

ELEMENTARY SCHOOL PUPILS' AND TEACHERS' PERSPECTIVES ON PHYSICS AS A SCHOOL SUBJECT

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1 INTRODUCTION

Several big changes have recently been introduced into compulsory education in Croatia. First, *the Croatian National Educational Standard*, the so-called *HNOS*, has been experimentally piloted in a few dozen schools. Then, on the basis of *HNOS*, a new *National plan and programme* was constructed and introduced into all of the elementary schools. In the coming years, the Croatian educational system is expecting an entirely new curriculum.

A comprehensive empirical research into the situation in Croatian elementary schools was conducted in 2003 on a representative sample of 121 schools. The purpose was to acquire the data that should be a useful foundation for the development of the new curriculum and for the future investigation of the implementation and the impact of the introduced curricular changes.

The data presented in this paper were collected through the aforementioned empirical research which was a part of a project financed by the Croatian Ministry of science, education and sports and the Open Society Institute. Research was conducted by the researchers of the Centre for educational research and development at the Institute for Social Research in Zagreb. One part of the results presented here has been presented with the results for other subjects in [1].

2 AIMS

The aim of the entire research was to gain insight into the recent state of the national curriculum from the teachers', pupils', and school principals' perspectives with the purpose of improving the quality of compulsory education in Croatia.

The aim of this paper is to present the part of the research data concerning the school subject physics. This includes elementary school pupils' and teachers' opinions and attitudes towards teaching plans, teaching methods, their perception of the subjects, etc.

3 SAMPLE AND METHODOLOGY

Research was conducted using questionnaires for the 8th grade pupils (14-15 year-olds) and for the teachers. Questionnaires were constructed in the Centre for educational research and development based on conclusions from work done with focus groups and piloting in 10 elementary schools in Zagreb and its vicinity. Scales are partly taken from other published surveys [2, 3, and 4]. Fieldwork was

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done during the spring of 2003 in 121 elementary schools in Croatia (14.7% of the total number of schools). From each school, one 8th grade class and all available teachers were included in the study sample. The sample of schools was chosen by a stratification procedure based on the proportion of the number of schools in a particular region to the total number of schools in Croatia. Within each region, schools were selected randomly. The pupils' questionnaire took ca 45 min to fill in, and the teachers' ca 60-90 min. In total, the sample included 2674 pupils and 2134 teachers - 77 of which were physics teachers.

4 RESULTS AND DISCUSSION

4.1 Pupils

In the pupils' questionnaire there are questions with the 7-point semantic differential scale by which the pupils had to evaluate each school subject in 5 dimensions: interest, comprehensibility, difficulty, usefulness in everyday life and importance for the future.

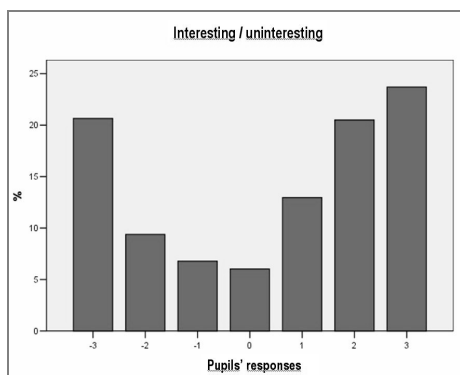


Figure 1 Pupils' response - interest.

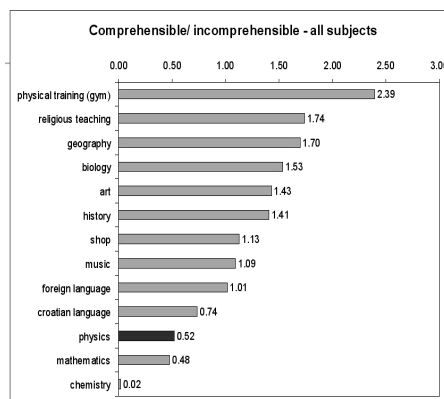


Figure 2 Pupils' response - comprehensibility.

Pupils' opinions about whether physics is interesting or uninteresting are polarized – the values in the middle of the scale (neutral opinion) were the least popular pupils' choice (Fig. 1). Almost half of the pupils choose the extremes – physics is either completely interesting or completely uninteresting (although more of them choose the positive values). It is worrying that more than 20% of the pupils find physics completely uninteresting. Compared to other school subjects, pupils' answers in the dimension of interest position physics in the lower part of the subject list; physics takes the 8th place among 13 subjects, right next to mathematics. The other science subjects were placed as follows: biology is at the top (3rd place) and chemistry is at the very bottom.

