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Drs. Janis Gedrovics[1], Martin Bilek[2], Todar Lakhvich[3], Luiz Caldeira Brant de Tolentino-Neto[4]

Martin.Bilek@uhk.cz

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EL INTERÉS POR LOS TEMAS DE CIENCIAS NATURALES COMO INDICADOR DE LA ACTITUD CIENTÍFICA DE LOS ESTUDIANTES

Janis Gedrovics[1], Martin Bilek[2], Todar Lakhvich[3], Luiz Caldeira Brant de Tolentino-Neto[4]

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STUDENTS' INTEREST IN SCIENCE TOPICS AS AN INDICATOR OF THEIR ATTITUDES TO SCIENCE: AN INTERNATIONAL COMPARISON.

Janis Gedrovics[1], Martin Bilek[2], Todar Lakhvich[3], Luiz Caldeira Brant de Tolentino-Neto[4]

[1] Riga Teacher Training and Educational Management Academy, Riga, Latvia
[2] University of Hradec Kralove, Hradec Kralove, Czech Republic
[3] Belarus State Pedagogical University, Minsk, Belarus
[4] Federal University of Santa Maria, Santa Maria, Brazil

Abstract

The paper provides a comparative study of interests in Natural Sciences of 15-year old learners in several European countries (Latvia, Poland, Czech Republic and Belarus) and one from South America (Brazil). It was shown that the general interest in the topics researched in the ROSE Project was on the same level, mainly in the field of human biology, but some differences were discovered in the roots from which the interest raised and seemed to originate from the national culture.

In all five countries, based on their relation to the school subject, shows that most respondents can be classified as "science negationists (students with negative attitude to science instruction)". The general level of interest in the science topics taken from the ACE (three parts of ROSE questionnaire - Part A, Part C and Part E - contents topic "What I can learn in Science Education?"). The average value depended on the group type to which the respondents were allocated.

Keywords: *interest, classification analysis, relation to Science, comparative analysis*

EL INTERÉS POR LOS TEMAS DE CIENCIAS NATURALES COMO INDICADOR DE LA ACTITUD HACIA LAS CIENCIAS NATURALES EN GENERAL

Resumen

El artículo ofrece un estudio comparativo de los intereses por las Ciencias Naturales de los alumnos de 15 años de edad en varios países europeos (Letonia, Polonia, República Checa y Bielorrusia) y Brasil (América del Sur). Se ha demostrado que el interés general por los temas investigados en el Proyecto ROSE estaba al mismo nivel, sobre todo en el campo de la biología del ser humano, pero se descubrieron algunas diferencias en las cuales radica el interés que ha despertado, la cual parece proceder de la cultura nacional.

La clasificación de los encuestados sobre la base de su relación con las asignaturas de Ciencias muestra que la mayoría de los encuestados en todos los países pertenecen a lo que se ha dado en llamar ""negacionistas de la ciencia (estudiantes com una relación negativa con la enseñanza de las ciencias)". El interés general en los mencionados temas de ciencias naturales, que está documentado por el valor promedio de la ACE, depende del grupo detectado al que pertenecen los encuestados.

***Palabras clave**: interés, análisis de clasificación, relación con las ciencias, análisis comparativo*

Introduction

An attitudinal relationship is usually expressed in the form of positive or negative approaches to anything or anybody. It includes two basic components, i.e. the affective and cognitive ones, the combination of which results in a certain type of behaviour of the subject

to the object, phenomenon, process etc. In other words - the relation to anything from the subject's side is expressed in feelings, emotions etc. and their development is influenced by personal (inner) and external factors.

During recent decades the decrease in the pupils´ and students´ interest in natural sciences has been monitored by researchers and teachers. Attitudes expressed were negative towards science subjects, i.e. Chemistry, Physics, sometimes even to Biology. Learners consider the subjects to be too difficult, not sufficiently interesting to be selected for future career in this field (Gedrovics, Mozeika & Cedere, 2010). But the negative attitude to the school subject cannot simple be the subject because the learner's experience is also formed by parents, friends, teacher-learner interrelations, study results etc. Another factor is mentioned by R. George (2000) – i.e. learner's self-confidence in own abilities (Adolfsson et al, 2011).

