



## MODERN NATURAL SCIENCE EDUCATION DEVELOPMENT TENDENCIES IN LITHUANIA AND LATVIA

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### Abstract

*In this article we analysed some tendencies of modern natural science education development in Lithuania and Latvia. This is a comparative research. The authors state, that in the past fifteen years, the Baltic States, including Latvia and Lithuania, experienced considerable changes in the educational system. Natural science education development has also experienced essential reforms. Also we indicate some differences among Lithuanian and Latvian pupils.*

**Key words:** *natural science education, general school, alternation of education.*

### Introduction.

In recent years natural science development issues become more and more topical. Globalisation, technological progress, and the world's polarisation alter the mission of development in principal. Knowledge based society raises completely new requirements for education. In this context, a person's knowledge of natural science becomes particularly significant for the person's adequate understanding of the world (the natural science conception of the world). It is evident that natural science education is first acquired at a secondary school. Hence, teaching / learning natural science subjects at school is first of all aimed to form this education. Incorrect, erroneous natural science development can cause undesirable consequences in the society. One of such problems is natural science literacy of society members. According to A.Töldsepp (2003) the main objective of science education is to prepare young people for a full and satisfying life in the world of the 21<sup>st</sup> century. In our opinion, principal changes take place in the presence of two significant points, which can be defined by the following statements:

- The world of nature is integral; therefore, when teaching pupils, one cannot limit oneself by teaching solely separate subjects of natural sciences. It is necessary to look for things in common, otherwise, to integrate natural sciences (content, process, and activities).
- Natural science development is particularly closely related to pupils' practical investigative activities, deeper cognisance of natural phenomena and regularities. Besides, practical application of the acquired natural science knowledge and abilities is very important (learning and the joy of discovery are integral phenomena of the development process).

In the past fifteen years, the Baltic States, including Latvia and Lithuania, experienced considerable changes in the educational system. Natural science development has also experienced essential reforms. Natural science subjects of 7<sup>th</sup> – 9<sup>th</sup> grades of a basic school in principal remained as separate subjects. In lower grades and in a primary school natural science subjects are quite significantly integrated. For example, in Lithuania the subject nature study is integrated into social development component, but natural science development component is given less than 50%. Natural science course in the Latvian primary school is much less integrated into social development subjects.

Latvian secondary school (10<sup>th</sup>–12<sup>th</sup> grades) changed over to development according to corresponding programs, in which natural science subjects like biology, chemistry, and physics, became compulsory. In the beginning of the 90-ies, in Latvia these were only optional subjects. Already since 2000, profile teaching has been introduced in Lithuania. The pupils of

the profile of exact and natural sciences have better conditions for learning natural science subjects. The pupils of the profile of humanities have a possibility to choose the integrated course of natural science subjects. However, bearing in mind that much less numbers of pupils choose the profile of exact and natural sciences than the profile of humanities, the natural science literacy of the latter significantly suffers (Lamanauskas, 2003a). As stated in the General Curriculum Framework for Lithuania's General Education Schools, the key objective of modern natural science development is *all persons' natural science literacy* (Lietuvos bendrojo lavinimo mokyklos ..., 2002). Natural science literacy is determined by numerous various factors, all of which cannot be fully revealed in this article. However, it is worth mentioning that in addition to internal factors, natural science literacy is also influenced by external factors. The society's opinion about natural sciences is a particularly important factor. For example, the results of the research carried out in Latvia demonstrate that only 15% of pupils' parents in Latvia think that their children should be learning mathematics and natural sciences. Similarly, the same number of parents states that they found physics, chemistry, and biology outside subjects at the secondary school (Гедровицс, 1999). Such attitude directly influences children's attitude and opinions too. By the way, it is established (Gedrovics, 2005), that about 51,5% of Latvian 15 y.o. students think that [natural] science and technology are the cause of the environmental problems. Unfortunately, this kind of thinking makes the society to have a negative attitude towards natural science in general.

Thus, does such approach, which was formed in Lithuania and Latvia after the 1990-ies, determine the effectiveness of natural science development? Does this influence the balanced development of Latvia and Lithuania, as small European states, in the whole context of the European Union? The answers to these and other questions require comprehensive, long-term and systematic both theoretical and empirical surveys in the sphere of natural science development problems.

