



SCIENCE TEACHER PROFESSIONAL DEVELOPMENT IN EDUCATION OF GIFTED STUDENTS

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Abstract

It is necessary to pay attention to education of gifted students in science because of the significant benefit of science for social development in a very competitive globalized environment. Gifted students have got specific educational needs. Family and science teachers play a crucial role in the education of gifted students. Current research has shown that special teacher professional competencies are important for recognizing and development of giftedness. Using appropriate teaching methods will enable the gifted students to grow to their highest potential. Innovative educational methods for motivation and development of gifted students are to be implemented in teacher professional training. We are presenting research findings of students' educational preferences and examples of concrete suitable teaching/learning methods based on experimentation for gifted students: inquiry-based science education, family science education, ICT-based collaborative education, and problem learning tasks. These teaching/learning methods have to be implemented in continuous professional development of science teachers.

Keywords: educational method, giftedness, teacher professional development, science education

INTRODUCTION

One of very important groups of students with special educational needs is a group of gifted students. Teachers devote their time mainly to disabled students as students with special educational needs. Unfortunately less attention is paid to gifted students (Rocard et al, 2007). Support of gifted students involves not only the identification but also development of giftedness. This educational support of the gifted students has played an important role in their personal development. School and family (Tannenbaum, 1983), have to create suitable conditions for the support of giftedness (Renzulli, 1986). According to experts there are 2-3 % of exceptionally gifted students. However, in suitable conditions for development of individual abilities, the rate of students excelling in some areas might rise up to 25 %. Therefore, it is necessary to develop appropriate teaching and learning methods for gifted students.

Naturalist Intelligence and Science Giftedness

The core question is: Who can be considered as a student gifted in science? Some experts include in this group students gifted in mathematics, physics, chemistry and biology. Students gifted in science, of course, may not be gifted in all those subjects. Usually there is giftedness in some subjects, which is combined with general interest in science.

According to the American psychologist H. Gardner giftedness in science relates to naturalist intelligence. He described naturalist intelligence in the multiple intelligence theory. "Naturalist intelligence enables human beings to recognize, categorize and draw upon certain features of the environment. It combines a description of the core ability with a characterization of the role that many cultures value." (Gardner, 1999, p. 48). R. J.

Sternberg (2003) defines intelligence as the ability to learn from experience, think clearly, remember important information and manage demands of everyday life well. He defines three types of giftedness in his theory of intelligence: (1) analytical intelligence (the ability to analyse a problem and understand its parts), (2) synthetic intelligence (the ability to understand a problem, intuition and creativity), and (3) practical intelligence (application of analytical or synthetic intelligence in practice). R. J. Sternberg (2007) has recently revised his theory of triarchic intelligence in a renew model WICS (three areas of intelligence applied in the model: W-wisdom; I-intelligence, C-creativity; S-synthesized).

Development of giftedness is an individualised demanding activity because each gifted student has many personal specifics including the type of intelligence. Education of gifted students may be more demanding than education of disabled students because of this variability of specific educational needs.

Expectations of Gifted Students And Science Teachers

The basis of suitable educational methods for gifted students is the analysis of their educational needs and expectations. It is important to compare these needs and expectations with the reality in instruction. Gifted students have high level of expectations of support for their giftedness from science teachers. Gifted students expect to meet teachers with high scientific level presented in a modern pedagogical way (experimentation, use of ICT, solving the problems etc.) and also a partnership between teachers and students. The teacher can significantly affect motivation of gifted students. We have carried out research on motivation of students gifted in science.

This research was conducted on a sample of Czech students gifted in science with the preferred interest in physics. The giftedness of respondents was identified on the basis of the expert diagnosis at the pedagogical-psychological counselling and on the basis of professional opinions of their teachers. We used a questionnaire which was distributed to 86 gifted students of upper secondary school aged from 16 to 18 years in the school year 2011/2012. We have presented a significant issue in the questionnaire (see Fig. 1).

Question: *Does your school environment motivate you to study physics?*

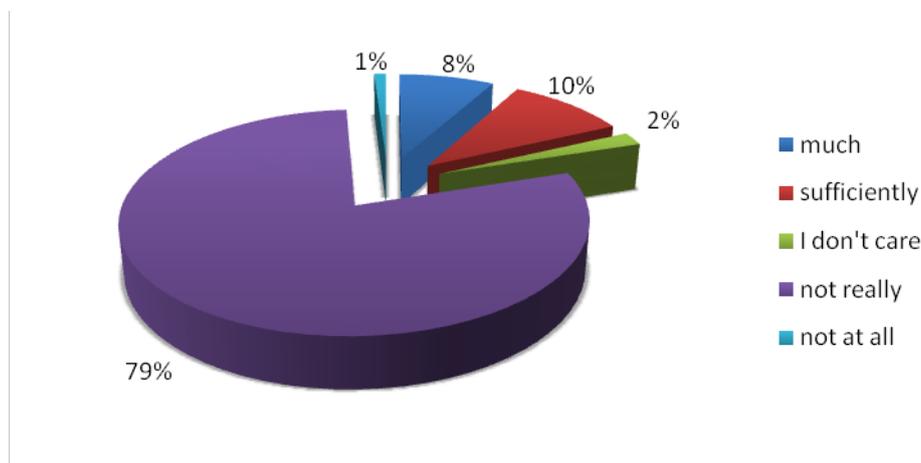


Figure 1. Frequency of students' responses - motivational school environment

The results of this investigation are not satisfactory. This and other studies show that gifted students do not meet with sufficient motivational support (Renzulli, 1986). There might be more causes of this condition. A significant factor, however, is the teacher and his/her appropriate teaching methods.

