

Education of Physics by the Prism of the Secondary School Pupils in the Czech Republic

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Abstract

This abstract shows opinions of representative choice of pupils at secondary lower schools in the Czech Republic on physics education. Investigation was realized in spring 2003 as part of the project "New approaches to the education of physics teachers following the analysis of situation at secondary schools". Nowadays science and technology are searching for its new position in general education.

Introduction

Investigation into pupils' opinions on physics education at secondary lower schools in the Czech Republic was carried out within an extensive project "New approaches to the education of physics teachers on the base of proper analysis of the situation at primary and secondary schools". Nowadays the average age of Czech physics teachers is increasing; qualification is decreasing from original figure close to 100 %. Teachers leave their jobs and find different occupations particularly due to their relatively high competence in information and communication technologies.

Before 1990 good mathematical and polytechnic education was stressed within general education in the Czech Republic. After 1990 the importance of this part of education has been weakened, and humanistic studies have been emphasized. **In this situation, science education is searching for its new position in general education.**

This investigation is being preceded by elaborated analysis of the situation at secondary schools.

1 New approaches to the education of physics teachers

The main question remains: **How to prepare physics teachers for a new generation of pupils?** The authors of this project decided to carry out research using questionnaire survey among physics teachers at primary and secondary schools with the aim to get answers to a set of questions. Schools for the research were chosen using random sampling within the Czech Republic. Questionnaire survey at the chosen schools was realized not only among physics teachers, but also among their pupils and students. Analysis of situation at schools was realized for secondary lower schools (11-15) and

secondary higher schools (15-19). Questionnaire survey was realized by the Czech school supervision. The whole research was planned for the years 2003 – 2005. This conference paper deals only with pupils' opinions at secondary lower schools (11-15).

2 Methods of Analysis of Situation at Secondary Schools

Questionnaire survey was the basis for extensive research focused on physics teachers and their pupils. **Questionnaire for physics teachers** contained 75 items. There were items focused on the age structure, length of school practice, social conditions, methods and forms of teaching, using textbooks, teaching aids, multimedia techniques, etc.

Questionnaire for pupils contained 30 items, and 7 subsidiary items for supervisors submitting questionnaires to pupils in the classroom.

Statistic evaluation of the questionnaire survey is realized in the form of arithmetic mean calculations, using scales and quantifying, using Kolmogorov-Smirnovov test, correlation, etc.

Result analysis of statistic processing is realized on three levels. **The first level** includes basic characteristics of statistical samples and their analysis. **The second level** includes comparison of groups of girls and boys. Within the teachers, groups of men and women teachers, school location, and the age of teachers are compared. **The third level is monitoring of pupils' evolution**, which is incorporated in the questionnaire items, which results we show in the following part. It is probable that the situation in other countries will be similar.

3 Results of investigations of pupils opinions

We give partial results and interpretation of questionnaire survey among pupils at secondary lower schools in the Czech Republic, which was realized in the spring 2003. Only the items concerning the pupils' evolution at the age 11 - 15 were chosen. In the following evaluation of a questionnaire survey you can find the item given in the questionnaire and then the table with average value, and a commentary on the results. Information on the tested set is in Table 1.

Table 1. Tested set

Kind of school	Boys	Girls	Sum
Lower Secondary	1935	1829	3764

There are 51 % of boys and 49 % of girls in the set. In the following evaluation of the questionnaire survey we give wording of questionnaire items, table with recorded values or relative frequency in %, comparison of group of boys and girls, and commentary on the results.

Item 1: In the following table find out the interval, in which your average grade from all subjects during the last classification period can be found and write the number, which is before this interval to your record list

1	1.00	2	1.51	3	2.01	4	2.51	5	3.01 and more
	–		–		–		–		
	1.50		2.00		2.50		3.00		

Classification scale in the Czech Republic contains 5 grades, grade 1 is the best, and grade 5 is the worst.

Table 1.1. Frequency of girls' and boys' average grade in individual intervals

Average grade	Boys in %	Girls in %	Φ
1.00 – 1.50	28.5	43	36
1.51 – 2.00	29	29	29
2.01 – 2.50	26	18	23
2.51 – 3.00	11	6	9
3.01 and more	4.5	4	3

In the subset of girls the most numerous group 43 % has average grade in the interval between 1.00 and 1.50. In the group of boys the numbers in the first three intervals are approximately the same that is between 25 % and 30 %.