### Methods and Sample

In 2003 – 2004, complex Upper and Lower Secondary School pupils' surveys (14-18 years) were carried out in Lithuania and Latvia. The sample of Lithuanian pupils consisted of 1930 respondents, and the sample of Latvian, 900. The method of research was a questionnaire in writing (nominal and ordinal scales were applied). The respondents have answered the following questions: How do you evaluate natural science education acquired at the basic school? What is your favourite subject of natural sciences? What is your field of future studies after the secondary school? What is your activity in nature? What are the most negative points of learning natural sciences, etc..

The statistical bundle of the SPSS programmes has been applied to analyze research data. To determine the differences between features under analysis the Fisher's multifunctional criterion  $\phi$  have been used. The statistical importance of answers depending on a class in which the respondent studies, and sex was defined by t-criterion ( $\alpha = 0,95$ ).

### Data analysis and Results

In spite of the fact that pupils can choose a learning program (Latvia) or a learning profile (Lithuania), current social-economical situation not always allows the pupils to choose the desired learning trend. Biology (Lithuania) and geography (Latvia) are most favourite subjects both for junior and senior pupils. However, the evaluation quite significantly differs depending on the respondents' gender. For example, biology is the most favourite subject for 35,6% girls of the basic school and 43,1% girls of the secondary school (Lithuania). Meanwhile, the boys of the Lithuanian basic school prioritize geography (37,5%), and senior pupils, physics (35,1%). In Latvia the situation is a little different. Both boys' and girls' favourite subject, irrespective of which grade they are learning in, is geography (44,9 of girls and 48,5 % of boys in 8<sup>th</sup> -9<sup>th</sup> grades; 36,0 of girls and 43,9% of boys in senior grades). All respondents' least favourite subject is chemistry.

The most significant criterion is the respondents' self-assessment (with respect to the knowledge of natural science). 27,5% of Lithuanian pupils of 8<sup>th</sup> –9<sup>th</sup> grades and 24,8% of Latvian pupils of the same grades evaluate their knowledge as good. In senior classes 41,6 of Lithuanian and 56,9% of Latvian respondents assessed the knowledge of natural science as good. Correspondingly 10,9% (Lithuania) and 6,7% (Latvia) of respondents evaluated the knowledge as unsatisfactory.

The respondents have interesting intentions regarding the future studies.

Table 1.

#### Students' future plans concerning the studies at the university level (%)

Area of University studies	Lithuania		Latvia	
	8–9 grades	10–12 grades	8–9 grades	10–12 grades
Social sciences	17.6	22.3	5.1	17.6
Technology	8.0	18.2	9.2	15.3
Humanities	12.1	10.0	7.9	7.8
Natural sciences	7.9	5.8	6.5	10.6
Arts	0.5	–	–	–
Undecided	52.4	43.4	49.3	47.3
Are not going to study further	1.5	0.3	1.0	1.4
No answer	–	–	13.5	–

This table quite evidently demonstrates how the respondents are distributed according to their future intentions. The fact that a considerable part of respondents have not made a decision is a matter of concern. Those who have made a decision prioritise social sciences and the humanities as well as technological sciences. Around 6% of Lithuanian and 11% Latvian respondents plan to choose natural sciences.

An interesting indicator and a partly hypothetical situation is the answer to the question whether one would choose the profession of the teacher of natural sciences if there were no other choice alternative. The received results demonstrated that about 40-42% of Lithuanian and 52-56% of Latvian respondents in such situation would choose the profession the teacher of geography. The least number of respondents would choose the profession of the teacher of chemistry.

Answers of pupils demonstrate that natural sciences is not so attractive sphere. What to do, what steps to undertake to raise them, youth, interest to natural sciences? Respondents have offered some ways (methods) of increasing pupils' interest to natural sciences (see table 2).

Table 2.

#### The methods to be used to increase the youth interest in natural sciences (natural history) /%/

Method	Lithuanian pupils	Latvian pupils	$\phi_1-\phi_2$	Fisher's criterion $\phi$	
				$\phi_{\text{empir.}}$	$p$
To extend the network of natural history and technological centres for pupils	14.3	10.8	0.106	1.64	=0.05
The media should be more involved into solving science problems	8.7	13.9	0.165	2.55	0.004
To coordinate the content of teaching of natural sciences and other subjects	23.2	16.6	0.166	2.57	0.004

To encourage general projects that involve schoolchildren and students	30.5	28.6	0.041	0.63	>0.05
To devote more attention to nature study in primary school (forms)	17.8	21.8	0.101	1.56	>0.05
Other offers	5.5	8.2	0.108	1.67	=0.047

Latvian pupils give the priority to press (media), and Lithuanian pupils do to the integrated contents of natural sciences and other subjects of teaching. Both Lithuanian and Latvian pupils consider joint research project of pupils and students as the basic method to increase their interest in natural sciences (Lamanauskas, Gedrovics, Raipulis, 2004).

