Statistical Research of Pupils Pre-concepts at Basic Schools in the Czech Republic

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1 Introduction

A statistical research on pupils pre-concepts (transcendental images) took place at selected basic schools in the Czech Republic at the end of the school year 2005/2006.

The questionnaires were modified to the current form on the basis realized preliminary research which took place in Olomouc (basic schools Holečkova and Hálkova – a school with extensive education of foreign languages). Approximately 75 informants (42 boys and 33 girls) took part in this preliminary research.

The whole research was realized within the GA CR project entitled „Constructivism and his Application in Integrated Conception of the Science Education“. The project was proposed by the team of professional physicists, chemists and biologists (engaged in didactics) at the Faculty of Science (Palacky University in Olomouc) and the Faculty of Education (University in Hradec Králové and Tomáš Baťa University in Zlín). The basic aim of this project is to develop the constructivistic approach to the theory of physical, chemical and biological education.

Partial objectives of the project:

- Cross-disciplinary conception of science (interconnection of the science sections);
- Creation of the didactic model – integrated physical, biological and chemical education at a primary school;
- Specifications of the aims, contents, methods and forms of the education and evaluation;
- The definition of the database of the basic terms in science teaching;
- Statistical research on pupils pre-concepts at basic schools.

418 responders (196 boys, 222 girls) have taken part in the countrywide research of pre-concepts so far. Roughly double the number of questionnaires

has been sent out. The remaining questionnaires will be included to the evaluation. Pupils had an hour for filling out the questionnaire.

2 The statistical research results

Method of valuation:

Every question was rated – spectrum 1, 2, ..., 5 (1 = the best, ..., 5 = the worst). If there are questions type „ correct – bad answer", was mark 1 (correct) or 5 (bad).

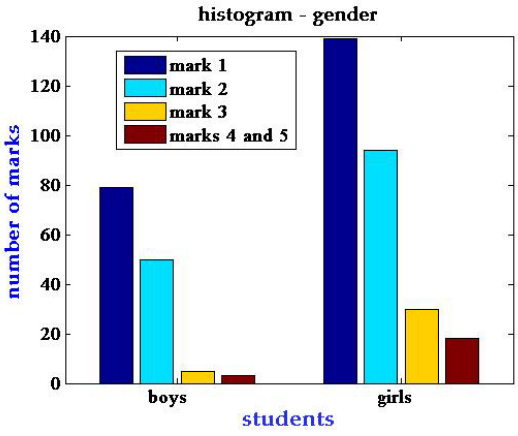
Statistical processing was carried out in MATLAB.

Question issue 1

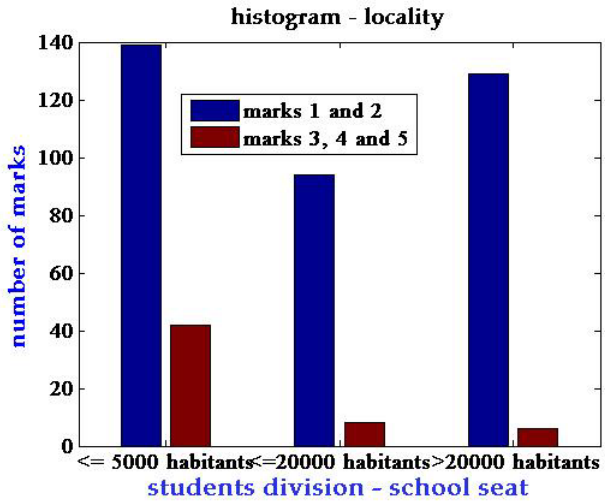
Divide the words ***elephant, flint, brick, water, granite, fly agaric, rock, lime tree, television, ant, pin, needle, air, car***, into the groups and write them down into the table.