The learner's interest in the field also plays important role in spite of the fact that the direct relation between the attitude to something and the interest in it has not been proved. We can see that the learner's interest in natural science may be expressed in the form of the interest (or non-interest) in nature or in natural science's school subjects (Sølberg & Troelsen, 2008), or the interest may relate to the future anticipated profession. All the characteristics may not prove any interest in natural science school subjects. Above all, the interest in general is a complex phenomenon, which includes the individual interest (depending on the personal characteristics), and the situational interest, which depends on numerous facts, e.g. individual teacher's decisions[1], including natural sciences, which are also influenced by numerous factors, e.g. educational stereotypes in the family (Dahlbom, 1988).

A wide scale of definitions describing the term learner's interest cannot be taken into account, these are quite difficult to measure directly. The changes in time are usually monitored by descriptive characteristics on the test basis comparable to TIMSS, OECD PISA types etc. which provide data for subsequent analyses. The learner's interest to natural science topics is considered such an indicator.

Based on this approach, authors emphasize following research questions:

1. What are the learners´ interests in the field of natural sciences in geographically distant countries with different levels of the social-economic development?
2. What is the influence of the attitude to the school natural sciences on the interest in objects natural sciences explore?

Research Methodology

The methodology is based on ROSE Project (The Relevance of Science Education). "ROSE is an international comparative project meant to shed light on affective factors of importance to the learning of science and technology. Key international research institutions and individuals work jointly on the development of theoretical perspectives, research instruments, data collection and analysis. The target population is students towards the end of secondary school (age 15). The research instrument is a questionnaire mostly consisting of closed questions with four-point Likert scales." (Schreiner & Sjøberg, 2004).

ROSE ran in several countries in 2003-2009 and partial results of which were published (Bilek et al, 2006; Gedrovics et al, 2008; Schmutzerová & Bílek, 2010), including the PhD degree thesis (Tolentino-Neto, 2008). Instead of this, a survey on the ROSE Project basis ran

[1] Detailed information is available in the summary of this work (Lavonen et al, 2008)

in Belarus (Minsk, the Capital of Belarus, and surroundings) in 2009 so that the data could be compared to those collected in Brazil in 2007 and in other participating countries within the second round of testing (Czech, Poland, Latvia, autumn 2007 – winter 2008). The research sample is described in table 1 where we can see that the gender structure differs slightly from 50 %: 50 % (1:1) ratio, Brazil (55.6 % of girls) and Poland (53.9 % of girls) excluded. The girl-boy ratio reflects the situation in each country, so the results are expected to reflect the general real situation.

Table 1 Gender Distribution in Participating Countries

	Latvia (LV)		Poland (PL)		Czech Rep. (CZ)		Belarus (BY)		Brazil (BR)	
	N	Per cent	N	Per cent	N	Per cent	N	Per cent	N	Per cent
Girls	144	50.3	76	53.9	80	51.3	81	49.4	318	55.6
Boys	142	49.7	65	46.1	76	48.7	83	50.6	254	44.4

The received results showed no statistically significant difference in increase the interest of the 15-year-old learners between 2003 – 2008 (Gedrovics et al, 2008). the results collected in Brazil (2007) and Belarus (2009) are not expected to differ from the above mentioned countries, and thus they can be used for comparisons.

The SPSS programme (version 19) was used for analysing the collected data. It follows the structure below:

- first, the most and least interesting topics were distinguished out of 108 presented ones covering comparatively similar natural science phenomena (Schreiner & Sjøberg, 2004), and also the mean classification (M_{aver}) was made calculated by four-level Likert scale *not interesting – very interesting* ($1 \leq M_{aver} \leq 4$). Instead of this, the mean value of $2.5 < M_{aver} \leq 4$ was discovered, which means that respondents of the particular group are interested in the concrete topic, while if $1 \leq M_{aver} \leq 2.5$ the general interest is not significant.[2]

- second, under provided methodology (Gedrovics & Lavonen, 2008), the classification of respondents was done, starting from their relation to the school natural science education, and following four groups were distinguished: *science negationists*, *ductiles*, *choosies* and *science enthusiasts*.