The newest surveys in Latvia, (Bartuseviča, 2004), demonstrate that the pupils of 8<sup>th</sup> – 9<sup>th</sup> grades show considerable interest in chemistry, but such interest very quickly decreases. Among essential points why interest in chemistry (as well as in physics) decreases are complicated chemical and mathematical formulas, insufficient relation with life realities, in most cases the absence of any experiments and tests, many abstractions, etc. Teaching biology and geography also contains a considerable number of shortcomings; these include a lot of theory, too many home works, weak relation to everyday life and its realities, etc..

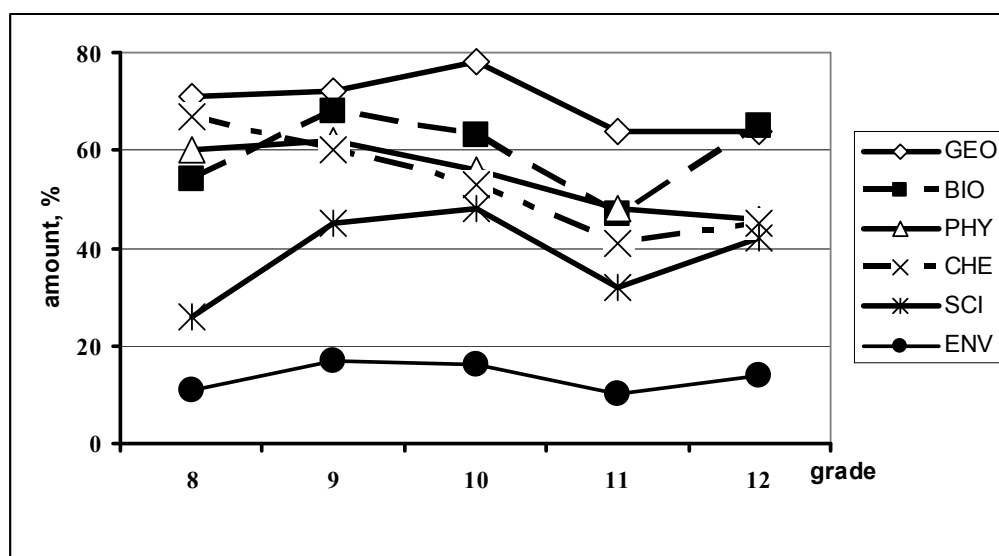


Figure 1. Obligatory school subjects as viewed by students

In a context of our research it is important to know as varies opinions of respondents concerning obligation of studying of natural science subjects. In Latvia these subjects to treat as selective. In research the condition is accepted, that these subjects are obligatory for choosing. Opinions of respondents depending on a class<sup>1</sup> and a sex are investigated. In a context of democratization of a society the concept "is obligatory" can present archaic. But in the program of education (teaching) the list of subjects is planned in advance. For comparison have been chosen not only natural science subjects (see Figure 1: SCI - science, ENV – environment<sup>2</sup>, GEO – geography, PHY – physics, CHE – chemistry, BIO – biology) but also

<sup>1</sup> More may was carrying out longitudinal researches when in current of some years the same respondents were exposed to research, however by virtue of some the reasons, including, financial and demographic, it was not represented possible.

the Latvian language (LAT), the mathematics (MAT), English language (ENG). English language, the mathematics, the Latvian language is considered as obligatory subjects in upper secondary school (88-95% of respondents). Classical natural science subjects are distributed so: biology (47-65%), chemistry (41-67%) and physics (48-62%). On the basis of obligation value of these subjects decreases up to 11 classes. Only pupils of 12<sup>th</sup> classes recognize value of these subjects. As the obligatory subject considers biology 47% eleventh-formers and 65% twelfth-formers (the difference is statistically significant on t-criterion,  $p = 0,000$ ;  $\alpha = 0,95$ ). Value of a subject of physics increases for 5 percent in 12<sup>th</sup> class and value of a subject of chemistry increases for 4 percent in 12<sup>th</sup> class (such difference statistically is not significant).

