Evolution and Perspectives of Science Curriculum in the Czech Republic

ČTRNÁCTOVÁ Hana (1), JANOUŠKOVÁ Svatava (2), STRATILOVÁ URVÁLKOVÁ Eva (3), TEPLÁ Milada (4)

Charles University – Faculty of Science, Czech Republic (1)
Charles University – Faculty of Science, Czech Republic (2)
Charles University – Faculty of Science, Czech Republic (3)
Charles University – Faculty of Science, Czech Republic (4)

Abstract

The education system in the Czech Republic went through a series of significant changes in the last 30 years; changes related mostly to the society-wide changes after 1989 and gradual connection of Czech Republic into the European Union. After 40 years of implementing unified school system and centralization of education, the educational system was transformed from 1990s onwards and the autonomy of the schools increased thanks to the unified curriculum. Despite that, the contents and methods of teaching of scientific subjects in primary and secondary education have changed only little. This relates to the overall problem of current concept of science education not only in our country but also in the rest of EU.

The goal of the first part of the article is to introduce the evolution of the science teaching paradigm in the Czech Republic in the last 30 years using the thematic qualitative analysis with the help of strategical and conceptual documents of the Ministry of Education and other documents created by organizations that are responsible for education in the Czech Republic. In the second part of the article, we would like to use an analysis of curricular targets in science education since 1990s to focus on transformation of science education goals and on projecting of alternative methods and educational processes into science curricula. We will also state current main problems and necessary changes that are being prepared on the basis of the analysis.

Keywords: *science education, primary and secondary education, content and methods of the curriculum, STEM and STEAM, IBSE;*

1. Introduction

The tradition of science education at primary and secondary level in the Czech Republic is long. However, the approach to science education has stayed almost unchanged for over 30 years. Since the current world is actually changing and evolving very fast in all of its areas and the Czech Republic is an inseparable part of the world, it's not possible to stagnate at the achieved science education level. Many studies point out the problems of the scientistic approach to science which eventually leads to lack of understanding and interest about science at all levels of education. We can observe a worldwide swerve from this concept of education and focus on science themes that students could use in their future lives regardless of their eventual profession.

Apart from the requirement about changes in science curriculum contents, there is also emphasis on new methods and processes that should be used in teaching of those subjects. One of the demands is an interdisciplinary approach that would better correspond to real scientific research. There is also an emphasis on the connection between science and mathematics/ICT. EU projects focused on science education often talk about the „STEM“ approach (including mathematics), or the „STEAM“ approach (that also includes arts). Research shows that use of the abovementioned methods and techniques brings positive results in science education. Therefore, changes in teaching of science are now being prepared, even in the Czech Republic.

2. The evolution of science education paradigm

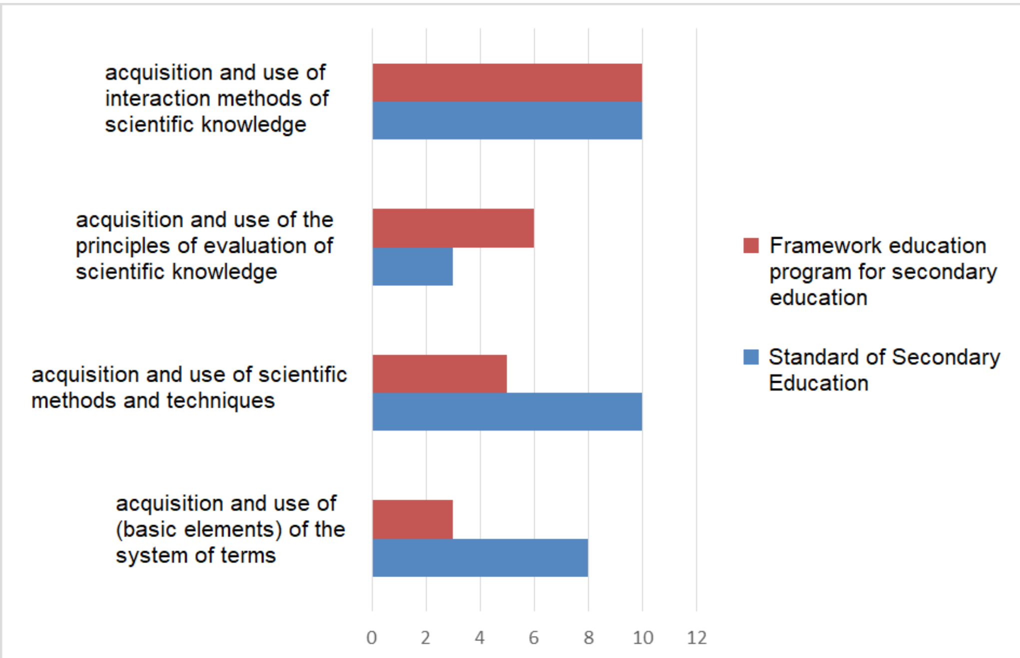
The science education has been going through many changes since 1990; changes that go in the name of new standing and concept of science disciplines. Some authors, like Osborne and Wittrock (1983) even talk about science education crisis. Both science paradigms that were used up to that point – humanist and scientistic – seemed to be too rigid. Therefore, they had to be replaced by other paradigms that would better reflect dynamic changes in science, technology and organization of society (Maršák & Janoušková, 2006). However, the beginning of the 21st century also brings another