- third, applying the classification module, which is included in the SPSS programme, the crucial factors were defined influencing the general natural science interests of 15-years-old learners. The interest is researched under the gender criterion and the respondents´ relation to the natural science education.

Research Results

Results of the comparative research proved that only 23 topics, i.e. 21 %, (Table 2) out of 108 are considered the most interesting by respondents of all five countries. There belong e.g. C13 (*Why we dream while we are sleeping, and what the dreams may mean*) is included in statistically significant differences in all countries, or C08 (*The possibility of life outside earth*) – this one is considered interesting by four countries (except Czech respondents). The

[2] The number of categories in ROSE´s Likert scale was deeply discussed as well as its headings. The researchers involved decided to use an even numbers of answer´s possibilities to ´forced´ respondents to take a stance on each item. The decision of put headings only above the extreme categories followed the same rhythm: it also simplified the translations and avoid ambiguity in meanings. The pilot tests of ROSE did not indicate the lack of middle options headings as a problem. (SCHREINER, 2006)

C13 topic is included in statistically significant differences in all countries by girls, because the difference in mean values M_{aver} is much higher than with boys (α=0,95).

Table 2 Items with Statistically Significant Differences in parts A, C and E of ROSE questionnaire (in bold, significant difference between girls and boys)

Topic[1]	Context (for detailed information see Appendix)	Latvia		Poland		Czech Rep.		Belarus		Brazil	
		M_{aver}	R	M_{aver}	R	M_{aver}	R	M_{aver}	R	M_{aver}	R
A09.	*HY*	2.94	20	2.99	**10**[3]	3.22	**1**[n]	2.95	11	2.91	30
A22.	*UZ*	3.02	13	2.76	33	2.50	51	3.07	**6**[n]	2.75	56
A23.	*UZ*	3.03	12	2.90	19	2.83	17	2.77	26	3.06	**10**[n]
A30.	*CZ*	3.04	**10**[2]	2.82	25	2.74	23	2.85	21	3.01	15
A34.	*UM*	3.34	**2**[2]	2.77	29	3.07	**7**[n]	2.93	16	2.96	20
A37.	*HF*	2.96	17	2.72	35	2.60	41	2.99	**9**[n]	2.89	34
A40.	*HF*	3.18	**5**[3]	2.92	16	2.93	13	3.01	**8**[n]	3.04	12
C04.	*ST*	2.74	44	2.56	51	2.63	37	2.59	48	3.06	**8**[2]
C07.	*T*	2.92	25	3.01	**9**[n]	3.01	**10**[2]	2.90	17	3.14	**5**[2]
C08.	*UM*	3.18	**7**[n]	3.21	**2**[n]	2.86	16	3.17	**2**[n]	3.06	**9**[n]
C10.	*UM*	2.95	19	2.91	18	2.67	32	2.96	**10**[n]	2.78	51
C11.	*HM*	3.21	**3**[3]	3.07	**7**[3]	2.86	15	3.17	**1**[3]	3.01	16
C13.	*HM*	3.40	**1**[3]	3.12	**3**[3]	3.18	**2**[3]	3.16	**3**[3]	3.12	**6**[3]
C14.	*M*	3.03	11	2.87	23	2.64	36	3.02	**7**[3]	2.37	99
C15.	*HM*	3.20	**4**[3]	3.11	**5**[3]	2.99	11	3.11	**4**[3]	2.75	57
E08.	*HQ*	3.07	**9**[3]	2.87	22	3.03	**9**[3]	2.94	12	3.20	**2**[3]
E09.	*HQY*	2.93	24	3.09	**6**[3]	3.11	**5**[3]	2.94	13	3.19	**3**[3]
E10.	*HQ*	2.99	16	2.96	12	3.14	**4**[3]	2.93	15	3.27	**1**[3]
E11.	*HQ*	3.01	14	3.11	**4**[3]	3.09	**6**[3]	2.82	22	3.17	**4**[3]
E12.	*HY*	3.00	15	2.97	11	3.18	**3**[3]	2.69	32	3.03	13
E13.	*HY*	2.96	18	3.05	**8**[3]	3.06	**8**[3]	2.66	36	3.10	**7**[3]
E23.	*HY*	3.08	**8**[3]	2.94	14	2.78	20	2.75	28	2.81	46
E42.	*X*	3.18	**6**[n]	3.22	**1**[n]	2.99	12	3.10	**5**[n]	3.02	14
ACE_{aver}		2,61	-	2.52	-	2.47	-	2.55	-	2.73	-