According to the pupils, physics is among the subjects which are the most incomprehensible (Fig. 2). Only mathematics and chemistry are less comprehensible. Approximately only one third of the pupils rate physics positively in the dimension of comprehensibility.

Similarly, in the dimension of difficulty, physics also receives predominantly negative results. More than 20% of the pupils find physics extremely difficult. Physics is among the most difficult subjects; only mathematics, chemistry and the Croatian language are more difficult.

The position of physics is better in the dimensions of usefulness in the present life and importance for the future, but it is still in the lower half of the school subjects (8th out of 13 subjects). In this dimension, biology is again placed better than physics, and chemistry worse. It is interesting that the pupils find mathematics difficult and incomprehensible but also one of the most useful subjects in their present life and one of the most important for the future. This is not the case with physics.

One of the questions for the pupils was 'What is your favourite subject?'. Physics is chosen by less than 4% of the pupils. Eight subjects are more popular than physics (including mathematics and biology, while chemistry is again worse). Those who choose physics as their favourite subject, choose it because it is interesting (50%), because of the teacher (23%), because it will be useful in the future (13%) and because it is easy (10%). Physics is the least favourite subject for 12% of students.

The only subjects which are less popular than physics are chemistry (18%) and mathematics (17%). 40% of the students who consider physics their least favourite subject say it is because it is difficult and incomprehensible. It is worrying that 26% of the students say it is because of the teacher. Approximately the same percentage says it is because it is uninteresting and 7% because it is too extensive.

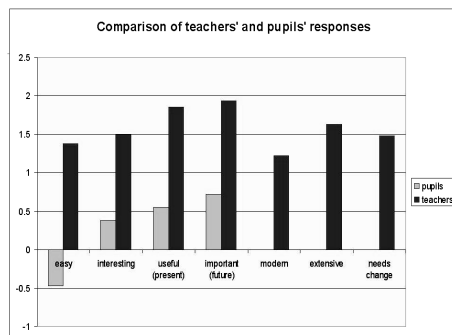
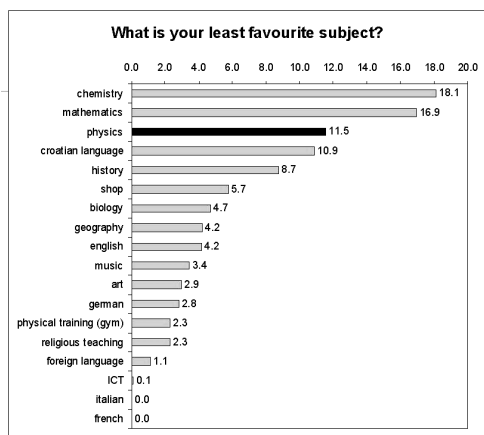


Figure 3 Pupils' response - least favourite subject.

Figure 4 Comparison of the responses.

When asked how many hours per week they spend writing homework, studying and preparing for physics lessons, the pupils revealed that they spend very little time on physics outside class. 15% of the students say that they don't do anything for class at home, and more than 50% of the students spend less than one hour per

week on physics. Approximately 30% of the students spend between 1 and 3 hours per week on physics. Around 10% of the pupils spend more than that. Here are some other results:

- 50% of the pupils claim that they have to invest a lot of effort to learn physics
- 16% of the pupils want to learn more about what they heard in class
- 28% think they have to study too much in class
- 51% think that what they study in physics is related to other subjects (here physics is at the top)
- 3% think pupils can influence what will be done in class
- 10% think pupils have influence on the learning activities in the class.

When asked how often the pupils do experiments in the subjects where they learn science, 20% of the pupils choose the answer *never*, 56% *rarely*, 20% *often* and only a few percent *always*.

4.2 Gender differences

Research data show statistically significant gender differences in the pupils' answers. Boys give much more positive answers than girls, which can be seen in Fig. 5 and Fig. 6.

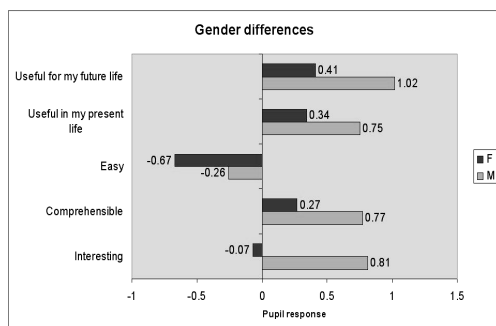


Figure 5 Gender differences.