Group Title:	Live product of nature	Lifeless product of nature	Human product
Choice words			

Evaluation of question issue 1:



Boys		Girls	
Classification mark 1	57 %	Classification mark 1	50 %
Classification mark 2	36 %	Classification mark 2	33 %
Classification mark 3	5 %	Classification mark 3	11 %
Classification mark 4, 5	2 %	Classification mark 4, 5	6 %



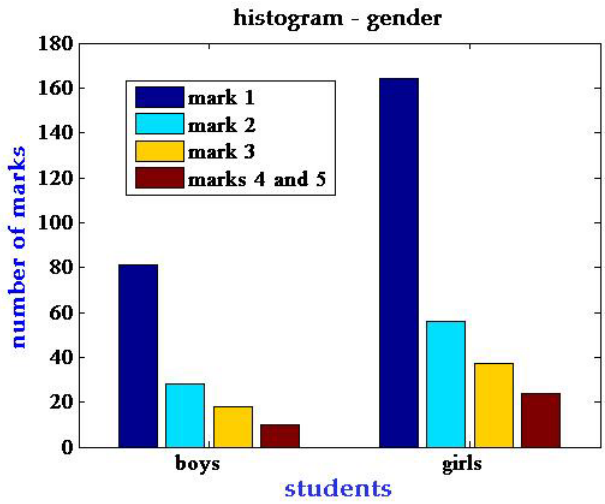
< 5000 habitants		5 000 – 20 000 habitants		> 20 000 habitants	
mark 1, 2	77 %	mark 1, 2	91 %	mark 1, 2	95 %
mark 3, 4, 5	23 %	mark 3, 4, 5	9 %	mark 3, 4, 5	5 %

Question issue 2
Find out **the words** that have **a common feature** – the same state or contain the same material. Write down the words into the chart.
Water, iron, wood, paper, ice cream, milk, apple, car, sea, snow, bench, book, rain, tree, stone, air, fog, book.

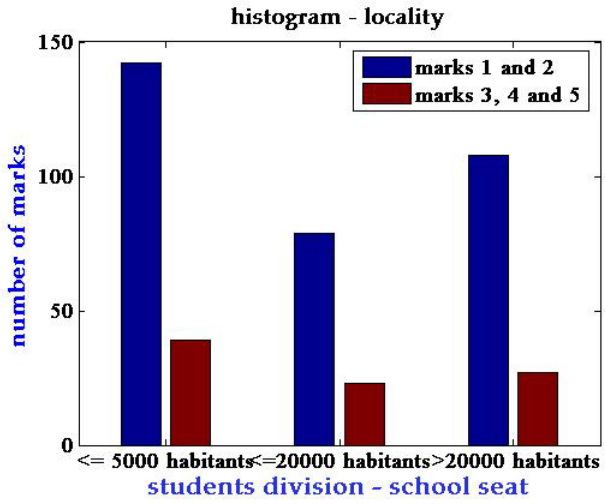
State

Solid	Liquid	Gas

Evaluation of question issue 2:



Boys		Girls	
Classification mark 1	60 %	Classification mark 1	58 %
Classification mark 2	20 %	Classification mark 2	20 %
Classification mark 3	13 %	Classification mark 3	13 %
Classification mark 4, 5	7 %	Classification mark 4, 5	9 %



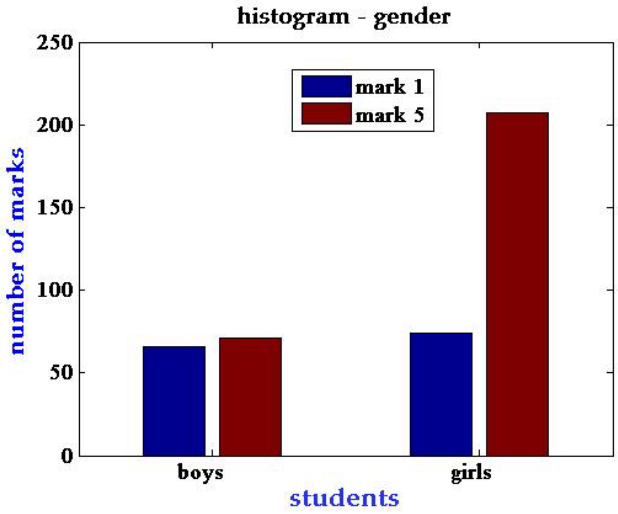
< 5000 habitants		5 000 – 20 000 habitants		> 20 000 habitants	
marks 1, 2	78 %	marks 1, 2	77 %	marks 1, 2	80 %
marks 3, 4, 5	22 %	marks 3, 4, 5	23 %	marks 3, 4, 5	20 %

