The Investigation of Czech Lower Secondary School Pupils Toward Science Subjects

Milan Kubiatko

Institute for Research in School Education,
Masaryk University, Brno,Czech Republic

Abstract

The contribution is focused on the investigation of the Czech lower secondary school pupils toward science subjects (biology, chemistry, physics and geography). The curriculum of the Czech Republic included these subjects in the group call "Man and Nature". The published studies showed, the pupils' attitudes toward science subjects are relatively negative. This kind of subjects belongs among the least favorite. The physics and chemistry ranked very often at as the least favorite. In or study was the questionnaire with 25 Likert type items used. Only for the subject geography was used 27 items. It is due to the position of geography, this subject is standing between science and social subjects, so the character of several items was different from the items for other science subjects. The construct validity was established by factor analysis, which divided items into 4 (geography, chemistry and physics) or 3 (biology) dimensions. The dimension are not homogenous, some items are in other dimension in one subject and in other dimension in second subject. The pupils perceived the biology as the most positive and chemistry and physics are perceived as the least favorite subjects. The conclusion contains implications for further research.

Keywords: *Attitudes, lower secondary school pupils, questionnaire, science subjects*

Introduction

The Czech educational system in the last twenty years passed through some changes. The last one included the science subjects in the group called "Man and Nature".   The science subjects incorporated in this group are biology, chemistry, geography and physics. The biology, geography and physics are taught all 4 years of lower secondary education (level ISCED II) in the Czech Republic. The chemistry is taught only two years. In the Czech Republic (also in other countries) is the decreasing interest about science subjects. The government knows about this situation, but its answer is only increasing of subsidy for the teaching of foreign languages and decreasing of teaching hours for science subjects. So it can cause big damages, because science is an important component of the cultural heritage of every country. It provides the most important explanations we have of the material world. In addition, some understanding of the practices and processes of science is essential to engage with many of the issues confronting contemporary society.

There are many investigations, which are focusing on the problematic of the perceptions of the science subjects. Some researchers are evaluating science subject in general view, and some are evaluating separately biology, chemistry, physics and geography. It is nonsense to write about every of study and their results, so below are presented only the results of the most important investigations. The problematic of attitudes of learners toward science is important for investigators for a relatively long time. As Osborne et al (2003) stated the attitudes toward science subjects are decreasing. These authors used data from the other investigators. The original results say about the same problem – attitudes toward science are decreasing. For instance, Hendley, Parkinson, Stables,

and Tanner's (1995) study of 4023 Key Stage 3 pupils in Welsh schools uses overall means obtained from a Likert questionnaire. Their findings show that, out of the four core subjects – science, English, mathematics and technology – science is the least popular. This view of science is confirmed by a smaller scale qualitative study based on interviews with 190 pupils (Hendley, Stables, and Stables 1996). When asked which three subjects they liked best, science was ranked fifth out of 12 subjects. However, this contrasts strongly with the response to the question 'Which three subjects do you like least?', where science emerged as the most disliked subject and, interestingly, least preferred by boys. Hendley, et al. concludes that science is a 'love–hate' subject that elicits strong feelings in pupils. Other recent research into subject preference has been conducted by Colley, Comber, and Hargreaves (1994), who found that there were significant gender differences among 11-year-old to 13-year-old pupils with girls favoring English and humanities, and boys favoring science. It was brief view on the science subjects overall. But there is amount of studies focusing on the individual science subjects. For instance Trumper (2006) investigated attitudes of Israeli students toward biology and he found out relatively positive attitudes toward this subject. The next analysis was focused on the comparison of boys and girls, girls achieved higher score in comparison with boys. Prokop, Tuncer and Kvasnicak (2007) investigated the effect of field program on students' attitudes toward biology. Authors found out positive increase of attitudes toward biology after the field program. Moreover, students displayed better understanding concepts like ecosystems and food webs. In the next study Zeidan (2010) investigated the attitudes toward biology and perceptions of the biology learning environment among grade 11 students in the cities and villages in the Palestine. These data were used to determine whether there were significant differences in and interactions between the attitudes toward biology and perceptions of the classroom learning environment for students of different genders and residency. Furthermore, it analyzed the relationship between the attitudes toward biology and perceptions of the biology learning environment. The students expressed positive attitudes toward biology. There were no significant difference between residence and females had got positive attitudes toward biology in comparison with boys. The attitudes toward chemistry was investigated for instance by Cheung (2009). The purpose of his quantitative study was to examine the interaction effect between grade level and gender with respect to students' attitudes toward chemistry lessons taught in secondary schools. Salta and Tzougraki (2004) investigated 11th grade Greek students' attitudes regarding the difficulty, the interest, the usefulness of chemistry course, and the importance of chemistry. Gender and study specialization differences in students' attitudes toward chemistry were examined for this population. Report card grades for the chemistry course were used to measure students' achievement in chemistry and its correlation with students' attitudes toward chemistry was explored. Students at 11th grade in Greek high schools consider the chemistry course neither difficult nor easy. The students' attitudes regarding the interest of chemistry course are also neutral. Although there are no differences between boys' and girls' attitudes regarding the interest, usefulness, and importance of chemistry, girls, more than boys, tend to express negative attitudes regarding the difficulty of chemistry courses. Our study suggests that the correlation between attitudes toward chemistry and achievement in chemistry is low up to moderate. The correlation was stronger between difficulty and achievement, indicating that a positive attitude regarding difficulty of chemistry course is more necessary for students in achieving high scores.