[2] statistically significant differences in mean in favour of boys
[3] statistically significant differences in mean in favour of girls
[n] there exists the statistically significant difference in girls´ and boys´ responses
ACE_{aver}: average for all ACE ROSE items
R: 'rank order' from all 108 items.

There is a wide general consensus in the twenty least interesting topics within all five countries. The list of them is provided in Table 3 (R=99-108). As we can see there appear only 20 topics within them, which is 18.5 % of all topics, e.g. A15 (*How plants grow and reproduce*), E01 (*Symmetries and patterns in leaves and flowers*). The A17 (*Atoms and molecules*), C01 (*How crude oil is converted to other materials, like plastics and textiles*), E19 (*Organic and ecological farming without use of pesticides and artificial fertilizers*) and E25 (*Plants in my area*) are not popular in four countries only. The E26 topic (*Detergents, soaps and how they work*) belonged to the Top-10 in Brazil despite the mean value M_{aver} was quite close to other countries´ results (Table 3).

Table 3 The Twenty Least Interesting Topics (from Parts A, C a and E of ROSE questionnaire) in the Field of Natural Science[1]

Topic[1]	Con-text	Latvia		Poland		Czech Rep.		Belarus		Brazil	
		M_{aver}	R	M_{aver}	R	M_{aver}	R	M_{aver}	R	M_{aver}	R
A02.	C	2.14	97	2.20	91	2.22	79	2.09	n **101**	2.54	84
A03.	G	2.09	**102**[2]	2.22	89	1.85	n **105**	2.07	**102**[2]	2.48	92
A04.	G	2.10	n **100**	2.02	**101**[3]	1.85	n **104**	2.22	96	2.40	98
A05.	G	2.19	93	2.34	72	1.98	**100**[3]	2.39	80	2.56	82
A10.	HY	2.41	79	2.89	20	2.64	34	2.48	63	2.34	**100**[3]
A15.	F	1.83	**106**[3]	1.74	**106**[3]	1.75	n **107**	2.00	n **104**	2.28	n **103**
A17.	C	1.78	**107**[2]	1.98	n **102**	1.90	n **103**	2.10	**100**[2]	2.43	94
A21.	S	2.27	90	2.11	95	1.93	n **101**	2.51	55	2.51	88
A35.	UM	2.67	49	2.04	n **100**	2.38	63	2.77	25	2.70	61
A47	CT	2.11	**99**[2]	2.11	96	2.40	60	2.24	60	2.63	70
C01.	CR	2.09	**101**[2]	1.66	**108**[2]	1.83	n **106**	1.99	**105**[2]	2.62	72
C14.	M	3.03	11	2.87	23	2.64	36	3.02	7	2.37	**99**[3]
E01.	PB	1.51	n **108**	1.74	n **107**	1.44	**108**[3]	1.66	n **108**	1.95	n **108**
E17.	PR	2.16	95	1.82	n **105**	2.19	83	2.01	n **103**	2.26	n **105**
E19.	PW	2.04	**104**[2]	1.89	n **103**	1.92	n **102**	1.94	n **107**	2.42	96
E25.	PR	2.05	n **103**	2.06	n **99**	2.06	94	2.17	n **99**	2.27	n **104**
E26.	CR	2.13	98	2.23	87	2.09	91	2.23	94	2.15	n **106**
E33.	WX	1.98	**105**[2]	2.43	63	2.01	n **99**	1.98	n **106**	2.33	n **101**
E36.	X	2.31	89	2.23	88	2.14	89	2.29	88	2.33	n **102**
E37.	X	2.17	94	1.86	n **104**	2.09	92	2.27	90	2.05	n **107**

[1] see notices to Table 2

Instead of this, in most cases (66 %) there was no statistically significant difference in girls´ and boys´ responses in the least interesting topics, which also proves that the sample groups of all five countries are equal.

