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Students' Attitude to the Role of Science and Technology in Contemporary Society

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Abstract

Students´ interest and knowledge in the field of natural science and technology provided by the public has been decreased, which can be seen both in the natural science education on the secondary level and in the amount of tertiary education applicants. The article focuses on the evaluation and interpretation of attitudes of the 15-year-old learners from five countries (Latvia, Czech Republic, Poland, Brazil and Belarus) to the role of natural science and technology in the contemporary society. Analyze is based on survey provided by international project ROSE. In all five countries 15-year-old students consider science and technologies significant for the development of their country and society but they are changing their attitude to the role of science and technology in society, which can be seen from the decrease in positive answers; moreover in separate countries the decrease is statistically significant. From the results is evident that improving of learning science can develop a positive attitude to the role of science and technology in society.

Key words: interest, natural science, project ROSE, society, technology.

Introduction

The interest and knowledge in the field of natural science and technology provided by the public have been decreased, as it has been showed by different researchers, f. e. J. Osborne and J. Dillon (2008). It can be seen both in the natural science education on secondary and partly higher education level, which certifies by decreased number of students which choose natural sciences oriented university programs (Dopita, Grecmanová & Chráska, 2008). Results of case studies are available which prove the escalating decrease of participants in natural sciences competitions. The youths and adults understand the science, mainly the natural sciences, to be the field separated from everyday life, results of which are not useful etc. Different researchers has

pointed, that significant part of society prefer pseudoscientific phenomena such as horoscopes, dreams etc., which testifies about low level of science understanding.

One of explanation recommended by researchers and practicians, involved in science didactics is – the public has unsufficient scientific literacy, which has been defined by OECD as *the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity* (What is Scientific Literacy, 2011). On the other hand, a good result for the capacity to use scientific knowledge etc. is possible when every people, both student on different education level and adults understand the role of science, usually accepted only as natural science – biology, chemistry and physics, in and for society. Approximately the same is possible to say about the role of technology, although the concept *scientific literacy* do not include directly the term technology. Therefore it needs to clarify how different peoples understand the role of science and technology in society, as well as is the understanding permanent or variable, and which factors affect the understanding of role of science and technology in and for society.

Methodology of research

One of possible alternative to get answers on the above mentioned questions is to use results, obtained by researchers, involved in the international comparative project *The Relevance of Science Education* (ROSE; see Schreiner & Sjøberg, 2004), which deals with 15 y.o. students.

As regards Latvia, the Czech Republic and Poland, the questionnaire data obtained during a repeated (autumn 2007 – early 2008) ROSE pilot-research, whereas in the two remaining countries these are first research data (Brazil – 2007, Belarus – 2009). The distribution of respondents by gender is presented in Table 1, and according it girls being in a small majority, except in Belarus.

Table 1

Distribution of respondents

	Latvia		Poland		Czech Republic		Brazil		Belarus	
	N	**Per cent**	**N**	**Per cent**	**N**	**Per cent**	**N**	**Per cent**	**N**	**Per cent**
Girls	383	51.5	76	53,9	80	51,3	358	54,9	81	49,4
Boys	358	49,7	65	46,1	76	48,7	294	45,1	83	50,6

The scientific instrument of the ROSE project is a questionnaire containing 250 statements arranged in 10 sections (items), one of which (Item G, 16 statements, see Appendix) is devoted to students' attitude towards the role of science and technology in society. Respondents had to provide their answers using the 4 category *Likert* scale in the range from *do not agree* to *agree*. Encoding the data into the range from 1 to 4, which was necessary for computerised processing, actually provides us with a pseudo interval scale. Regardless several disadvantages of the Likert scale, it is fully applicable to analysing trends in responses, which has been stated by several researchers from different countries (Teppo, 2004; Schreiner, 2006; Bilek, Radkova & Gedrovics, 2006;

Holsterman & Bögeholz, 2007; Jidesjö, Oscarsson, Karlsson & Strömdahl, 2009). Unfortunately the majority of researchers has analysed different other parts of ROSE project, but the Item G has been analysed relatively less (Schreiner, 2006; Sjøberg & Schreiner, 2006; Matthews, 2007).

The evaluation is based on comparing the average mean values ($1 \leq M_{aver} \leq 4$): in case of $M_{aver} \leq 2.5$ we can conclude that the particular group of respondents does not agree to the particular statement, while at $M_{aver} > 2.5$ the overall trend reveals that respondents agree to the particular statement. Hereby the conclusion that the closer the average mean is to the possible (theoretically) maximum, i.e. $M_{aver} = 4$, the more positive respondents are about the particular statement and science and technology in general.

The questionnaires were also analysed in gender context. The questionnaires were processed by means of the 12.0.1. version of SPSS program, and Microsoft EXCEL (Version 7).

Results of research

The average values (M_{aver}) are reflected in Fig.1, revealing that respondents from these five countries hold surprisingly similar views. For instance, all respondents actually agree that science and technology are significant for society development (G01, *Science and technology are important for society*; $M_{aver} > 2.5$). Equally high results ($M_{aver} > 2.5$) are reached regarding statements G02 – G05, G11 – G12 and G16, and most respondents have evaluated those positively.

