

NATURAL SCIENCE EDUCATION AT BASIC SCHOOL: SOME DIDACTIC ASPECTS

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Abstract. *Some aspects of Natural Science Education at Lithuania's Basic School are being researched in the article. It is being introduced a part of the survey "Situation and peculiarities of Natural Science Education at Basic School", that took place in 2000/01 and was addressed to the essential didactic features. Particular attention is being paid to the analysis of the views and opinions of the teachers of Natural Science Education. Also, the view of teachers to the structure of Natural Science subjects, teaching methods, standardization and other questions, connected with Basic School, is being analyzed in the article.*

Key words: *Natural Science Education, Basic School, Teaching Process.*

Urgency

The problems of Natural Science Education were exceptionally pressing and actively examined in the last decade of the 20th century (Bunderson D., 1996; Anderson T., 1996; Gedrovics J., 2001). Regular researches on this subject are held by The International Association for the Evaluation of Educational Achievement. 44 countries took part in the TIMSS workshop in 1996. Preliminary jobs have started on a broader scale of the research in the PISA (*Program for International Student Assessment*). It will be carried out by OECD. Unusually a great deal of attention is being paid to Natural Science Education in the countries of the North. In autumn 1997, a conference of Council of Ministers of countries of the North was held in Bergen (Norway). It looked into the questions of Natural Science Education in this region. Scientific conferences of countries of the North named "*Natural Sciences at school*" take place every three years. For example, in June, 1999, the 6th symposium of countries of the North, discussing questions of Natural Science Education was organized in Finland (the 7th is supposed to happen in Norway, in 2002). In September 7-14, a convention of higher schools lecturers of countries of the North took place in Greenland, where much attention was also paid to Natural Science Education. In October 3-6, 2000, an international symposium was arranged in Minsk, the capital of Belarus, where tendencies of Natural Science Education were also actively analyzed (*Science and Education on the Threshold of the 3rd Millennium*). The latter workshop paid great attention to the problems of education scope of the so called "East". By the way, the same year the second international scientific conference "*Science and Teacher Training*" took place in Daugpilis (Latvia). In March 21- 23, 2001 the third international scientific conference "*Science and Teacher Training*" took place in Riga. In March 15-18, 2001 the 29th congress of NERA (*Nordic Educational Research Association*) of countries of the North took place in Sweden. Not a much attention has been paid to teaching Natural Sciences at school.

Of late years concern over falling education in the sphere of Natural Science Education is being expressed in Lithuania as well as in foreign countries. Different surveys (5, 7, 8, 10) show, that pupils poorly know animate and inanimate nature after graduating secondary school. Also, their modern, true world's image of natural science is not formed. Holistic understanding of natural

phenomena is insufficient. Systematic point of view is missed when analyzing natural phenomena. The bases of systematic thinking are weak. It is obvious even in the U.S., that there is a big part of the environment that is completely lost becoming acquainted with science, mathematics or technical matters next to the one of progress of science and perfect representatives of it (Goodstein, D., 2001). A rhetorical question is formulated by D. Goodstein: *how can the same system produce scientific elites and illiterates?* Not without reason the prestigious U.S. organization AAAS (*American Association for the Advancement of Science*) made ready a project, that is called the Project 2061. The aim of this project is literacy of Natural Science for all Americans' / (AAAS, 1989).

Problems of Natural Science Education in Lithuania in 1990-2000 have been researched and analyzed not actively enough. The lack of methodological substantiation, search of new conceptions and theories is being evidently felt.

The goal of the article is analysis of some didactic aspects of Natural Science Education at Basic School presenting results of the research.

Tasks of the research:

1. Giving proof of Natural Science Education problems in the new century.
2. Analysis of views, regulations and estimation of natural science teachers discussing the questions of natural science education at Basic School.
3. Carrying out analysis of monographic opinions of natural subjects' teachers with respect to developing programs, student books and workbooks.
4. Making conclusions and statistic analysis of the research data.

The method of the research and a characteristic of the respondents

The research is carried out using a special questionnaire. The nominal and ranking scales are being used in the questionnaire. It covered the following main spheres:

1. Professional competence of natural subjects' teachers.
2. Didactic aspects of Natural Science Education at Basic School.
3. Resources of Natural Science Education (visual, technical and other teaching material and literature, etc.) at Basic School.
4. Demographic indexes.