With all countries a strong negative correlation was found (r = -0.860) among the factors as Human Development Index (HDI, Human Development Report, 2009) and the ACE_{aver}. The similar phenomenon was discovered before, within the 11 countries participating in the ROSE project in 2003 (Gedrovics, Lavonen & Raipulis, 2010). This is in agreement with the above discovered positive correlation between the HDI and general result of international projects as the TIMSS; thus it can be deduced that in countries of low gross national product *per capita* high values cannot be expected (Kangro & Geske, 2001).

In this case the negative correlation was found between the ACE_{aver} and HDI (the higher value the HDI reached, the lower the interest in science was proved).

The analysis continued by classifying the respondents according to their relation to the school natural science education. The results show (Table 4) that in all five countries most respondents belong to the science negationists (Group I, *science negationists*), i.e. from 42.8 % in Brazil to 59.7 % in the Czech Republic.

Table 4 Distribution of Respondents

Country/ Number of Respondents	Typological Groups, per cent			
	I	II	III	IV
Belarus/ 164	48.8	11.6	9.8	29.9
Brazil/ 572	42.8	15.7	14.5	26.9
Czech Republic/ 154	59.7	11.0	14.9	14.3
Latvia/ 287	57.8	9.1	16.4	16.7
Poland/ 141	56.7	6.4	17.7	19.1
Total, N = 1318	663	161	194	300
Per cent	50.3	12.2	14.7	22.8
ACE_{aver} $(1 \leq M_{aver} \leq 4)$	*2.46*	*2.77*	*2.66*	*2.91*

The second most numerous group, the science enthusiasts, was discovered in Belarus (Group IV, *science enthusiasts*, 29.9 %) and Brazil (26.9 %), and the least numerous one in the Czech Republic 14.3 %. The number of respondents also slightly differs in the group of ductiles (Group II, *ductiles*) and choosies (Group III, *choosies*).

Within the final phase with a special module of classification analysis, included in the SPSS programme, the factors defining the ACE_{aver} of the whole research were discovered describing the interest of the research group in natural sciences learning.

The independent variables include *country*, *gender*, *attitude to school natural science* education (typology group). The classification chart is presented in Fig. 1 showing the ACE_{aver} depends mainly on respondents´ affiliation to a certain typology group, i.e. on the respondents´ relation to school natural science education. Within the group of *science negationists* (Group I) the following factor is the respondent's country, in the Group II (*ductiles*) it is the respondent's gender. For the Group IV respondents (*science enthusiasts*), the factor of country follows (the Brazil respondents are included in a special sub-group and other four European countries form another group).