The investigation of pupils' attitudes toward physics was realized by Stefan and Ciomos (2010). The sample size was created by Italian pupils, who considered physics for demanding, but on the other the physics is perceived as interesting subject. Authors found out, that the most important factor, which is influencing the attitudes toward physics, is a teacher. The similar result was presented in the study of Angell et al. (2004).

The attitudes toward geography are investigated at least with comparison of other science subjects. Brook (1977) examined the general attitudes towards geography held by ninth and tenth grade students and college students. Education level, gender, and students' individual conceptualizations of geography were examined as possible influences on their attitudes towards geography. The results were not significant among independent variables. Detailed results showed that the youngest students in this case ninth grade) had better attitudes towards geography in comparison with the older ones (tenth grade and college students). The influence of grade level was also investigated from fourth grade to sixth grade in the study of Sack and Petersen (1998) who found a decreasing interest in geography the higher the grade level of respondents. The same authors examined gender differences in attitudes towards geography and found that boys had more positive attitudes towards geography in comparison with girls.

On the previous lines was provided the brief possibilities of the investigation of attitudes toward science subject. Some of the subjects (biology, chemistry, physics) are investigated in higher level in comparison with geography. On the majority of cases is used quantitative approach with the Likert type questionnaires as the main research tool. In the some cases is used interview.

Methodology

The number of respondents participated on the investigation of attitudes toward physics was 390, toward biology it was 496, toward geography it was 540 and toward chemistry it was 379. The selection of respondents was random. All of participants attended lower secondary schools, where the style of teaching was conventional without any alternative methods incorporated into teaching process.

The research tool was the questionnaire contained 25 Likert type items with five possibilities (strongly disagree – slightly disagree – not disagree/ not agree – slightly agree – strongly agree). There was the effort to use similar questionnaire for all science subject. The specific position of the geography (somewhere between social and science subjects) compelled authors to use different items in the questionnaire.

The questionnaire for geography was dividing into four parts (1. Geography as a school subject; 2. Geography and the environment; 3. Importance of geography; 4. Relevance of geography for pupils life). The chemistry and physics questionnaire was also divided into four parts (1. Interest about chemitry/physics; 2. Relevance of chemistry/physics; 3. Future life and chemistry/physics; 4. Chemical/Physically experiments). The biology items was distributed into 3 dimensions (1. Interest about biology; 2. Relevance of biology; 3. Biological experiments). The items from category "Future life and <subject>" were in this case incorporated into category "Relevance of biology".

Copies of the questionnaire were administered Czech lower secondary schools. Students were informed that the questionnaire was anonymous and that it was not a test but rather a research attempt to explore attitudes towards geography. Administering of the questionnaires was random. No time limit was given for the finalization of the questionnaire, but the longest time taken to complete it was approximately twenty minutes. The distribution of the questionnaires was done by researchers themselves or by teachers who were instructed about its distribution.

