

# SOME ASPECTS OF NATURAL SCIENCE LITERACY AND COMPETENCE OF PRIMARY SCHOOL TEACHERS

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Natural science competence of primary school teachers is one of the constituent parts of general professional competence. It is obvious that the students, would-be teachers (future teachers) of primary school, should receive considerably high education in the field of natural science education in the process of studies. Working primary school teachers should also develop their professional competence. It is obvious, that teaching in a primary school as a specialization, and teaching in general as a profession has always had a special role (Sinka, 2006). Educational literature emphasizes that the gaps do exist in primary school teachers' knowledge and can be outlined by the following aspects (Bentley, Watts, 1994, p.179):

- content knowledge (it is necessary that teachers themselves understand the concepts being explored);
- pedagogic knowledge (it includes how children learn, how to start and end lessons, and what to do in the bits in between);
- strategic knowledge;
- professional knowledge (this is the knowledge that teachers have about their role in the profession; it includes understanding the ethics and morals of teaching – what can, should or could be done and not done with the children under their care of the school, the personal and social education aspects of a school and how it operates);
- situational knowledge;
- personal knowledge.

The opinion that a major focus of primary school teacher's competence is his/her ability to hold audience can be met (Hill, Jennings, 1992; Bentley, Watts, 1994). However, it is not enough as competence also requires progressive thinking about the teaching and learning processes, about relationship, about theory and practice and about the need to acquire self-appraisal skills the goal of which is continual professional enhancement. According to V. Mellado, L. Blanco and C. Ruiz (1999, p. 274), prospective primary teachers have to know the aspects of science teaching/learning which are most relevant to their professional level:

- theories of science learning;
- science teaching strategies;
- problem solving in science;
- school laboratory and science practical work, conceptual and methodological change;
- the intuitive ideas of students of different ages about each specific topic,
- student characteristics (attitudes, motivation, level of maturity, etc.);
- knowledge of the school science curriculum, organisation of the science classroom (principles, rules and routines, use of time, etc.);
- the resources of the science classroom (textbooks, audio-visual media, teaching material, etc.);
- evaluation of the sciences.

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);
- primary teachers with a low level of scientific knowledge have difficulty in carrying through educational changes (Grimellini, Pecori, 1988);
- science is an increasingly important component of the primary 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);
- learning to teach primary science through problem-based learning (Peterson, Treagust, 1998); developing primary teachers' science subject knowledge in practice (Asoko, 2000, p.90); broadening primary school teachers' natural history abilities and developing the cognitive motivation of the interaction with nature (Lamauskas, 2002). Teacher development implies changing teacher knowledge, thinking and practice (Dillon, 2000, p.97);
- 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);
- a basic prerequisite for change is teachers' "*self-development*" or "*self-cultivation*" (Terhart, 1999).

M. Wenham (1995) points to the fundamental importance of base natural science knowledge of primary school teachers and contends that the teacher must be able to explain many relevant questions to children. He distinguishes two important aspects:

- children are most likely to develop an in-depth understanding of any object, change or event if they have experienced it at first hand;
- first-hand experience alone is not enough to develop scientific knowledge and understanding. If the scientific knowledge and understanding of children is to develop, teachers must help them to interpret their experiences and observations in terms of the facts, concepts and theories of science.

M. Wenham evaluates the above aspects and discusses the following fields in his book "Understanding Primary Science": *science: investigation, invention and experiment; life and living processes; humans and other animals; plants; variety, adaptation and interdependence; states of matter and physical change; mechanical properties of materials and objects; explaining physical changes; obtaining and making materials; Earth science: weather, rocks and soils; energy; electricity; forces and their effects; gravity and magnetism; sound; light; the Earth in space*. Obviously, the primary school must have enough knowledge of natural sciences (physics, chemistry, biology, etc.). In any case, natural science education gained in secondary school is not sufficient. This is the way how the issue develops – what level natural science component should be included into the curricula of studies when training primary school teachers. P. Ovens (2000) has examined the personal professional development of teachers and tutors or others who support teacher development (reflective teacher development in primary science).

The mentioned important natural science issues presuppose an idea that the teacher's competence is a keystone of successful and effective training and has to be given a priority. Bearing in mind that teacher training was ideologically-based for long decades the system of Lithuanian education sees it as a question of primary importance.

In general, the problems of competence (models, structural components, testing, etc.) are frequently debated in foreign educologic literature (Raven, 1999). Competence can vary (for example, two types of competence are mentioned – teaching and pedagogic; in turn, each of them has its own competence of a narrower scope). However, educologic literature most frequently is presented with *general and specific* (according to the content criterion) and *dispositional and abilities* (according to the nature criterion) competence. Competence can

be defined as the ability to be effectively engaged in an activity agreeably to qualification, knowledge, skills (Jovaiša, 1993).