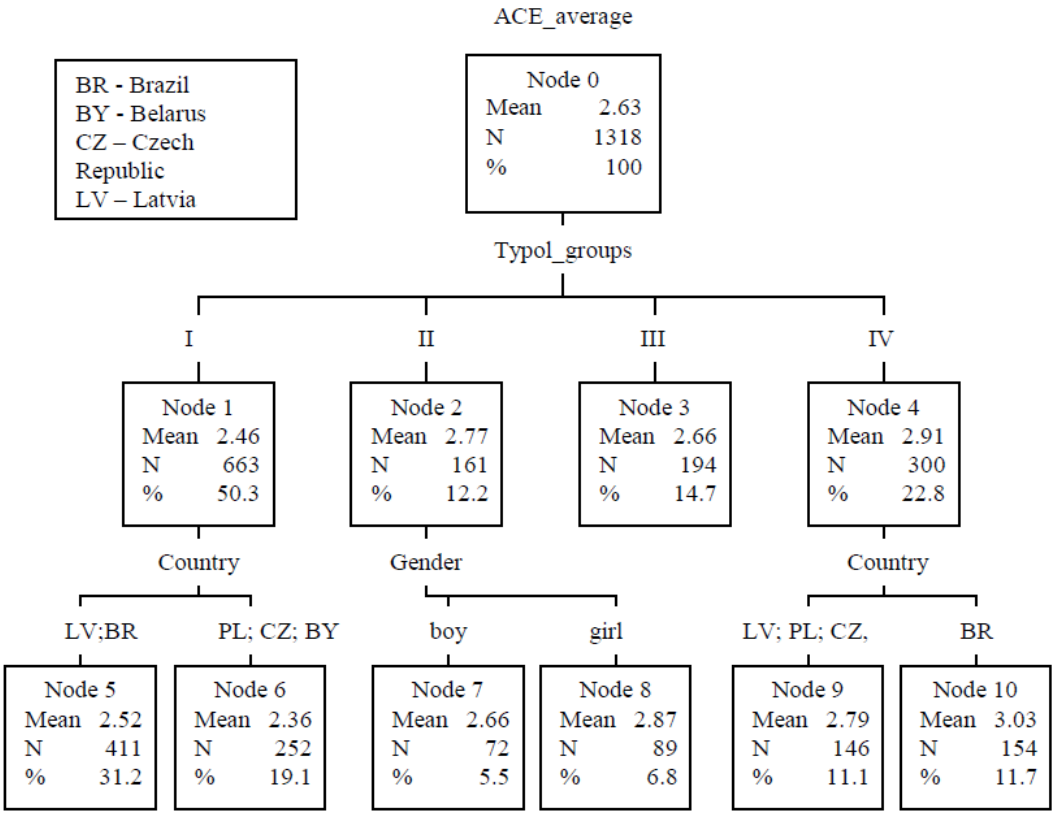

Fig.1 Classification Chart

Thus, we can conclude that the ACE_{aver}, which characterizes the general interest in learning different natural science topics, first - depends on respondents´ relation to school natural science education, second - to the country (except for Group II), followed by the gender criterion. This relates to some special characteristics of natural science education in a single country, but any other similar research of methodological factors was not included.

Discussion

The results of the science topic popularity suggest that in the first round of the research even in the geographically distant countries (South America - Europe) general interests of 15-year-old learners are not identical but they show some similar features. First of all, it is the interest in the *Human biology and health* topic. Second, another group of topics being interested for the respondents are the questions relating to cosmic space. The increased interest was discovered in science-mystery or pseudo-scientific topics, e.g. C10 (*Unsolved mysteries in outer space*), C13 (*Why we dream while we are sleeping, and what the dreams may mean*) and C08 (*The possibility of life outside earth*).

The comparable results are in topics, which respondents are least interested in. First of all, there belong topics from the chemistry field (A02: *Chemicals, their properties and how they react;* A17: *Atoms and molecules;* C01: *How crude oil is converted to other materials, like plastics and textiles*; E26: *Detergents, soaps and how they work*), followed by biology, e.g. A15 (*How plants grow and reproduce*), E01 (*Symmetries and patterns in leaves and flowers*), E25 (*Plants in my area*) and Earth geology, e.g. A03 (*The inside of the earth*) and A04 (*How mountains, rivers and oceans develop and change*).

The unexpected result appeared in the C14 topic (*Ghosts and witches, and whether they may exist*), which either belongs to Top-10 most interesting ones in all the four European countries (except for Belarus: R = 7), or it is considered very interesting one because M_{aver}

>2.50. The Brazilian respondents include it in the Top-10 least interesting ones (R=99; M_{aver} =2.37). This topic is not understood to be a typically science one but very interesting, mainly with girls, their responses exceed the boys´ responses in the statistically significant way (α=0.95).

Another interesting situation is with the C15 topic (*Thought transference, mind-reading, sixth sense, intuition, etc.*), which unlike the previous example C14 can be partly understood as pseudo-scientific, despite it includes fully scientific phenomena but not completely explained on the scientific basis yet. Respondents of all four countries classified this topic in the Top-10 interesting ones (for Czech students M_{aver} =2.99; R=11; Table 2), while the Brazilian respondents do not show much interest in it (M_{aver} =2.75; R=57).

It seems clear that such significant differences in evaluation of European countries and Brazil in the two mentioned examples (C14; C15) would be explained either in national traditions, or partly in their current national educational systems.