Peculiarities of Natural Science Education were analyzed after estimating the sample of **362** Lithuanian teachers. The research "*The state and peculiarities of Natural Science Education at Basic School*" took place in 2000/2001. Results of the research, connected with didactic aspects of Natural Science Education at Basic School are presented in the article (sphere 2). The sample was made using a seriated (bunch) principle. The teachers working at schools of different regions in Lithuania (districts) got into the researching sample. The following numbers of participants of the research can be provided: 18,5% of respondents represented schools situated on the countryside, 23% of those were teachers from district centers and 57,7% - from the biggest Lithuanian towns (Vilnius, Kaunas, Klaipėda, Šiauliai and Panevėžys). Distribution of respondents according to the previous experience of teaching and the rank of qualification is presented in the tables 1 and 2.

Table 1

Distribution of respondents according to the previous experience of teaching

| Previous experience | Absolute frequency N | Relative frequency % |
|---------------------|----------------------|----------------------|
| 0 – 5 years | 37 | 10,2 |
| 6 – 10 years | 75 | 20,7 |
| 11 – 15 years | 62 | 17,1 |
| 16 – 20 years | 45 | 12,4 |
| 21 – 25 years | 42 | 11,6 |

| | | |
|-------------------|-----|-------|
| 25 years and more | 101 | 27,9 |
| Total | 362 | 100,0 |

Table 2

Distribution of respondents according to the rank of qualification

| Rank | Absolute frequency N | Relative frequency % |
|-------------------------|----------------------|----------------------|
| Teachers | 52 | 14,4 |
| Senior teachers | 196 | 54,1 |
| Teachers methodologists | 76 | 21,0 |
| Teachers experts | 38 | 10,5 |
| Total | 362 | 100,0 |

Following the appraisals of the presented results in the above tables, the preliminary conclusion, that the least of the young teachers having a period of the previous experience less than 5 years are working at school, can be done. The most predominating rank of qualification is that of a senior teacher.

Although the profession of a natural science teacher, to our mind, is “sufficiently fits for men”, 92,3% of the women teachers and only 7,7% of those of the men participated in the research. That shows us being Lithuanian school a “womanlike” one once again. We think that the latter fact influences on natural pupils’ motivation and personal interest in relating their future with natural science subjects a great deal.

The most part of the respondents (62,4%) have graduated the Pedagogical University of Vilnius (earlier the Pedagogical Institute of Vilnius), 24,6% - Vilnius University, 9,7% - the University of Šiauliai (earlier the Pedagogical Institute of Šiauliai) and 3,3% - different educational institutions having non- pedagogical type.

To edit the results the SPSS statistic package has been used. The criterion of χ^2 has been put into practice for examination of hypotheses and Spearman’s coefficient of correlation has been used to point out connections existing among indications.

Results of the research

There is little publications in the literature of Lithuanian education where Natural Science Education research should be presented. As a matter of fact, there are no exhaustive and representable research to be done during the period of 1999-2000. In the literature of foreign countries there are not a few publications analyzing different pedagogic, didactic, methodic, etc. aspects of Natural Science Education at general school. Notably much attention is being granted to the problems of integrated Natural Science Education (Pigdon K., 1993; Woolley M., 1993; Eric V. Tsang, 1997; Gedrovics J. & Wareborn, 1999 and others). Our research, carried out in 1997, lets us affirm that questions connected with Natural Science Education in Lithuania are very urgent (Lamanauskas V., 2000). The task of modern pedagogy in Lithuania is to analyze purposes, tasks and content of Natural Science Education and to examine peculiarities of methods and teaching technologies involving other questions as well. On the basis of research the process of Natural Science Education can be improved successfully and effectively enough in all stages of Lithuanian general school including primary, basic and secondary schools.

Very often the teachers of natural subjects at basic school emphasize lack of knowledge of natural science education at primary school. It is clear enough, that primary school plays a very important role in the whole system of general education and here obtained *propedeutic* natural

science education is very important. Basically, natural science preparation at primary school is being realized as a course of “*World’s Cognition*”, that consists of two conditionally marked parts:

1. A child and nature.
2. A child and the social environment.

The component of social raising predominates in this course. Cognition of nature takes less than 50%. Extra activities based on cognition of nature slightly influence pupils’ education of natural science at primary school. Estimation results of natural subjects’ teachers certifying pupils’ natural science education at primary school are being presented in the table 3.