Item 2: Write down into the sheet your mark in physics at the last school report.

Table 2. Frequency of marks in physics

Mark	Boys		Girls		Sum	
	Number	%	Number	%	Number	%
1	464	24	500	27	964	26
2	634	33	716	39	1350	36
3	572	29	432	23	1004	27
4	249	13	173	10	422	11
5	10	1	5	1	15	0
Sum	1929		1826		3755	
Average	2.33		2.16		2.25	

The most frequent mark in physics for both boys and girls is mark 2. 24 % of boys and 27 % of girls have the best mark in physics that is 1. This result means that although in the group of the best school average there were 43 % of girls and only 28,5 % of boys, in physics the situation is better for pupils.

Item 3: Write two figures for each subject to the table in your record sheet. Indicate the first figure (a) how you like it, the second (b) how difficult it is for you – according to the scale:

Unpopular			Middle (un) popular			Very popular
0	1	2	3	4	5	6

Very difficult			Quite difficult			Very easy
6	5	4	3	2	1	0

Table 3.1 Frequency of popularity of individual subjects – from 0 points to 6 points (the most favorite)

Order	Subject	Pupils' evaluation
1	Informatics	5.1
2	Physical education	4.9
3	Art education	4.35
4	Practice, technique	4.35
5	Family education	4.30
6	Music education	4.10
7	Civics	4.04
8	Biology	3.91
9	Science	3.9
10	History	3.76
11	Geography	3.76
12	Maths	3.49
13	English language	3.43
14	Chemistry	3.38
15	German language	3.32
16	Physics	3.32
17	Other foreign language	3.27
18	Czech language	2.97

Natural sciences are in the second part of the list of popularity, as expected. It is interesting, that the physics is at the third place from the end. The sequence of scientific subjects and mathematics is: biology, geography, mathematics, chemistry, and physics.

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Table 3.2 Frequency of points of difficulty at individual subjects - from 6 points (the most difficult) to 0 points

Order	Subject	Pupils' evaluation
1	Practice	0.79
2	Family education	0.82
3	Physical education	0.87
4	Informatics	0.88
5	Art education	0.88
6	Music education	0.97
7	Civics	1.15
8	Biology	2.10
9	Geography	2.18
10	Science	2.24
11	History	2.44
12	Other foreign language	2.69
13	German language	2.93
14	Chemistry	2.98
15	English language	3.01
16	Physics	3.01
17	Mathematics	3.04
18	Czech language	3.21

If we compare the two lists, i.e. popularity and the difficulty, we discover, that mathematics is more difficult than physics but in spite of that it is more popular than physics and chemistry.

Item 4: How are you looking forward to a physics lesson? Use corresponding number in your record sheet.

4: I'm definitely looking forward to	3: I'm quite looking forward to	2: I do not know	1: I'm not looking forward to	0: definitely I am not looking forward at
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Table 4. Frequency of "be looking forward to" a physics lesson, 4 points (I am looking forward) to 0 points (I'm not looking forward).

Points	4	3	2	1	0	Φ
Boys	10	35	25	20	10	2.15
Girls	6	25	27	29	13	1.83
Sum	8	30	26	25	11	1.99

45 % of boys and only 31 % of girls look forward to physics lesson.

Item 5: Write number 1-6 a) popularity, b) frequency of different tasks carried out in the lesson into the chart. If you prefer any other activity, please fill it into the record sheet. Use a scale similar to the one used in 4:

Very unpopular			Quite(un) popular			Very popular
0	1	2	3	4	5	6

Never			50% of all lessons			Every lesson
0	1	2	3	4	5	6

Order of popularity of particular parts of the lesson: Teacher experiments (5.09), Video (4.96), Movies (4.87), Pupils experiments (4.85), Internet (4.77), Explanations (3.72), Present a paper (3.13), Tales (3.12), Problems (2.69), and Revision (2.08).