Question issue 3

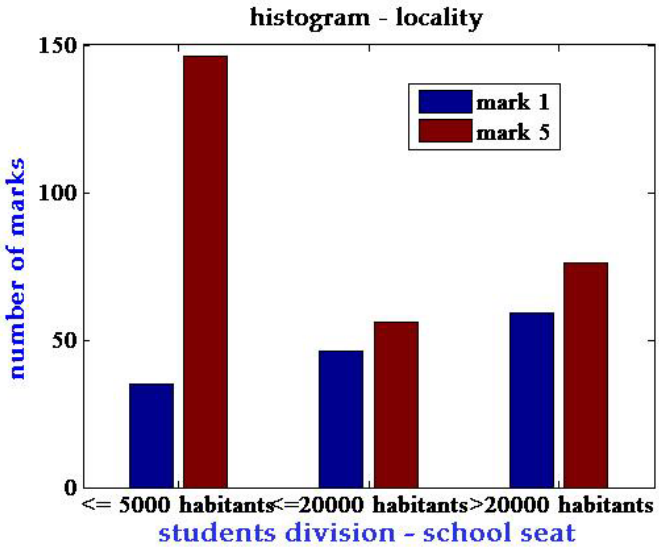
Imagine that you have got a small cup filled with water and you are heating it with a flame of a candle. Water starts to boil (you know that boiling water has a temperature of 100 °C). What happens, when you use two candles? Choose the right answer.

a) Water will boil at temperature of 200 °C.
b) Water will boil at temperature of 100 °C.
c) Water will boil at temperature of 50 °C.
d) I don't know.

Evaluation of question issue 3:



Boys		Girls	
Classification mark 1	48 %	Classification mark 1	26 %
Classification mark 5	52 %	Classification mark 5	74 %



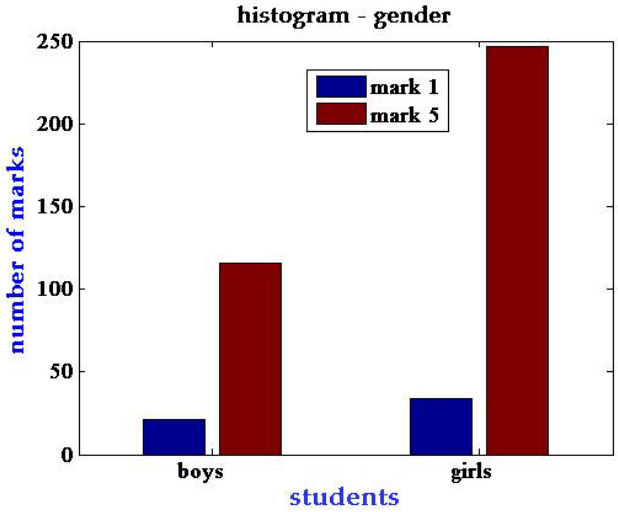
< 5000 habitants		5 000 – 20 000 habitants		> 20 000 habitants	
mark 1	20 %	mark 1	45 %	mark 1	43 %
mark 5	80 %	mark 5	55 %	mark 5	57 %