Analysis of data

The obtained data were coded into numbers following: strongly disagree – 1; slightly disagree – 2; not disagree/not agree – 3; slightly agree – 4; strongly agree – 5. It was valid for positive items, the

negative items were coded reversely. The total score of individual participants provides a composite index of attitudes towards geography. A low score reflects a relatively negative attitude and a high score reflects a relatively positive attitude toward individual science subjects. The score between <2.75, 3.25> indicated neutral attitude toward subjects.

The acquired data was subsequently processed with factor analysis with Varimax rotation and factors/areas/dimensions with eigenvalues greater than 1.0 were derived.

The reliability of the questionnaire was calculated using Cronbach's alpha coefficient. The values of reliability were high for every questionnaire (α = 0.86 – 0.89). These values indicated acceptable reliability of the questionnaire (Nunnaly 1978). The high value of reliability coefficient in our study implies that the instruments used for investigation of students' attitudes towards science subjects are reliable and its usage for further analysis is appropriate.

The analysis of obtained data was following. There was used percentage evaluation in the analysis of items. The descriptive statistical methods (mean score, standard deviation) was used due the determination of perception of the science subjects, if the attitudes toward them are positive, negative or neutral. The inductive statistic (ANOVA, t-test, Pearson product moment) was used for the determination of significant differences (between boys and girls, …) and to determine the strength of the relationship. The multidimensional statistics (factor analysis, Cronbachs alpha) are presented above, their main using was into the determination of validity and reliability.

Findings

In this chapter we introduce some basic results of the analysis of attitudes toward science subjects. On the figure 1 are shown the values of score for the individual subjects. The highest score achieved biology (x = 3.45) and the lowest one chemistry (x = 3.27). There is possible to observe two interesting aspects. First of them is, the all subjects are perceived positively, although the chemistry and physics achieved boundary values, but the value are still positive. Second thing, the biology is perceived by lower secondary school pupils the most positive from all subjects. The chemistry is the worst evaluated subject in the tight sequence with physics.

***Figure 1** The mean score for the individual subjects.*
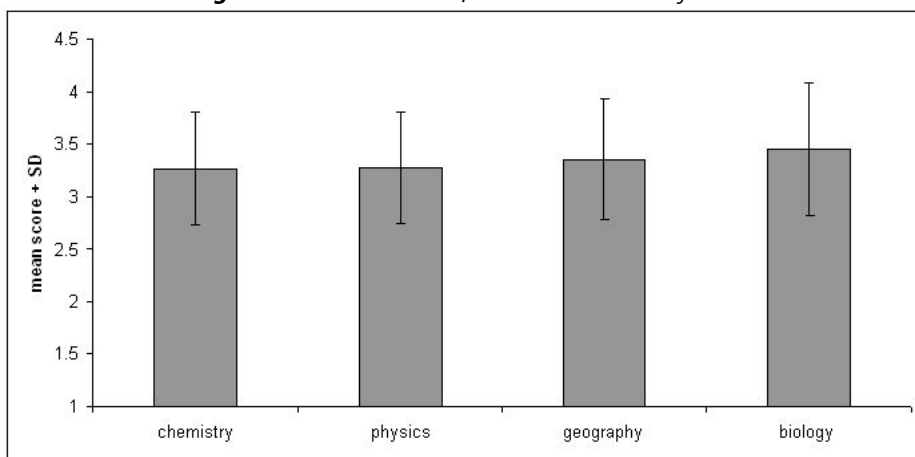
The next analyses are focused on the evaluation of the dimension, which was created by factor analysis. There are necessary three different approaches. The first approach is to evaluate only geography, because this subject is placed little bit different in comparison with other science subjects. As it is possible to observe on the figure 2 the dimension "The Relevance of geography for pupils life" was evaluated the most positive. Also the category "Geography and the environment" was evaluated positive. Other two categories was evaluated as negative.