Table 5. Frequency of different programs in the physics lessons

	Type of the lesson part	Φ	Interpretation
1.	Presentation	5.07	Nearly every lesson
2.	Revision	3.56	A little more than 50 % of lessons
3.	Task solving	3.45	A little bit more than 50 % of lessons, less then revisions.
4.	Teacher experiment	2.79	Less than 50 % of lessons – approximately at each lesson.
5.	Pupils experiments	2.15	Approximately in every third lesson
6.	Tales	1.59	Approximately in every third lesson, lower frequency than with pupils experiments
7.	Present a paper	1.42	Similarly as with tales
8.	Video	1.36	Approximately in every fifth lesson
9.	Movies	1.06	Very low frequency
10.	Internet	0.86	Almost never

Order of popularity within pupils and real presence of the lesson part count against experiments.

Item 6: How often do you prepare for a physics lesson?

Never		...	In ½ cases	...		Always
0	1	2	3	4	5	6

Table 6. Frequency of preparation at home

Points	0	1	2	3	4	5	6	Φ
Boys	1	14	16	23	13	13	9	2,87
Girls	5	8	14	27	17	18	11	3,43
Total	8	11	15	24	16	16	10	3,13

Item 7: Who helps you with preparation for physics lessons 1. parents, 2. grandparents, 3. brothers and sisters, 4. classmates, 5. friends 6. teacher / educator, 7. another person, 8. nobody.

Table 7.1 Frequency of help with preparation in %

Persons	1	2	3	4	5	6	7	8
Boys	31	2	7	3	4	1	1	51
Girls	30	2	10	4	9	1	1	43
Total	31	2	8	4	6	1	1	47

Table 7.2: Order of persons helping with preparation

Boys in %		Girls in %	
Nobody	51	Nobody	43
Parents	31	Parents	30
Brothers and sisters	7	Brothers and sisters	10
Friend	4	Friend	9
Classmates	3	Classmates	4
Grandparents	2	Grandparents	2
Teacher	1	Teacher	1
Another person	1	Another person	1

Item 8: What is your opinion on necessity and usefulness of physics?

1. We cannot live without physics and technique
2. Physics and technique make our life pleasant but we could live without them
3. Physics and technique influence our life more negatively than positively
4. I am against physics and technique

Table 8. Frequency of opinion on necessity of physics and technique

Points	1.	2.	3.	4.	Φ
Boys	70	23	4	3	1.39
Girls	63	28	5	4	1.50
Total	67	26	4	3	1.45

Item 9: Are you thinking about your future professional orientation in the field of mathematics or science (physics, chemistry, biology...)?

1. I'm oriented on science and mathematics exclusively
2. It can be one direction of my study besides the others
3. I have not decided yet
4. Most probably no
5. Definitely no

Table 9. Frequency of professional orientation in %

Points	1	2	3	4	5	Φ
Boys	8	20	26	27	19	3.29
Girls	6	17	24	31	22	3.45
Total	7	18	25	28	22	3.36

54 % of boys and 57 % of girls claim they could be oriented science and mathematics in future.

Item 10: From the following list, choose the occupation that is highly respected in society according to you (for a case of any other occupation specialize the occupation in the record sheet)

Table 10. Frequency of occupation which is highly respected in society in %

Boys	%	Girls	%
1 Physician	24.1	1 Physician	34.5
2 Other	19.5	2 Lawyer	10.7
3 Scientist	10.6	3 Other	10.4
4 Businessman	10.2	4 Scientist	9.9
5 Lawyer	9.2	5 Politician	6.9
6 Soldier	5.6	6 Businessman	5.6
7 Politician	5.4	7 Actor	5.3
8 Actor	5.1	8 Artist	5.0
9 Artist	3.5	9 Teacher	4.1
10 Economist	3.2	10 Economist	3.7
11 Teacher	2.5	11 Interpreter	2.0
12 Interpreter	1.1	12 Soldier	1.9

Item 11: Write into the record sheet corresponding number: What I learn in physics I will need in my life.

0 definitely disagree	1 rather disagree	2 do not know	3 rather agree	4 definitely agree
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Majority of pupils, i.e. 61 % (67 % boys and 55 % girls) claim, that the knowledge they acquire in physics lessons will be needed in their further lives.

Conclusions

We presented only very brief overview of results arising from the opinion survey among secondary lower schools pupils in the Czech Republic. Individual items are elaborated into subsequent items so there is enough material for further decision how to change education in physics. The conclusion of the research is positive: Pupils do not refuse physics, they are fully aware of the necessity of physics for their lives. The problem is, „which physics“ and „in which way“ we prepare it for the new generation of pupils and how qualified the physics teachers will be.