It is necessary to note that is not established any bright statistically significant distinctions about obligation of natural science subjects between all respondents of Latvia from 8-th up to 12-th classes. At comparison of answers of respondents of 8-th and 12-th class statistically significant distinctions it is observed only on evaluation chemistry ( $p = 0,000$ ;  $\alpha = 0,95$ ) and biology ( $p = 0,044$ ;  $\alpha = 0,95$ ). At comparison of answers of respondents of 10-th and 12-th class statistically significant distinctions it is observed only estimating geography ( $p = 0,001$ ;  $\alpha = 0,95$ ).

Only 10-17 percent of respondents estimated a hypothetical subject "Environment" as obligatory. Also it is established, that opinions on natural science subjects do not vary for certain time. It is found out (Gedrovics, Jeronen & Kuusela, 2005), that from 1998 till 2004 the quantity of respondents which are considered with studying natural science subjects obligatory in upper secondary school decreases. So thinks pupils of 9-th and 11-th classes. Statistically significant distinctions are fixed only in chemistry ( $p = 0,006$ ;  $\alpha = 0,95$ ) and biology ( $p = 0,037$ ;  $\alpha = 0,95$ ) among pupils of 9-th class and in geography ( $p = 0,008$ ;  $\alpha = 0,95$ ) among pupils of 11-th class.

### Conclusions and Implications

In our opinion, low interest in natural sciences is caused not only by the shortcomings, mentioned by the pupils. Together with altering development paradigms, the whole panorama and the structure of education are altering. The positivism of natural sciences of the 20<sup>th</sup> century considerably damaged to the society's way of thinking (man is the ruler of Nature). The striving to humanise society prioritised the subjects of the humanities and social sciences. This wave undulated not only through schools. It also affected the labour market, making management, law, administration, economics, political science, etc. the most appreciated professions. In general, the researches carried out in Lithuania demonstrate that after the graduation from school only around 5-6% of school-leavers take school-leavers' examination in natural science subjects (biology, physics and chemistry).

On the other hand, training and qualification of teachers of natural sciences remains a problematic domain. Besides, in our opinion, teaching natural sciences in a primary school is of particularly low quality and ineffective. Children, aged 7-12 years, are ontogenetically very receptive to the development of the positive interaction with nature. The researches demonstrate that primary class teachers lack natural science competence (Lamanauskas, 2003b). This is one of the most topical educational problems both in Lithuania and in Latvia. The learning society and the lifetime learning paradigm require a new quality attitude not only towards the content of teaching natural subjects, but also towards the whole learning process in general.

Natural science education is an integral phenomenon that requires a systemic approach and assessment. Therefore, most of the issues should be discussed in a broad context of general natural science education. However, two inconsistent moments can be mentioned:

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<sup>2</sup> The hypothetical subject which is really not existing, but offered to respondents.

- the correlation between research and practice is weak. First, teachers' competence level in the field of educational research is rather low; second, partnership with the researchers' community remains unexpanded; the teacher is, first of all, a subject of pupils' training for life and their integration into society (socialization) who is responsible for high quality education and better results. Therefore, there are a few bitter reproaches about problematic research of educological natural science education that might be irrelevant in terms of teachers' work experience;
- the correlation between a higher school lecturer and comprehensive school and educational practice in general, is very weak in most of the cases; a mission of the scientist is knowledge about scientific educational reality. From this point of view, teaching natural sciences at higher school seems to be rather complicated when educating the teachers of this profile. Often teaching science subjects at higher school is limited by "dry" academicism, a didactic cover is thin. The "real" naturalists hypothetically renounce the educologists working in the field of natural science education. The latter frequently feel being misunderstood by the "real" pedagogues – didacticists.

Therefore, natural science education is not the only subject of discussions today. It is more frequently examined in a very broad context which is *natural science – technological – noospheric* education. The professionals of natural science education accept personal responsibility for the creation and extension of natural science education which is supposed to be a primary duty and obligation. Consequently, training of the comprehensive school teachers of natural sciences and the permanent development of natural science competence are very important features from this point of view. School cannot effectively work without the teachers and education managers of suitable qualification.