Figure 2 The mean score of the dimensions regarding to geography
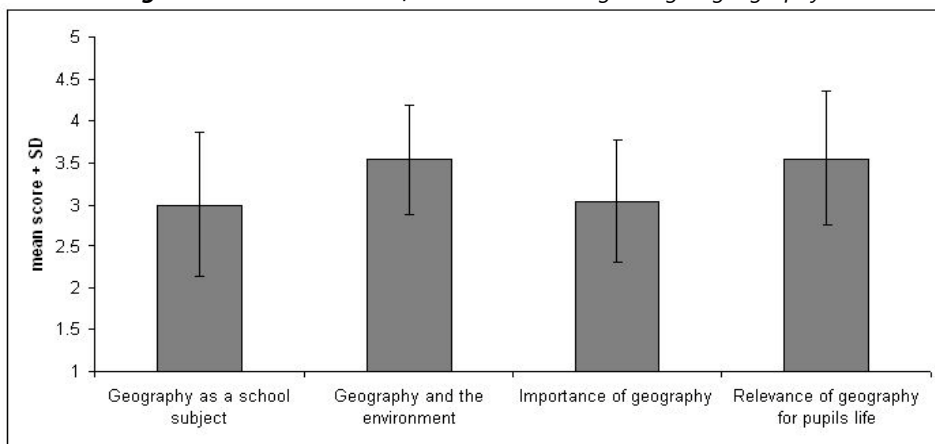

The next approach is to evaluate physics and chemistry dimension together, because the factor analysis divided items into these dimensions. However further analysis is little bit problematic, because the items in the dimensions are not similar. For example in the first dimension "Interest about <subject>" 8 chemical items, but 10 physical items. We can see, that as in "geography" the dimension "Relevance of <subject>" was evaluated the most positive. The lowest score was found out in the dimension "Future life and <subject>".

Figure 3 The mean score of the dimensions regarding to chemistry and physics
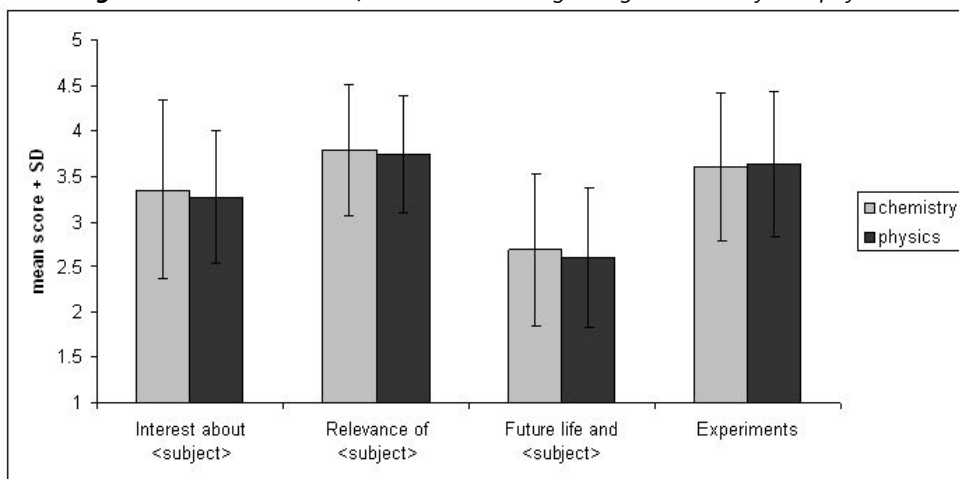
The last approach is to evaluated dimension regarding to biology. This subject is evaluated separately due the fact, the items regarding to biology was divided into three dimensions. As we can see on the figure 4 all dimension regarding to biology was evaluated positive. The most positive was evaluated the category "Experiments" and as in the previous subjects the lowest score pupils achieved in the category "Interest".