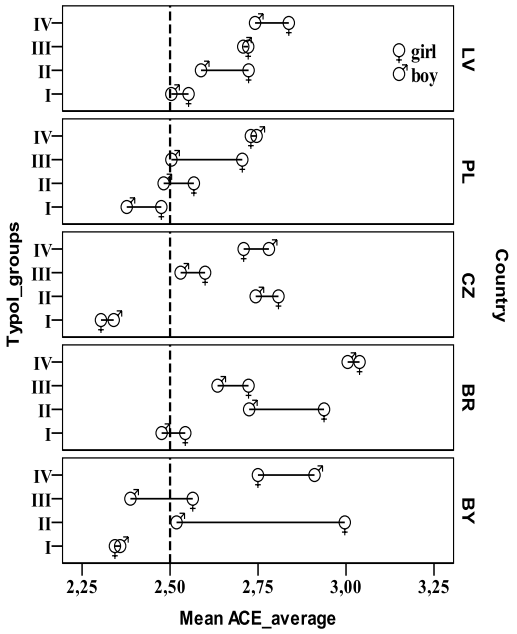

Fig. 2 Distribution of Respondents in the Typology Groups of Gender

Considering the distribution of respondents in typology groups (Table 4) and evaluating the *ACEaver* of 108 topics, it can be concluded that the least interested group in the topics are the *science negationists* (Group I), and the most interested group are the *science enthusiasts* (Group IV). It is interesting that quite strong interest to natural sciences is also shown by the *ductiles* (Group II), i.e. the group, which includes those respondents who consider science not interesting but as it is included in the school curriculum, they all have to learn it (Gedrovics & Lavonen, 2008). This increased interest in science topics was discovered in Czech Republic, Brazil and Belarus, while in Latvia and Poland the interest is slightly higher in comparison to the *science negationists*.

It should be also mentioned that (as usual) only in Group II (*ductiles*) the statistically significant difference was discovered (p<0,001 at α=0,95) in responses of the whole research group within the *ACEaver* for girls ($M_{aver(g)}$ =2,87) and for boys ($M_{aver(b)}$ =2.66); in other typology groups of all countries and each single country the statistically significant difference in this case was not discovered (Fig.1). It indicates that within one typology group no significant difference appears between girls' and boys' and the learners´ interest depends mainly on respondents´ interest in school natural sciences. In this case, particularly with

Brazilian and Belarusian learners the biggest difference in means was discovered namely in Group II, which influenced the statistical significance (Fig.2).

The same figure clearly shows that in decreasing amount of cases the interest in natural science topics with girls is slightly higher than with boys, which is in the contrary (to some extent) to stereotypes on girls´ stronger relation to natural sciences than boys´. The repeated research within the ROSE Project in 2007-2008 in Latvia showed the girls´ interest was increasing, and thus the girls´ and boys´ positions approached to each other (Gedrovics, Mozeika & Cedere, 2010).

In Brazil the project ROSE was not repeated so conclusions cannot be made on changes in single typological groups of respondents within a time period, but such a comparison 2003 – 2008 was made in Latvia, Czech Republic and Poland (Gedrovics et al, 2008). Results were as follows: in 2003 – 2008 the group of *science negationists* (Group I) slightly increased, and consequently the amount decreased in the group of *science enthusiasts* (Group IV), which means the interest in certain topics slightly decreased in all three countries (Latvia, Czech Republic and Poland) in 2003 – 2008, but the difference was not statistically significant.

In another publication (Gedrovics, Cedere, Jeronen, Wareborn & Vasilevskayja, 2012), and included results, partly based on ROSE project and obtained 2010, has found that the number of science negationists (Group I) in Belarus has decreased slightly, while the number of science enthusiasts (Group IV) has been significantly increased. This means that the distribution of typological groups of students in a given country is not strictly defined - it changes over time, but that it is influenced by various factors, including students' attitudes towards school science.

Conclusions

2. The interest in natural science topics in the first lap of the research is similar both in Brazil and European countries, which is partly explained by the similar level of the cognitive development of 15-year-old learners of various countries from one side and certain general methodological principles of science education on the other side.

