.

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