challenge in the area of national education, and that is globalization. Globalization is usually meant to be the worldwide intensification of social relations that lead to local events being formed by things happening thousands of kilometres away and vice versa (Held, 1991). For this reason, globalization erases, to a point, national borders, enhances and requires certain cohesiveness and has significant effect on the organization of national identity (Torres, 2002). This necessarily had to reflect in the education politics (and it does), especially since the globalization was supposed to act as a introduction and development of knowledge-based society and economics.
At the same time, we have to realize that while the world started to approach science education as a way to understand the world and get oriented within it, there was a significant decline in students‘ interest about the study of science and technological disciplines (Osborne & Wittrock, 1983). This crisis lasted until the beginning of the 21st century and the deciders saw its existence as a serious problem since science and research of new technologies that stems from it have been and are one of the strong preconditions of success and competitiveness of individual countries (Krammer, 2017).
However, 1990s are not just the period of searching for new approaches to science education; they are also a period of creation and implementation of the first globalized research studies in measuring of the students‘ results in science. The impact of these comparative surveys on participating countries‘ educational systems was extraordinary, which might come as a surprise for some of those countries. The first survey, which is regularly implemented globally in a four-year cycle (usually encompassing over than 50 countries) since 1995, is TIMSS (Trends in International Mathematics and Science Study) coordinated by the company The International Association for the Evaluation of Educational Achievement (IEA). The second survey, by the Organisation for Economic Co-operation and Development (OECD), is the PISA research (Programme for International Students Assessment), implemented in three-year cycles since 2000 (however, the preparation stated in late 1990s). Czech Republic is a regular participants in these surveys.
However, these international surveys were not the impetus for changes in science education in the Czech Republic. There were two reasons for that. The first one was the necessity to focus on fundamental transformation of the whole educational system and make it conform to the needs of new democratic society. This task was fairly complicated even from the point of view of curriculum transformation – there was gradual increase in the autonomy of schools. The second reason, just as important, was the fact that the Czech Republic achieved above-average results in the international survey TIMSS from 1995. It would therefore seem that the contemporary approach to science education had good results (ÚIV, 2002). In 2000‘s PISA survey, Czech students achieved an above-average scientific literacy rating among the OECD countries. At the beginning of the 1990s, the science education had a unified curriculum (for lower secondary education since 1982, for upper secondary education since 1984). Attempts to make the curriculum less strict led to the curricular synopsis becoming non-mandatory, but mid-1990s saw the publication of new curricular documents, so-called Educational Standards. The Standards contained mostly educational goals and basic subject matter. The educational goals delineated the basic framework of education students should achieve by graduating from the specific kind of school. They included knowledge goals, skills and competencies, values and approaches. The basic subject matter expressed the contents of the education; its important elements. It was divided according to education areas and disciplines into the areas of language, social sciences, mathematics/IT, science, esthetics/pedagogy and healthy lifestyle.
In 2005-2007, the educational standards were gradually replaced by *framework education programs* (FEP). These delineate generally binding demands for various stages of schools and individual scientific disciplines. They also contain binding rules for creation of *school education programs* (SEP), curricular documents that should be the guide for implementation of education at a specific school. According to FEP specification, each school should create its own SEP, opening space for asserting the potential of the individual schools.
Each stage of education has its own individual FEP that states specific *key competences* for that stage. Each key competency is then developed using bullet points that state what a student should know in that particular stage of education. Apart from the key competencies, FEP also defines *education areas*. The education areas are understood to be a widely concepted whole formed by one or more education disciplines whose contents is related. Scientific disciplines are a part of the area Man and Nature. Each area lists its characteristics and target focus, each discipline lists expected outputs and subject matter. FEPs contain so-called *cross-section themes*, focused mostly on upbringing – developing and affecting the students‘ approaches, value systems and conduct. They are a mandatory part of education and their pedagogical and integratory content focus helps with acquisition of key competencies.

Next, the area of science education was impacted by another new worldwide phenomenon: inquiry-based science education (IBSE). Although IBSE was far from a new concept and many countries worked with it since 1960s, we can assume that a report of the European Commission by Michel Rockard called *Science Education NOW: A Renewed Pedagogy for the Future of Europe* was a major factor in achieving greater prevalence of this concept. This report concluded that young people's interest in studying science is declining in European countries, despite the fact that science's importance for society is seen as fundamental. It also concluded that one of the reason for this disinterest in science is the way it's taught. The report repeatedly emphasizes the necessity of support such methods of science education at schools that would lead from primarily deductive education methods to inquiry-based ones; this is also reflected in the recommendations and conclusions of the report. (EC, 2007). A British study called „Science Education in Europe: Critical reflections" helmed by renowned scientists Osborne a Dillon (2008) also supported the EC report in this regard