3. The learners´ interest seems to be influenced by some factors of the historical development of the nation and country, which participate (or not) in the process of developing an interest in some pseudo-scientific topics.

4. The correlation between the general interest in natural science topics and the Human Development Index was supported (similarly as in many research studies based on ROSE); the higher value the index reached, the lower the general interest in the presented set of topics was.

5. The sample of respondents' analysis shows that the group of science negationists is the largest (from 42.8 % in Brazil to 59.7 % in Czech). The science enthusiasts are on the second position (from 14.3 % in Czech to 29.9 % in Belarus). The distribution of typological groups of students in a given country is not strictly defined - it changes over time.

6. The results prove that the comparable interest in natural science topics is found in the group of ductiles, which verifies the hypothesis on the importance of hard work supporting the interest in learning natural science.

7. The results of the classification analysis prove that the crucial factor, which influences the general interest in the field of natural sciences is the respondents´ affiliation with the typological group, which defines their relation to the school natural science education, i.e. to the school natural science subjects.

8. The interest in the comparably large set of science topics can serve as the general indicator of researching learners´ relation to the natural sciences in general.

The knowledge of how and what students think about science, their interests and priorities are essential to a significant education. By this perspective, teachers can plan its classes, authors can plan its textbooks based on evidences, on a reflexive and tailor made way.

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APPENDIX

Theme	Context[1]	Statements
A02[2]	C	*Chemicals, their properties and how they react*
A03	G	*The inside of the Earth*
A04	G	*How mountains, rivers and oceans develop and change*
A05	G	*Clouds, rain and the weather*
A09	HY	Sex and reproduction
A10	HY	*Birth control and contraception*
A15	P	*How plants grow and reproduce*
A17	C	*Atoms and molecules*
A21	S	*How different musical instruments produce different sounds*
A22	U	Black holes, supernovas and other spectacular objects in outer space
A23	U	How meteors, comets or asteroids may cause disasters on earth
A30	C	How the atom bomb functions
A34	UM	How it feels to be weightless in space
A35	UM	*How to find my way and navigate by the stars*
A37	HF	What to eat to keep healthy and fit
A40	HF	How to exercise to keep the body fit and strong
A47	CT	*How petrol and diesel engines work*
C01	CR	*How crude oil is converted to other materials, like plastics and textiles*
C04	ST	How cassette tapes, CDs and DVDs store and play sound and music
C07	T	How computers work
C08	UM	The possibility of life outside earth

C10	UM	Unsolved mysteries in outer space
C11	HM	Life and death and the human soul
C13	HM	Why we dream while we are sleeping, and what the dreams may mean
C14	M	Ghosts and witches, and whether they may exist
C15	HM	Thought transference, mind-reading, sixth sense, intuition, etc
E01	PB	*Symmetries and patterns in leaves and flowers*
E08	HQ	Cancer, what we know and how we can treat it
E09	HQY	Sexually transmitted diseases and how to be protected against them
E10	HQ	How to perform first-aid and use basic medical equipment
E11	HQ	What we know about HIV/AIDS and how to control it
E12	HY	How alcohol and tobacco might affect the body
E13	HY	How different narcotics might affect the body
E17	PR	*How to improve the harvest in gardens and farms*
E19	PW	*Organic and ecological farming without use of pesticides and artificial fertilizers*
E23	HY	How my body grows and matures
E25	PR	*Plants in my area*
E26	CR	*Detergents, soaps and how they work*
E33	WX	*Benefits and possible hazards of modern methods of farming*
E36	X	*Why scientists sometimes disagree*
E37	X	*Famous scientists and their lives*
E42	X	Phenomena that scientists still cannot explain

Notes:

[1]Context'abbreviations: U – Universe, G - Geo science, P – Plants, C – Chemicals, S – Sounds, T – Technology, H – Human biology, Q – Health, F – Fitness, Y – Young body, M – Mystery, B – Beauty, R – Everyday relevance, X – STS (Science and Technology in Society) etc. (Schreiner & Sjøberg, 2004)

[2] Non-popular themes are marked in italic