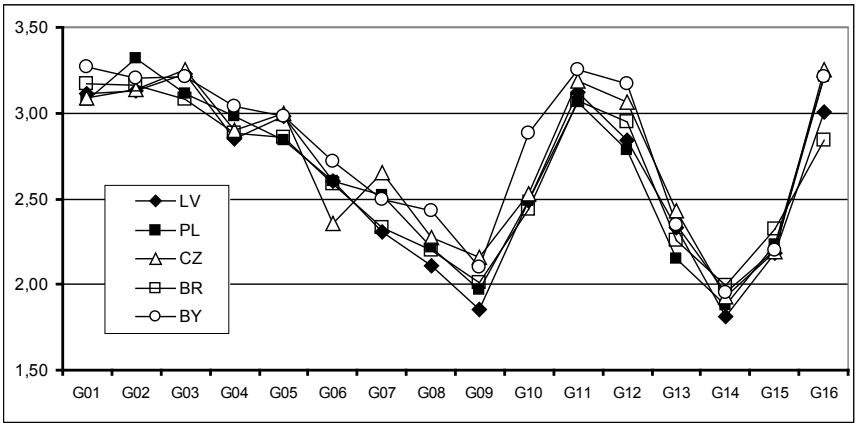

Fig. 1. **Average mean values ($1 \leq M_{aver} \leq 4$) for different statements G01 – G16**

LV – Latvia, PL – Poland, CZ – Czech Republic, BR – Brazil, BY – Belarus

Less agreement is reached regarding such statements like G06 (*The benefits of science are greater than the harmful effects it could have*) – $M_{aver} < 2.5$ in Latvia and Brazil, G07 (*Science and technology will help to eradicate poverty and famine in the world*) – $M_{aver} < 2.5$ in Poland and the Czech Republic, as well as G10 (*Science and technology are the cause of the environmental problems*) with $M_{aver} < 2.5$ only in the Czech Republic and Belarus.

Table 2

Gender related average mean values ($1 \leq M_{aver} \leq 4$)

Items	Latvia		Poland		Czech Republic		Brazil		Belarus	
	girls	boys	girls	boys	girls	boys	girls	boys	girls	boys
G01	3.13	3.10*	3.05	3.09*	3.05	3.14*	3.12	3.24*	3.25	3.30*
G02	3.28	2.98[3]	3.55	3.05[2]	3.19	3.08*	3.14	3.18*	3.24	3.16*
G03	3.31	3.14[1]	3.20	3.00*	3.16	3.35*	3.06	3.11*	3.19	3.23*
G04	2.88	2.82*	3.04	2.91*	2.75	3.05[1]	2.83	2.94*	2.97	3.10*
G05	2.98	2.99*	2.76	2.94*	2.88	3.12*	2.77	2.98[2]	2.94	3.02*
G06	2.59	2.61*	2.51	2.69*	2.24	2.49*	2.57	2.60*	2.53	2.90[1]
G07	2.16	2.47[3]	2.41	2.65*	2.54	2.76*	2.25	2.41*	2.36	2.63*
G08	1.99	2.23[3]	2.09	2.38*	2.13	2.41*	2.17	2.22*	2.32	2.54*
G09	1.74	1.97[3]	1.93	2.02*	2.10	2.22*	1.97	2.05*	2.04	2.17*
G10	2.49	2.48*	2.55	2.43*	2.58	2.47*	2.38	2.50*	2.82	2.93*
G11	3.12	3.11*	2.97	3.15*	3.17	3.21*	3.00	3.14*	3.10	3.39[1]
G12	2.81	2.87*	2.79	2.77*	2.89	3.23[1]	2.89	3.00*	3.18	3.17*
G13	2.23	2.42[2]	2.31	1.97[1]	2.34	2.53*	2.22	2.30*	2.46	2.24*
G14	1.65	1.97[3]	1.95	1.80*	1.87	2.00*	2.01	1.97*	1.96	1.94*
G15	2.12	2.25*	2.25	2.20*	2.22	2.15*	2.31	2.33*	2.17	2.23*
G16	3.07	2.95*	3.30	3.09*	3.20	3.31*	2.86	2.81*	3.17	3.25*

*Note: * non-significant difference for gender; [1]$p<0.05$; [2]$p<0.01$; [3]$p<0.001$*

There are also statements (G08, G09, G13-G15) mostly denied by respondents in all five countries: $M_{aver} < 2.5$. However, those negative evaluations only prove the general trend – young people in the five countries are close in their views regarding a variety of science and technology issues.

The analysis of answers in gender context has revealed (Table 2) that girls and boys often replied similarly and statistically significant differences can be noted only for separate statements. However, there is no statement that would produce statistically significant differences between girls and boys' answers in all five countries.