Table 3

Estimation of pupils’ natural science education obtained at primary school (N%)

| Estimation level | N | % |
|-------------------|-----|-------|
| Sufficient | 144 | 39,8 |
| Partly sufficient | 172 | 47,5 |
| Insufficient | 46 | 12,7 |
| Total | 362 | 100,0 |

As we can see from the above table, only 39,8% of natural subjects' teachers think that sufficient natural science education is being certified at primary school. 12,7% of them find it being insufficient. Such estimation depends on the teachers’ previous experience of teaching ($\chi^2=57,20$ df=6, p<0,05). Natural science education at primary school is estimated the most insufficiently by the teachers having the lowest rank of qualification. The teachers methodologists and experts estimate natural science education at primary school the most sufficiently. The estimation also depends on the teachers’ previous experience of teaching ($\chi^2=120,30$, df=10, p<0,05). The most critical (natural science education at primary school is estimated as insufficient one) are the teachers whose previous experience of teaching at school is less than 5 years. As a rule, these teachers have also the lowest rank of qualification.

A very important didactic component of teaching process is the structure of natural science subjects at school. At the moment, in Lithuania classes from 1 to 10 can be referred as Basic school. In the 5th and 6th year of teaching the integrated (inseparable different spheres of natural science) natural science course “Nature and the Human” is being taught. Physics as an independent course is being started to teach in the seventh form, chemistry – in the eight form and geography – in the sixth one. The course of biology in the seventh and eighth forms is partly integrated. But in the ninth form the most part of attention is being paid to the Human’s biology, in the tenth form – to ecology. As a matter of fact, the courses of biology (including the Human’s biology), chemistry and physics taught in the ninth and tenth forms can be described as generalizing ones. These two forms is a starting level of educational profiling (Lietuvos bendrojo lavinimo mokyklos Bendrosios programos, 1997). Such structure has formed since 1995 – 96. Results about teachers’ estimation of the latter are being presented in the table 4.

Table 4

The structure of natural subjects at basic school according to the teachers’ point of view (N%)

| Level of estimation | N | % |
|---------------------------|-----|-------|
| Suitable structure | 75 | 20,7 |
| Partly suitable structure | 278 | 76,8 |
| Unsuitable structure | 9 | 2,5 |
| Total | 362 | 100,0 |

Only 20,7% of the teachers think that such structure is suitable and have no reproofs. 76,8% of the respondents think that this kind of arrangement is a partly suitable one and possible to be improved.

An urgent didactic task is standardization of natural science education. The projects of standards of natural science education for the basic school were arranged in Lithuania in 1997 (Bendrojo išsilavinimo standartai..., 1997). They define knowledge, abilities and regulations of value that should have pupils after basic school graduation. The standards are being presented using three levels: a minimal one, describing pupils' achievements necessary for favorable response, the main one, establishing basic literacy of natural science, and the higher level that points out outstandingly good accomplishments. Different opinions exist when being discussed the projects of standards. The teachers of natural science at basic school estimate them as follows (table 5).

Table 5

The standards of natural science education at basic school according to the teachers' point of view (N%)

| Level of estimation | N | % |
|------------------------------|-----|------|
| Properly prepared | 57 | 15,7 |
| Preparation is partly proper | 278 | 76,8 |
| Improperly prepared | 14 | 3,9 |
| Having no acquaintance | 13 | 3,6 |

76,8% of the teachers think that the standards of education were prepared in inappropriate way and almost 4% of the respondents are completely unfamiliar with those. The standards vary when being estimated by the teachers of different subjects. Statistically important variations among different subjects teachers' estimation are established. The most benevolently (properly prepared) the standards are being estimated by the teachers of physics and biology, the most unfavorably – by those of chemistry ($\chi^2=70,72$ df=12, $p<0,05$). The standards as properly prepared were estimated by 37,5% of physicists, 16,4% of biologists and 9,5% of chemists.

Teaching subjects of natural sciences is specific. Original teaching methods and forms are being put into practice in the process of Natural Science Education. We tried to disclose what method of teaching is the most appropriate for the teachers of natural science subjects.