Question issue 4

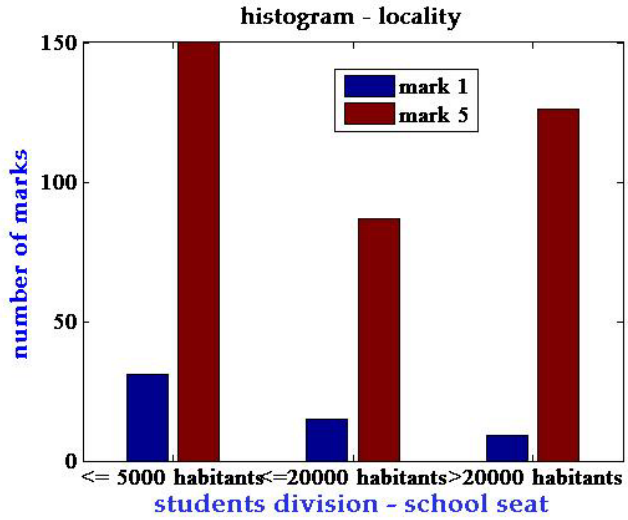
A jacket can pleasantly warm you in winter. What happens to a scoop of ice cream, when you wrap it into the fur coat? (circle the correct answer)

a) Ice cream will melt slower.
b) Ice cream will melt earlier.
c) Ice cream will melt in the same way, as lay freely on the table.
d) Ice cream will not melt.
e) I don't know.

Evaluation of question issue 4:



Boys		Girls	
Classification mark 1	15 %	Classification mark 1	12 %
Classification mark 5	85 %	Classification mark 5	88 %

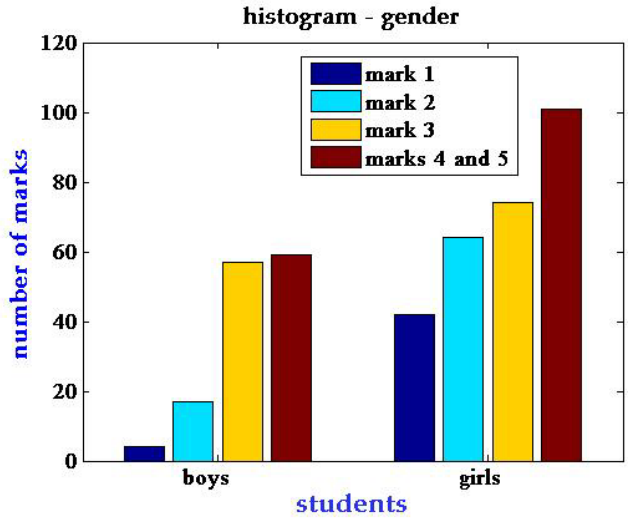


< 5000 habitants		5 000–20 000 habitants		> 20 000 habitants	
mark 1	17 %	mark 1	15 %	mark 1	6 %
mark 5	83 %	mark 5	85 %	mark 5	94 %

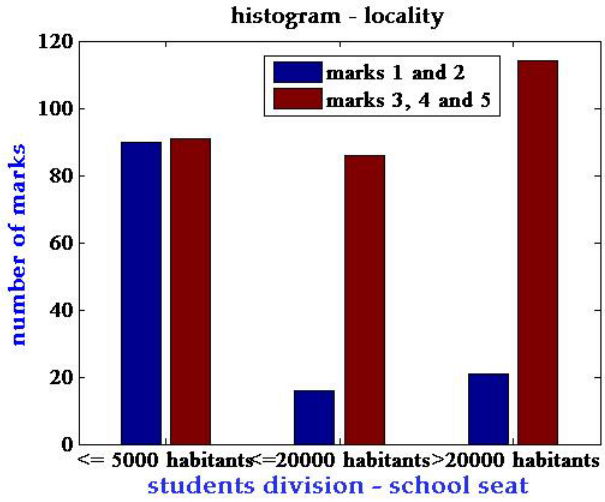
Question issue 6
Label the correct answers (circle YES or NO):

a) Glow-worm radiate luminous energy.....YES – NO
b) Snow melts faster around snowdrops (because they give out / radiate heat)….....YES – NO
c) Whale exhales water vapor in the water.....……..... YES – NO
d) Walls of a fermenting vessel (where fermentation is taking place at the moment) warm up .....YES – NO
e) Your body radiates warmth……..... YES – NO