Figure 4 *The mean score of the dimensions regarding to biology*
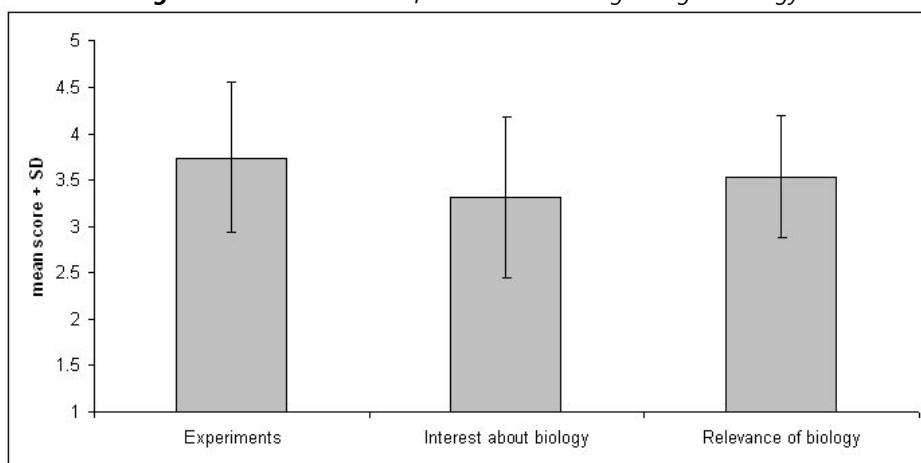
Conclusion

In this contribution were delineated the basic results of the Czech lower secondary school pupils toward science subjects. In the conditions of the Czech Republic are biology, chemistry, physics and geography included among science subject in the group called "Man and Nature". In the contribution we provided the basic literature review. In this part of the text are described basic studies, which are focused on the problematic of science subjects' attitudes. Our contribution is, that in the region of Czech Republic was not realized study of this character. The methodology and results part is focused on the description of the sample size, the description of the instrument tool, which was used for the finding of attitudes toward science subjects. The attention is devoted to description of the data analysis, mainly the using of factor analysis, which divided items into dimension. The results described the basic findings, the overall attitudes toward science subjects and the distribution of score among dimension.

There are many possibilities how to evaluate data, one of this is find out the influence of demographic variables like gender or year of study on pupils attitudes toward science, next to find out relationship among dimensions.

This contribution presented only basic results, the more detailed information about this kind of research could be consulted on the conference,

References

Angell, C., Guttersrud, Ø., Henriksen, E. K., & Isnes, A. (2004). Physics: Frightful, but fun, Pupils' and teachers' views of physics and physics teaching. Science Education, 88(5), 683-706.

Brook, D. L. (1977). Students' attitudes towards geography. Journal of Social Studies Research 1(2), 60-69.

Cheung, D. (2009). Students' attitudes toward chemistry lessons: the interaction effect between grade level and gender. Research in Science Education, 39(1), 75-91.

Colley, A., Comber, C., & Hargreaves, D. J. (1994). School subject preferences of pupils in single-sex and coeducational secondary schools. Educational Studies, 20(3), 379-385.

Hendley, D., Parkinson, J., Stables, A., & Tanner,H. (1995),Gender Differences in Pupil. Educational Studies,Vol 21(1), 85-97.

Hendley, D., Stables, S., & Stables, A. (1996). Pupils' subject preferences at Key Stage 3 in South Wales. Educational Studies, 22(2), 177-187.

Nunally, J. C. (1978). Psychometric Theory. New York: McGraw-Hill.

Osborne, J. F., Simon, S., & Collins, S. (2003). Attitudes towards Science: A Review of the Literature and its Implications. International Journal of Science Education, 25(9), 1049-1079.

Prokop, P., Tuncer, G., & Kvasničák, R. (2007). Short-term effects of field programme on students' knowledge and attitude toward biology: a Slovak experience. Journal of Science Education & Technology, 16(3), 247-255.

Sack, D., & J. F. Petersen. (1998). Children's attitudes toward geography: A Texas case study. Journal of Geography, 97(3), 123-131.

Salta, K., & Tzougraki, C. (2004). Attitudes toward Chemistry among 11th grade Students in high schools in Greece. Science Education, 88(4), 535-547.

Stefan, M., & Ciomos, F. (2010). The 8th and 9th gradegrades students atttitude towards teaching and learning physics. Acta Didactica Napocensia, 3(3), 7-14.

Trumper, R. (2006). Factors affecting, junior high school students' interest in biology. Science Education International, 17(1), 31-48.

Zeidan A (2010). The Relationship between grade 11 Palestinian attitudes toward biology and their perceptions of the biology learning environment. International Journal of Science and Mathematics Education, 8(5), 783-800.