3. Evolution of the goals of science education

The evolution of goals of science education at the secondary level can be well-illustrated by analysis of the primary curricular documents from the last 30 years. We have chosen the Standard of Secondary Education (MŠMT, 1995) and the Framework education program for secondary education (MŠMT, 2007) for our analysis. The documents were analysed as a whole, i.e. the goals of science education were identified not only in the specific goals of the disciplines or in the characteristics of the education area of the scientific disciplines, but also in the introductory general parts of the curricula.
We used the Atlas.ti software as a coding system; this allowed for synoptic highlighting of parts of extensive text documents related to science education and for categorizing the data. The categories were deductively derived (Mayring, 2000) from the definition of scientific literacy according to the study „Literacy in education" with a slight change in the fourth category where we have included a new subcategory *health and healthy lifestyle*. The reliability of the data was ensured via double independent coding of the documents and via a consultation with a creator of both curricula who helped with interpretation of unclear parts. The results of the analysis of these curricular documents are shown in Graph 1.



Graph 1: Frequency of categories in the Educational Standards and Framework educational program for secondary education

This graph shows that the FEP significantly reduced the category of acquisition and use of terms, compared to the Educational Standards, corresponding to the demand for reduction of the subject matter scope of scientific disciplines. What's less positive is the finding that there was a significant reduction of acquisition and use of scientific methods and techniques in the FEP. On the other hand, acquisition and use of the principles of evaluation of scientific knowledge has more space in the FEP, and the scope of acquisition and use of the interaction methods of scientific knowledge is quite extensive (and almost identical) in both documents. Therefore, we cannot claim that FEP unequivocally pushed the teaching of science subject in the required direction, and this is also the opinion of the analysis of the Department of Education which summarizes basic flaws of FEPs and the necessary changes.

A revision of the FEP system is due shortly. Its goals are:

Goal 1: To make the curricular document system more transparent for schools and public and to conceptually unify all FEPs so they would form self-contained, internally logical system of demands on education from pre-school to secondary.

Goal 2: To make creating SEP easier for schools via formulation of clear goals and expected outputs and via the offer of model school educational programs that would be available to them.

Goal 3: To remove the curriculum overload, to make the individual curricular documents more transparent, to have only demands necessary for education in the FEP, and to work the key competencies directly into the educational disciplines.

Goal 4: To focus the general education curriculum on what‘s important in the 21st century: practical applicability of knowledge and skills in further study and life, distinguishing core subject matter and expanding subject matter, meaningful integration of education content into wholes and into the following evaluation system.

4. Conclusion

An extensive search of approaches to science education in the last 30 years on both national and international levels and analysis of the goals of science education showed that the Czech Republic respects most of the trends from abroad that appear in teaching and that the curriculum revision shifted science education in desirable direction, at least when considering the intended curriculum. The current setting of the curriculum allows to develop all interconnected dimensions of scientific literacy. These dimensions correspond to the analysed literature on current delineating of science literacy, as well as with the general goals of education, given by the current strategic documents, both national and international.

This publication was supported by the the University Research Centers Program of Charles University, No. UNCE/HUM/024.

References

European Commission. High Level Group on Science Education, European Commission. Science, Economy, & Society. (2007). *Science education now: A renewed pedagogy for the future of Europe* (Vol. 22845). Office for Official Publications of the European Communities.

Held, D. (1991). Democracy and Globalization. *Alternatives: Global, local, Political*, 16 (2), 201-208.

Krammer, S. M. (2017). Science, technology, and innovation for economic competiveness: The role of specialization in less-developed countries. *Technological Forecasting & Social Change,*123, 95-107.

Maršák, J. & Janoušková, S. (2006). Trendy v přírodovědném vzdělávání. *Metodický portál RVP,* http://clanky.rvp.cz/clanek/c/Z/1055/trendy-v-prirodovednem-vzdelavani.html/

Mayring, P. (2000). *Qualitative Content Analysis.* Dostupné z: http://www.qualitative-research.net/index.php/fqs/article/view/1089

MŠMT (1995). *Věstník Ministerstva školství, mládeže a tělovýchovy České republiky*, ročník LI, sešit 9, Standard základního vzdělávání. Praha: MŠMT, ČR.

MŠMT (2001). *Národní program rozvoje vzdělávání v ČR*. Praha: Tauris.

MŠMT (2007). *Rámcový vzdělávací program pro základní vzdělávání*. Praha: MŠMT, ČR.

Osborne, J., & Dillon, J. (2008). *Science education in Europe: Critical reflections* (Vol. 13). London: The Nuffield Foundation.

Osborne, J. & Wittrock, M. (1983). Learning Science: A generative process. *Science Education*, 77, 393–406.

Torres, C.A. (2002). Globalization, Education and Citizenship: Solidarity versus Markets? *American Educational Research Journal,* 39 (2), 363 – 378.

ÚIV (2002). *Výsledky českých žáků v mezinárodních výzkumech 1995-2000*. Praha: ÚIV. ISBN 80-211-0415-5.