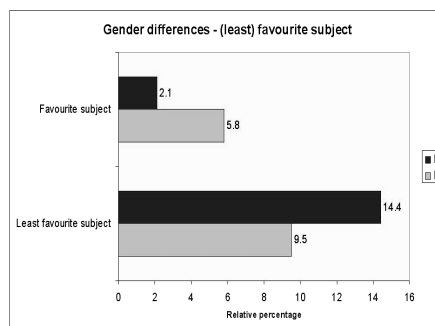


Figure 6 Gender differences - (least) favourite subject.

Girls find physics much more difficult and incomprehensible. They find it less important and useful, and especially less interesting. 14.4% of the girls choose physics as their least favourite subject in school (compared to 9.5% of the boys). Physics is the favourite subject of only 2.1% of the girls (compared to 5.8% of the boys). These results could be a cause for concern even though research in other countries has shown similar results [1].

4.3 Teachers

Out of 77 teachers of physics in the sample, 40% are female and 60% are male, and this is where physics differs from other subjects; in the entire sample of 2134 teachers, 74% of them are female. The average age of physics teachers is 50 years, and the average age of all the teachers in the sample is 45 years. The average

working experience is 24 years which is also more than the average of the entire sample (20 years). 70% of physics teachers have a two-year college degree (49% for the entire sample).

The ICT competence for physics teachers wasn't highly developed in 2003. Almost 50% of the teachers say that they use computers never (15%) or rarely, and the internet more than two thirds. More than 50% don't use e-mail for communication.

Almost all of the teachers say that they use textbooks in class. They predominantly also use teacher handbooks (95%), workbooks (92%), professional literature (91%), overhead projector (90%). It is interesting that 39% of them claim that they use computers in class, and 30% use the internet.

More than 80% of the schools in the sample have a specialized classroom for physics. They are always used by more than 65% of the teachers, and often by 17%. Around 55% of the teachers think their classroom is averagely equipped. Classroom materials are always or often available in school for more than 80% of physics teachers. More than 40% of physics teachers make their own classroom materials.

Physics teachers have listed pupils' activities in class in the following order (according to frequency): *Participate in the discussion. Ask questions. Express and discuss their ideas. Solve problem tasks. Do experiments. Repeat what they learned. Listen and write down what I teach. Help other pupils. Work in small groups. Make an object, picture, model, etc. Write comments, observations, reports, etc. Do a presentation. Participate in projects. Read silently. Do fieldwork.*

Teachers' and pupils' questionnaires had a few corresponding questions so they can be compared (Fig. 4). The teachers have a better opinion about physics as a subject than the pupils, but they think that physics is extensive and needs to be changed.

Physics teachers averagely don't manage to cover 7% of the prescribed content in the 7th grade, and 9% in the 8th grade. On average, the teachers think that 10% of the content can be omitted in the 7th grade, and 11% in the 8th grade. The main obstacles in teaching physics are as follows (according to frequency): different abilities of the pupils, unequal level of motivation of the pupils, large number of pupils in the classroom, lack of time and bad material conditions. Only 25% of physics teachers think their school is ready for the implementation of the new curriculum.

The results of the research show that more than 50% of physics teachers are mostly satisfied (48%) or extremely satisfied (8%) with the working conditions in their schools, while less than 10% of them are mostly unsatisfied or extremely unsatisfied.

5 CONCLUSIONS

The research data presented in this paper show that physics as a school subject is rather unpopular among the pupils. Most of them consider physics uninteresting, hard to understand and not very useful for the present life or important for the

future. On the list of the most unpopular subjects physics is in the 3rd place mostly because it is difficult and incomprehensible, but also because of the teachers. Physics is especially unpopular among the girls – their opinions are more negative than those of boys in all the measured dimensions.

It is a serious challenge for the physics education to take advantage of the oncoming curricular changes to 'raise' the physics in pupils the eyes of the pupils in order to gain conditions for greater effectiveness of the teaching process (this is particularly important for the motivational factors). Research shows some points of weakness among the teacher population. First of all, it is the use of the new technologies. Physics teachers are on average older than their colleagues in other subjects, and most of them finished pre-service education long ago, so in-service teacher training is of great importance. Although teachers' opinions are more positive than the pupils', most of them think that curricular changes are desirable.

Since curricular changes in Croatia have already begun, further research of the results and tendencies would be useful and desirable in order to improve the quality of physics education in elementary schools.

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