Discussion

The analysis of questionnaires reveals that 15-year-olds from various countries have an overall positive attitude towards the role of science and technology in society and their significance for the development of the state (G11). Youths are convinced that improvement in those spheres will allow us to fight such currently incurable diseases as HIV/AIDS and cancer (G02), that future generations will have more opportunities (G03) and that *Science and technology make our lives healthier, easier and more comfortable* (G04). Adolescents are obviously well able to evaluate the advantages of modern technologies; therefore they believe that *New technologies will make work more interesting* (G05). At the same time students are fully aware that neither science nor technology is able to solve every problem (G08). The overall conclusion would be that students from Latvia, the Czech Republic, Poland, Belarus, and Brazil are generally positive about the role of science and technology in society, as related to all countries involved in the ROSE project (Sjøberg & Schreiner, 2010).

Of course, in different statements the difference between girls' and boys' results (assessment) are statistically significant (Table 2), and it must be taken into account, especially by teaching separate scientific problems and discrete phenomena.

Comparing these results with the ones provided by other similar studies carried out in Europe during the last decade (Eurobarometer 55.2/ Europeans, Science and Technology, 2001; Europeans, Science and Technology, 2005; Qualitative Study..., 2008; Science and Technology, 2010), we can conclude that the 15-years-old students-participants of the ROSE project mostly correspond to those obtained from respondents of various ages during EUROBAROMETER questionnaires.

For several other ROSE questionnaire statements that are close in content to questions included in EUROBAROMETER questionnaire, there is a good correspondence to average results in Europe. This means that the opinion of 15-year-olds can well represent the general views on science and technology in a particular country. Meanwhile the year 2010 EUROBAROMETER research claims that, regarding many aspects, positive attitudes tend to decrease (Science and Technology/ Report, 2010), which might mean a change in views on science and technologies.

However, it is most surprising that young girls and boys so often would produce similar answers, considering the fact that students' attitude to science in general is clearly defined as gender related (Jones, Howe & Rua, 2000). Such similarity has been stated in about 40 countries, participated in ROSE project, by S. Sjøberg and C. Schreiner, (Sjøberg & Schreiner, 2006). Probably such assumption is based in dominant public opinions far more than in students' own experience at school and home, which respondents might not relate to their successes and failures at school science classes. As a result students' answers to several statements are influenced by such external factors. Besides the ROSE project does not provide us with detailed information on how well each 15-year-old is able to independently judge such issues as, for example, *Scientists are neutral and objective* (G15) and *Scientists follow the scientific method that always leads them to correct answers* (G13), and to what degree their answers to those statements have been affected by external factors. This phenomena needs to be studied more exactly.

The dominant public opinions are revealed by responses to statement G10 – *Science and technology are the cause of the environmental problems*. Regardless the grain of truth in this sentence, we should not forget that science and technologies themselves cannot be the cause of environmental problems. The cause sooner lies in insufficient understanding of scientific and technological ideas, or, equally important – in disregarding scientific and technological recommendations. The statement is generally agreed to only by Belarusian youths (M_{aver} = 2.88) and partly by the Czech students (M_{aver} = 2.53), although in the remaining countries respondents also, at least partly, agree to it – the average mean values are formally below M_{aver} = 2.50, but they still remain close to the neutral value (M_{aver} = 2.38 – 2.58) except girls and boys from Belarus (Table 2).

While teaching the basics of science, that could affect students' choice of their future career, we should, among other things, develop a positive attitude towards the role of science and technologies in society. Therefore, while covering science material in class, teachers have to pay attention to how their students view various science and technology issues. Even if students' ideas seem wrong, or, like in case with statements

G10, G12 etc. – respondents experience objective difficulties providing an answer due to their, perhaps, insufficient knowledge or skills. The teacher then must explain the essence of the problem and try to reveal possible solutions, as well as show how to objectively analyse similar problems. Such an approach will not only facilitate students' better understanding of science but also help in developing a more positive attitude towards the role of science technology in our modern society.

Conclusions

1. In all five countries 15-year-old students consider science and technology as significant factors for the development of their country and society.
2. Respondents' views on various science and technology aspects are generally quite similar, and often are not gender related.
3. Just like society in general, 15-year-old students are changing their attitude to the role of science and technology in society, which can be seen from the decrease in positive answers; moreover in separate countries the decrease is statistically significant.
4. Along with learning science, which helps in acquiring knowledge in the context of future career choices, students also can develop a positive attitude to the role of science and technology in society.

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APPENDIX

Items	Statements
G01	Science and technology are important for society
G02	Science and technology will find cures to diseases such as HIV/AIDS. cancer etc.
G03	Thanks to science and technology. there will be greater opportunities for future generations
G04	Science and technology make our lives healthier. easier and more comfortable
G05	New technologies will make work more interesting
G06	The benefits of science are greater than the harmful effects it could have
G07	Science and technology will help to eradicate poverty and famine in the world
G08	Science and technology can solve nearly all problems
G09	Science and technology are helping the poor
G10	Science and technology are the cause of the environmental problems
G11	A country needs science and technology to become developed
G12	Science and technology benefit mainly the developed countries
G13	Scientists follow the scientific method that always leads them to correct answers
G14	We should always trust what scientists have to say
G15	Scientists are neutral and objective
G16	Scientific theories develop and change all the time