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**Santrauka**  
**ŠIUOLAIKINIO GAMTAMOKSLINIO UGDYMO LIETUVOJE IR LATVIJOJE**  
**RAIDOS TENDENCIJOS**

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Straipsnyje glaudstai apžvelgiami naujausi tyrimai, atlikti Lietuvoje ir Latvijoje. Pagrindinė idėja – gamtamokslinis ugdymas integralus reiškiny, kurio analizė reikalauja sisteminės prieigos ir kompleksinio vertinimo.

Pastaraisiais metais vis aktualesni tampa gamtamokslinio ugdymo klausimai. Globalizacija, technizacija, pasaulio poliarizacija iš esmės keičia ugdymo misiją. Žinių visuomenė kelia visiškai naujus reikalavimus išsilavinimui. Šiame kontekste gamtamokslinis asmens išsilavinimas tampa itin reikšmingas, siekiant, kad žmogus adekvačiai suvoktų pasaulį (gamtamokslinė pasaulio samprata). Akivaizdu, jog gamtamokslinis išsilavinimas įgyjamas visų pirma bendrojo lavinimo mokykloje. Vadinasi, jog gamtos dalykų mokymas (-sis) mokykloje visų pirma skirtas šiam išsilavinimui formuoti. Neteisingas, klaidingas gamtamokslinis ugdymas gali sukelti nepageidaujamas padarinius visuomenėje. Viena iš tokių problemų – gamtamokslinis visuomenės narių raštingumas.

Mūsų nuomone, esminius pakitimus suponuoja du reikšmingi momentai, kuriuos galima nusakyti tokiais teiginiais:

- Gamtos pasaulis yra vientisas, todėl, ugdant moksleivius, negalima apsiriboti vien atskirų gamtos mokslų dalykų dėstymu. Reikia ieškoti bendrų sąlyčio taškų, kitaip tariant, integruoti gamtos mokslus (turinį, procesą, veiklą).
- Gamtamokslinis ugdymas ypač glaudžiai siejasi su moksleivių praktine tiriamąja veikla, gilesniu gamtos reiškinų ir dėsningumų pažinimu. Be to, gamtos moksluose labai svarbu praktiškai taikyti įgytas žinias ir gebėjimus (mokymasis ir atradimo džiaugsmas yra neatsiejami ugdymo proceso reiškiniai).

Mūsų nuomone, menką domėjimąsi gamtos mokslais sąlygoja ne vien tik moksleivių paminėti trūkumai. Kintant ugdymo paradigmoms, kinta visa švietimo panorama ir sankloda. XX amžiaus gamtamokslinis pozityvizmas padarė nemažai žalos visuomenės mąstysenai (žmogus Gamtos valdovas). Siekis humanizuoti visuomenę į pirmąją vietą iškėlė humanitarines bei socialinių mokslų disciplinas. Ši banga nusirito ne tik per mokyklą. Ji paveikė ir darbo rinką, kai labiausiai vertinamomis profesijomis tapo vadyba, teisė, administravimas, ekonomika, politologija ir t. t. Apskritai Lietuvoje atlikti tyrimai rodo, kad maždaug tik 5–6% abiturientų po vidurinės mokyklos baigimo laiko gamtos disciplinų (biologijos, fizikos ar chemijos) abiturientų egzaminus.

Kita vertus, problemiška sritimi išlieka ir gamtos dalykų mokytojų rengimas, jų kvalifikacija. Be to, mūsų nuomone, itin nekokybiškas ir neefektyvus gamtamokslinis ugdymas pradinėje mokykloje. 7–12 metų vaikai ontogenetiškai labai imlūs teigiamai sąveikai su gamta ugdyti. Tyrimai rodo, kad pradinį klasių mokytojai stokoja gamtamokslinės kompetencijos (Lamanauskas, 2003b). Tai viena iš aktualiausių tiek Lietuvos, tiek Latvijos edukacinių problemų. Besimokanti visuomenė bei mokymosi visą gyvenimą paradigma reikalauja kokybiškai naujo požiūrio ne tik į patį gamtos dalykų mokymo turinį, bet ir į mokymo procesą apskritai.

**Raktiniai žodžiai:** gamtamokslinis ugdymas, bendrojo lavinimo mokykla, švietimo kaita.



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