Table 6

The most appropriate method in teaching subjects of natural science (N%)

| The method of teaching | N | % |
|------------------------|-----|-------|
| Sensualistic | 0 | 0,0 |
| Empiric | 14 | 3,9 |
| Rational | 56 | 15,5 |
| Logical – algorithmic | 59 | 16,3 |
| Problematic | 228 | 63,0 |
| Euristic | 5 | 1,4 |
| Total | 362 | 100,0 |

As you can see from the above table, the most appropriate way of teaching is a problematic one. Even 63,0% of the teachers think it seems to be the best.

The content of Natural Science Education reflects on the student books and the workbooks. The main principles, rules, etc. of content of Natural Science Education are being conveyed in the programs and the teacher books. It is important that the student books and the workbooks used at school satisfied the programs of Natural Science Education. The teachers' estimations show that

virtually the student books and the workbooks satisfy the programs of Natural Science Education (table 7).

Table 7

Accordance of content of the student books and the workbooks to the programs of Natural Science Education (N%)

| Estimation object | Estimation level | N | % |
|-------------------|-----------------------|-----|------|
| Student books | <i>Satisfy</i> | 154 | 42,5 |
| | <i>Partly satisfy</i> | 206 | 56,9 |
| | <i>Don't satisfy</i> | 2 | 0,6 |
| Workbooks | <i>Satisfy</i> | 114 | 31,5 |
| | <i>Partly satisfy</i> | 245 | 67,7 |
| | <i>Don't satisfy</i> | 3 | 0,8 |

The tendency, that the workbooks meet the requirements of Natural Science Education programs less benevolently than those of the student books, is very noticeable but virtually these estimations are not interrelated ($\chi^2=407,07$ df=4; $p<0,05$; Spearman's coefficient of correlation is 0,67). It shows the estimations being connected very closely. The teachers, estimating the student books as ones meeting the programs, consider the workbooks similarly as well. But, according to the teachers' point of view, the content of Natural Science Education that is reviewed in the programs, is insufficiently related with reality (table 8).

Table 8

Estimation of connections of content of Natural Science Education with reality that is defined in the programs (N%)

| Estimation level | N | % |
|------------------|-----|------|
| Related | 79 | 21,8 |
| Partly related | 270 | 74,6 |
| Not related | 13 | 3,6 |

Only 21,8% of the teachers see the content of Natural Science Education and reality related considerably.

The 21st century produces new qualified projects of Natural Science Education. One of them is successive and systematic ecologically based education. This area is an integral one, joining into one complex different fields of Natural Science Education. The General Instructions /Programms/ of Lithuania's general school emphasize that these questions should be discussed at basic school sufficiently enough. The strategy and program of acts of ecological education of the environment of the Republic of Lithuania, ratified by the Government of Lithuania in 1998, require to be interested in this sphere more exhaustively (Lietuvos Respublikos visuomenės..., 1998). The task is hardly achieved. According to the teachers' point of view, the discussing sphere is being performed insufficiently at basic school in the present content of Natural Science Education (table 9).

Table 9

Indication of ecological and environmental problems at basic school in the content of Natural Science Education (N%)

| Estimation level | N | % |
|-------------------|-----|------|
| Sufficient | 109 | 30,1 |
| Partly sufficient | 210 | 58,0 |
| Insufficient | 43 | 11,9 |

As we can see from the table 9, only 30,1% of the teachers have favorable responses. They suppose the ecological – environmental questions being performed sufficiently well in the content of educational process.

To accomplish Natural Science Education effectively, new information is exclusively important. The results, pointing out the most frequent sources when searching for the latest information connected with Natural Science Education, put on the table 10.

Table 10

The most frequent sources used searching for the latest information by teachers of natural science

| Information source | % |
|--|------|
| Books | 48,1 |
| Newspapers, magazines, other kinds of press | 27,1 |
| Television | 12,8 |
| Internet | 11,5 |
| Others (courses, colleagues' experience, etc.) | 0,5 |

It is possible to affirm that still the main source of information is books. Television provides not much information. Actually, the commercial TV channels, which are broadcasting their programs in Lithuania, do not pay attention to the now discussing topic. Only 11,5% of natural science teachers obtain the latest information about different aspects of the subject using the Internet. The difference is notably high at schools on the countryside and in the small villages, where, actually, opportunities of using the Internet almost lost.

The most important teachers' ideas about improving Natural Science Education at school are being produced in the table 10.