Evaluation of question issue 6:



Boys		Girls	
Classification mark 1	3 %	Classification mark 1	15 %
Classification mark 2	12 %	Classification mark 2	23 %
Classification mark 3	42 %	Classification mark 3	26 %
Classification mark 4, 5	43 %	Classification mark 4, 5	36 %

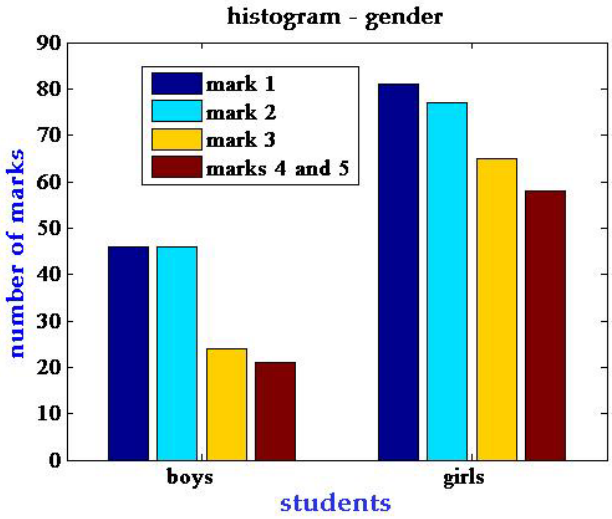


< 5000 habitants		5 000 – 20 000 habitants		> 20 000 habitants	
mark 1, 2	50 %	mark 1, 2	15 %	mark 1, 2	15 %
mark 3, 4, 5	50 %	mark 3, 4, 5	85 %	mark 3, 4, 5	85 %

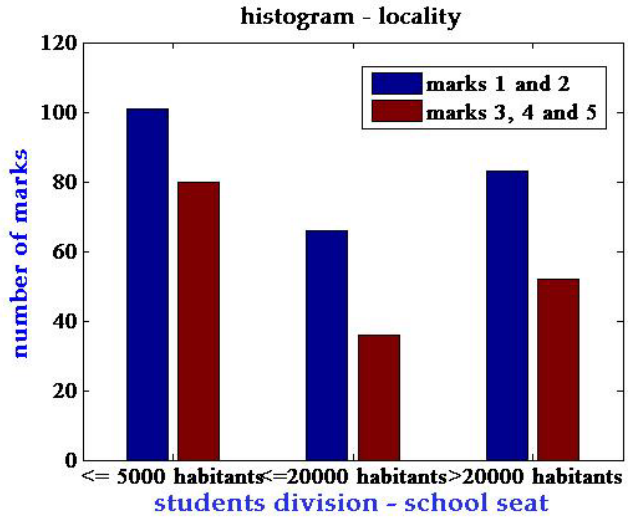
Question issue 7
Label, (circle) **floating** subjects and matters **in the water**.

- ferrous bullet
- bullet from wood
- bullet from glass
- cork
- polystyrene
- potato
- petrol
- oil

Evaluation of question issue 7:



Boys		Girls	
Classification mark 1	34 %	Classification mark 1	30 %
Classification mark 2	34 %	Classification mark 2	27 %
Classification mark 3	17 %	Classification mark 3	23 %
Classification mark 4, 5	15 %	Classification mark 4, 5	20 %