Expectations of Gifted Students and Educational Methods

Current research has shown that special teacher professional competencies are important for recognizing and development of giftedness. Using appropriate teaching methods will enable the gifted students to grow to their highest potential. Innovative educational methods for motivation and development of gifted students are to be

implemented in teacher professional training. There are a number of special educational methods and strategies for gifted students in science. Their choice depends also on the interest of the gifted students. We have also explored this interest of gifted students in innovative methods in the above described questionnaire research. We used a set of educational strategies from one of the U.S. independent charities National Association for Gifted Children (NAGC, 2012) that works well with families of gifted students and supports them.

- *Curriculum compacting*: if a gifted student demonstrates mastery of basic subject matters, he/she may be allowed to use the remaining time for other learning objectives.
- *Advanced placement*: the programme is created by a university where upper secondary school gifted students can attend courses according to the criteria listed for secondary education.
- *Pull-out program*: the programme which exempts gifted students for a day from regular learning activities and enables him/her to do special activities.
- *"Academy" for advanced students*: special programme proposed by universities for gifted students from upper secondary schools (mostly in mathematics and science).
- *Individual education plan*: it is an individual education plan for concrete students.

Gifted students selected an educational method according to their interest after being told the nature of the method (see Fig. 2).

Question: *What modern educational method would you choose for yourself?*

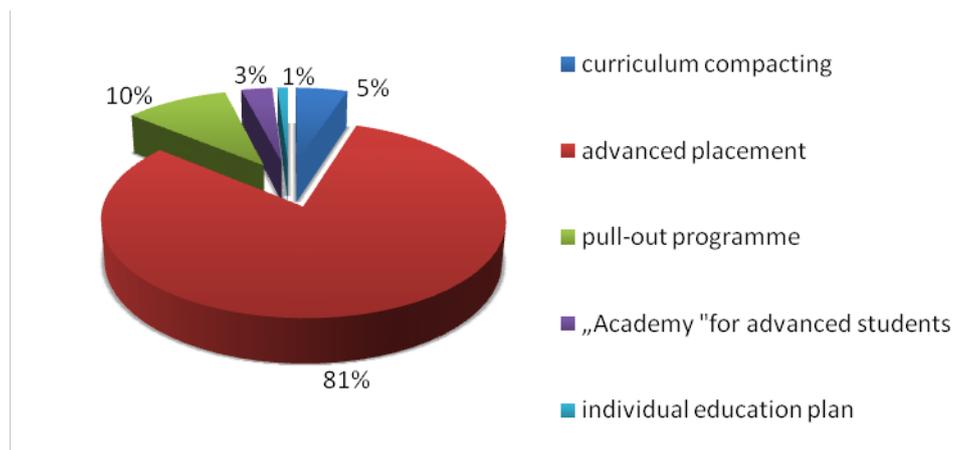


Figure 2. Frequency of students' responses – modern educational methods

Gifted students in science are also interested in acquiring new knowledge and skills on higher levels of schools with innovative teaching/learning methods.

Teacher Training in Educational Methods for Gifted Students

Science teachers have to be equipped with new competences to support gifted students. This teacher training is a new dimension of science teacher continuous professional development (Trnova & Trna, 2011). Educational strategies and methods have to be included in the pre-service and in-service science teacher training. We have developed a set of innovated educational methods for gifted students in science based on experimentation. We used the design-based research method. These methods include particularly the following:

- IBSE experimentation
- Family science education based on experimentation
- ICT-based collaborative science education based on experimentation
- Problem learning tasks based on experimentation

We are presenting as an example the educational method “Problem learning tasks based on experimentation” (see Fig. 3).

A polystyrene cube is put on the water surface in a large glass. The cube floats on the water surface. Using a smaller empty glass we cover up the cube and push it down. The cube floats on the water surface, which is lower than the level in the large glass. Please explain whether the law for swimming works.



Figure 3. Floating polystyrene cube

Solution: The law for swimming bodies applies. The polystyrene cube floats on the lower level.

CONCLUSIONS AND IMPLICATIONS

Our research has shown that it is necessary to implement special educational methods for gifted students in teacher training. Without these professional competencies giftedness cannot be developed. School environment is the main factor in the development of giftedness. The role of the teacher is therefore totally irreplaceable. Therefore it is necessary to include the specific methods in pre-service and in-service teacher training for effective implementation to education. Since education of gifted students is realized in very variable conditions and situations, it is necessary for the teacher to be creative. The development of creativity and teacher mastery of specific educational methods for gifted students must be involved in the continuous professional development of science teachers.

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