Table 11

The most important ideas of teachers about improving Natural Science Education

| With respect to the educational programs | With respect to the student books | With respect to the workbooks |
|---|---|--|
| <p>”Much time is required for practice”; ”Clear inter-subjectivistic integration is necessary”; ”The programs of different subjects are poorly interrelated”; ”Contribution of the teachers-practitioner compiling the programs should be more influential”; ”Poor material conditions prevent from fulfilling tasks and aims foreseen in the program”; ”Lack of specific character in the programs.”</p> | <p>“Less theory”; “There is only formal news in the student books for the forms 5 and 6. The absence of material for education about understanding of nature is being felt”; “The units of measurement should be unified in the student books of physics and chemistry”; “The student books vary too often”; “Translated student books are not suitable”; “The latest student books of chemistry are extremely difficult to understand”; “The content of the student books must be integrated”; “Some student books have hygienic inadequacy: they are difficult, format is not suitable, etc.”</p> | <p>“The workbooks are expensive and not all pupils can obtain them”; “The tasks should be arranged according to the seasons of the year”; “The workbook have to satisfy the content of the student book really well”; “The workbooks are often being adapted not paying attention to the standards”; “The tasks have to be differentiated according to the levels and separate courses in the workbooks”; “The workbooks shouldn't be published separately and practice should be presented in the student books.”</p> |

Conclusions

1. The teachers of natural science estimate proposed natural science education at primary school rather critically. The young teachers, whose experience of teaching is less than a period of 5 years, are the most critical.
2. The teachers of physics and biology estimate the standards of Natural Science Education the most benevolently and the teachers of chemistry are the most unfavorable with the present situation.
3. The teachers of natural sciences prefer a problematic way of teaching (63% of respondents).
4. The analysis of teachers' estimations shows that the student books and the workbooks of the latest editions used at basic school virtually satisfy the requirements of Natural Science Education programs.
5. The most important source of the latest information about natural science for the teachers is books. The Internet is still poorly used by the teachers of natural science. Only 11,5% of the teachers the most frequently find the latest information when using the Internet.
6. According to the teachers, ecological and environmental problems at basic school in the content of Natural Science Education revealed insufficiently well.

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Резюме

ЕСТЕСТВЕННОНАУЧНОЕ ОБРАЗОВАНИЕ В ОСНОВНОЙ ШКОЛЕ: НЕКОТОРЫЕ ДИДАКТИЧЕСКИЕ АСПЕКТЫ

Винцентас Ламанаускас

Естественное образование одна из самых важных областей в реформируемой общеобразовательной школе Литвы. Приоритет естественнонаучного образования разумеется сам собой, т. к. эта область включает в себя весь спектр самовыражения учащихся, а также их взаимоотношения с природой. Нельзя утверждать, что в Литве не было теоретического обсуждения проблемы естественнонаучного образования, однако, это не стало ярко выраженной тенденцией. Интегрирование учебного содержания и учебной деятельности в преподавании естественнонаучных предметов на второй ступени общеобразовательной школы – актуальная дидактическая задача. Вопросы интегрированного обучения естественнонаучных дисциплин должны рассматриваться комплексно: система ценностей личности, теоретические знания личности, практические умения личности. В учебных программах должна проявляться не только интеграция содержания, но и интеграция учебного процесса.

Проводя исследование, мы руководствовались двумя предпосылками: 1) исследования содержания развития обобщающего характера и изменений процесса часто не приносят желаемого результата, если не получается оперативная и исчерпывающая возвратная информация; 2) индикаторы мнений (в данном случае учителей) являются очень важными при оценке изменений и процесса содержания развития и предвидения возможности совершенствования. При организации исследования использовалась анкета опросов - мнений и оценок (экспертное исследование). В исследовании приняло участие 362 педагога естественных предметов.

Основные выводы:

1. Учителя естественники приоритет отдает проблемному способу обучения (63%).
2. Основной источник новейшей естественнонаучной информации – книги. Только 11,5% учителей пользуется Интернетом для получения информации.
3. Учителя естественники критически относятся к естественнонаучному образованию в начальной школе. Особенно критически относятся молодые учителя, со стажем работы в школе до 5 лет.
4. Положительно оценивает образовательные стандарты учителя физики и биологии, а учителя химии неблагоприятно к ним.
5. 58,0 % учителей считает, что экологические проблемы отчасти хорошо отражены в содержании естественнонаучного образования основной школы.

Ключевые слова: естественнонаучное образование, основная школа, процесс обучения.

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