It is clear that the terms „*qualification*“ and „*competence*“ are not equal. Qualification can be defined as a degree of human ability to do a job, as a certain amount of knowledge, skills, and experience (Vaitkevičiūtė, 1999, p.702) while *competence* is described as a functional ability to be adequately involved into the particular activity (Vaitkevičiūtė, 1999, p.641). We support an opinion that the concept of competence in terms of the concept of qualification carries out a broader meaning. It can be underscored that despite the fact that these two concepts are closely interrelated, the other European countries more frequently use the concept of competence (for example, English Competence, German Kompetenz). From this point of view, the teacher's primary natural science competence can be accepted as the ability to apply acquired natural science knowledge in the real situations of training (for example, in the classroom, excursion, practical natural history activities, etc.).

One of the most significant types of competence is supposed to be the one of primary natural science. The other types of competence (*pedagogic, professional, objective, social, methodic, business, etc.*) seem to be also consequential. However, the process of studies, as a rule, devotes much attention to the pedagogic-psychologic issues. The primary school teachers teach all subjects, and therefore their training is complex, specific and requires a carefully considered strategy. Primary school teacher training experience in Lithuania allows to state that natural science competence is minimum developed as it is not given enough attention. Similar problems can be noticed in other countries. To our mind, the formal natural science qualification of primary school teachers should include the following main components (qualification characteristics) (Lamanauskas, 2001; 2003):

- Mastering of the system of the concepts of the category „natural science education“ (for example, environment study, natural history, sensual perception of nature, etc.).
- The comprehension of the scientific knowledge of nature, the interaction between nature and society, nature and technologies, nature as a unique phenomenal system.
- The understanding, comprehension and management of the most important natural science theories (for example, cell theory, etc.), laws (for example, the law of conservation of energy, etc.) and consistent patterns (for example, symmetry, polarity, periodicity, etc.) in different situations.
- The awareness of nature as a value (respect for life concept).
- Primary school pupils' (junior school age) knowledge and comprehension of matter, goals and tasks of natural science education. The knowledge of general curricula and didactic attitudes of natural science education standards.
- Ability to apply scientific cognition methods in specific practical activities.
- Primary school schoolchildren's knowledge of contemporary natural science tendencies, mastering of natural science education forms, methods and patterns.
- Ability to reveal the potential of natural science education of different educational subjects in primary school:
  - to foster learners' love and respect for nature, the need to protect environment;
  - to make pupils interested in the environment protection lookouts, to foster their cognitive and value-based relations with the outward natural environment;
  - to teach children properly behave and act in nature, to disclose the negative patterns of unacceptable behaviour in nature;
  - to be able to establish the qualitative changes of natural science education.
- Ability to schedule and manipulate the process of natural science education in primary school.
- Ability to discover natural science education achievements.
- Ability to use contemporary ICT in teaching process.

If a teacher's formal readiness meets the real content of pedagogic activity in the field of natural science education (for example, the implementation of didactic attitudes of the curriculum „Me and the World“), then we can agree that s/he has acquired sufficient natural science competence. The competence gained in the process of studies (from a qualitative and quantitative point of view) determines their further development. The following more important units of natural science competence (in terms of pedagogy) can be distinguished:

- the competence of animate and inanimate nature cognition;
- the competence of the diagnostics and correction of the junior pupils interaction with nature;
- the competence of individually designed educational curricula of natural science (for example, „Introduction into the Science of the World“, etc.);
- the competence of mastering the methods of teaching (learning) natural science;
- the competence of pupils' achievements control and evaluation in the field of natural science education;
- the competence of further development and correction layout of the natural science educational process effectiveness.

A detailed assessment of the model of the teacher's natural science competence is a complex task. For example, one of the chapters of teachers' educational standards of England presents 76 types of competence (Jurašaitė-Harbison, 2000). Therefore, training individual competence of a teacher is not self-seeking. Teachers' natural science competence can be examined only in the general context of competence. Evidently, the major characteristics of competence are effectiveness, mobility and enhancing of personal qualities (Babin, Kurant, 2000).

Systemic, integral natural science training of primary school 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***

A holistic concept (*Holism* is an attitude that requires to perceive a phenomenon as a particular single wholeness that is not equal to the total amount of its constituents; it is the evolution theory declaring that the unknowable wholeness of the world determines its creative evolution) of natural phenomena is supposed to be highly important to primary natural science competence of the teacher. Finally, it is important to stress that natural science teaching in primary school be powerful and purposeful. It is obligatory to avoid the marginalization of natural science education (teaching and learning) at the primary school level. Natural science education in primary schools, by contrast, must be consistent and efficient, because it is the basis for deeper study of the natural sciences in secondary and higher education.

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Received: October 31, 2011

Accepted: November 23, 2011

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