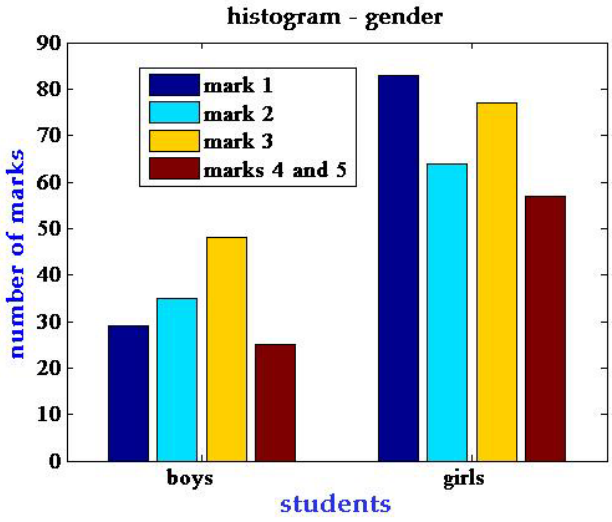


< 5000 habitants		5 000 – 20 000 habitants		> 20 000 habitants	
mark 1, 2	56 %	mark 1, 2	65 %	mark 1, 2	62 %
mark 3, 4, 5	44 %	mark 3, 4, 5	35 %	mark 3, 4, 5	38 %

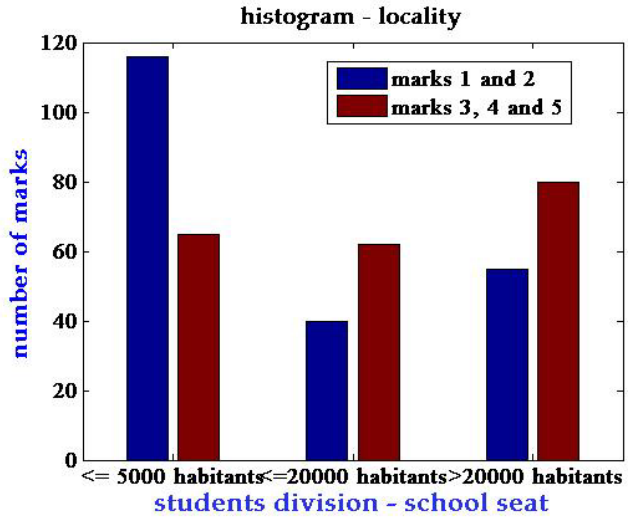
Question issue 8
Label (circle) the material or subject with **higher density** (in each couple).

- water – syrup
- wood – iron
- water – iron
- wood – water
- water – air
- oil – water

Evaluation of question issue 8:



Boys		Girls	
Classification mark 1	21 %	Classification mark 1	30 %
Classification mark 2	25 %	Classification mark 2	23 %
Classification mark 3	36 %	Classification mark 3	27 %
Classification mark 4, 5	18 %	Classification mark 4, 5	20 %

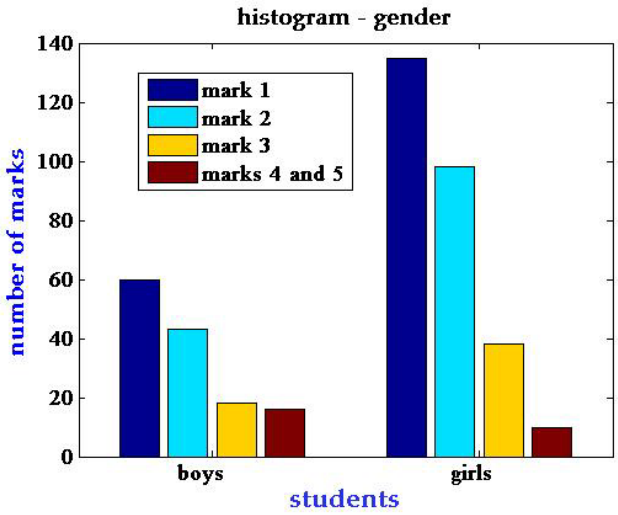


< 5000 habitants		5 000 – 20 000 habitants		> 20 000 habitants	
mark 1, 2	64 %	mark 1, 2	40 %	mark 1, 2	40 %
mark 3, 4, 5	36 %	mark 3, 4, 5	60 %	mark 3, 4, 5	60 %

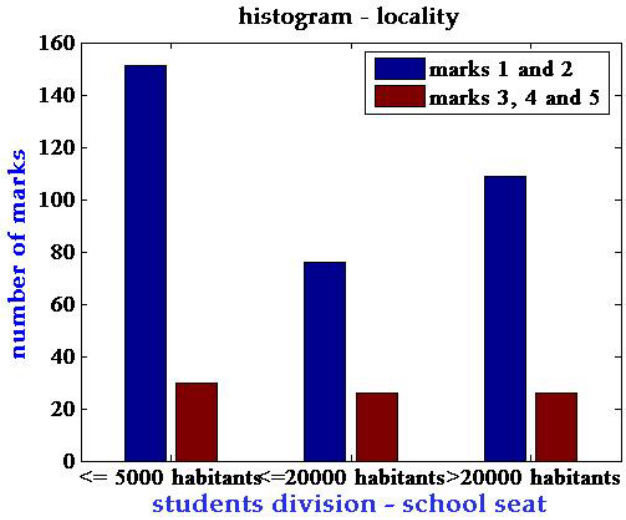
Question issue 9
Choose and circle what all living organisms need.

a) water
b) energy
c) air
d) ice
c) movement

Evaluation of question issue 9:



Boys		Girls	
Classification mark 1	44 %	Classification mark 1	48 %
Classification mark 2	31 %	Classification mark 2	35 %
Classification mark 3	13 %	Classification mark 3	14 %
Classification mark 4, 5	12 %	Classification mark 4, 5	3 %



< 5000 habitants		5 000 – 20 000 habitants		> 20 000 habitants	
mark 1, 2	83 %	mark 1, 2	75 %	mark 1, 2	80 %
mark 3, 4, 5	17 %	mark 3, 4, 5	25 %	mark 3, 4, 5	20 %

3 Conclusion

It is perceptible from this research that the best-answered questions, in case of boys and girls too, are the question number **1** (live, lifeless product of nature, human product), the question number **2** (solid, liquid, gas) and the question number **9** - biology field. Wrongly-answered questions were the question number **3,** only 26% girls answered correctly, most frequent mistaken answer was *a) water will boil at temperature 200 ^{o}C.* Further, it was the question number **4** (over 80% boys and girls gave the wrong answer– *b) Ice cream will melt earlier*. Only 15% girls and 3% boys was successful in the question

number **6** (biology area). Correct answer was „YES" for each item. Most frequent mistaken answerback was in cases *a), b), d).*

As to the geographical evaluation, the question number **3** was problematic for villages with 5 000 inhabitants (and less), where 80% pupils answered wrong. Contrary villages with 5 000 inhabitants (and less) was relatively more successful compared to the rest of cities in questions No. **6**. As well that was in questions No. **8** (physics field).

The most successful schools are from municipality: Horní Cerekev, Vyškov and Praha on average. The bad anwers were at schools in Mladá Boleslav, Mikulov and Cheb.

Within the framework of this statistical research, the questionnaires that the schools had sent back have been analysed so far. The rest of the questionnaires will be included into the overall evaluation after we obtain them.

In conclusion, it is necessary to point out that the pre-concepts are an individual characteristic of each learning person. Pre-concepts are formed by various influences (school, home, native country,...) and the experiences. Quite a number of aspects are important at their forming. These are partly exogenous factors (social, economics, ethnical, cultural etc.), and endogenous factors. They stem from psychological and psychosocial characteristics of each of pupil. Every individual has constructed transcendental images on the basis of the different experiences – past schooling, family background, hobbies, medial resources (internet, television …). Permanency and resistance to the changes are typical characteristics of transcendental images. The aim of these statistical researches resides in the pursuit of "breaking" the mistaken transcendental images and, of course, in teachers and pupils awareness of the most frequent errors in the pre-concepts organization. Pre-concepts researches and the concepts changes are the basis of the constructivist conception of the scientific education.

I'd like to thank to the involved schools for their cooperation and of course thank to the whole didactic team which has taken part in formation of the questionnaires.

References

[1] Konstruktivismus a jeho aplikace v integrovaném pojetí přírodovědného vzdělávání. Úvodní studie. Olomouc, Univerzita Palackého v Olomouci 2006.