

Slovakian Students' Attitudes toward Biology

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Students' attitudes toward science significantly alter their achievement in science. Therefore, identification and influence of attitudes became to be an essential part of educational research. This study has been initiated by the idea that; research in students' attitudes toward science often involves science in general, but particular disciplines like biology or chemistry have been overlooked. Thus, this study is about Slovak students' attitude toward biology through six dimensions; interest, career, importance, teacher, equipment and difficulty. The study used a 30-item Biology Attitude Questionnaire (BAQ) to measure students' attitudes toward biology education. The data were obtained from 655 secondary school students attending eight typical elementary schools in Slovakia. Multivariate analysis of covariance (MANCOVA) revealed a negative effect of age whereas the effect of gender was not significant. Univariate results, on the other hand, indicated that there is a significant interaction of students' interest in relation with grade and gender. One of the findings of the study is that, students' attitude toward biology teacher is strongly affected by teacher identity. This can be taken as a hint for future research. That effect of teacher should be included as a parameter to be considered for the studies related to student attitude.

Keywords: Learning Attitude, Biology Education, Student, Slovakia

INTRODUCTION

The quality of education that teachers provide to student is highly dependent upon what teachers do in the classroom. Thus, in preparing the students of today to become successful individuals of tomorrow, science and mathematics teachers need to ensure that their teaching is effective. Teachers should have the knowledge of how students learn science and mathematics and how best to teach. Changing the way we teach and what we teach in science and mathematics

is a continuing professional concern. Efforts should be taken now to direct the presentation of science and mathematics lessons away from the traditional methods to a more student centered approach.

Understanding of students' attitudes is important in supporting their achievement and interest toward a particular discipline. Students' attitudes toward science have been extensively studied (Dhindsa & Chung, 2003; Osborne, Simon, & Collins, 2003), but research was initially focussed greatly on science in general (Dawson, 2000) and less attention was addressed to particular disciplines like biology, physics or chemistry (Salta & Tzougraki, 2004). This can partly camouflage students' attitudes because science is not viewed as homogeneous subject (Spall et al., 2003).

In general, students' attitudes toward science decrease with age (reviewed by Ramsden, 1998; Osborne, Simon, & Collins, 2003), boys show more

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positive attitudes toward science than girls (Simpson & Oliver, 1985; Schibeci & Riley, 1986; O'Brien & Porter, 1994; Francis & Greer, 1999) and more negative attitudes are associated with the physical sciences rather than biological sciences (e.g. Spall, Barrett, Stanisstreet, Dickson & Boyes, 2003; Spall, Stanisstreet, Dickson & Boyes 2004). Keeves and Kotte (1992) and Jones, Howe and Rua (2000) showed that, unlike chemistry or physics, girls showed more positive attitudes toward biology than boys. Dawson (2000) was comparing changes in Australian students' interests and attitudes over 20 years reported that, girls' preferences in biology lead in human biology and general biology, but boys were greatly interested in earth sciences. Current study of Baram-Tsabari and Yarden (2005) using method of children's spontaneous questions found that children's interest in human biology increases with age relative to the interest in zoology which showed opposite tendency. Except gender differences, research on UK students' (aged 11 – 16) attitudes showed that attitudes toward biology exhibit different age-related patterns than attitudes toward physics (Spall et al., 2004). Attitudes toward physics became more negative as age of students increases, relative to more positive attitudes toward biology (Spall et al., 2004). In contrast, Stark and Gray (1999) in a large sample of Scottish students found that boys' preferences for science topics shifted from biologically oriented to physics as the age of students increases, while girls' preference for biological topics were less affected by age and relative high. This means that research in biology would explore different patterns in attitudes related with gender and/or age than other science courses. All factors reported above including basic factors such as such as effects of teacher, parents or environment (George & Kaplan, 1998; Haladyna & Shaughnessy, 1982) would affect students' attitudes toward biology. However, the effect of teacher is disputable; while Gardner (1975) reported evidence that curriculum and teacher effects on attitudes were slight, other studies suggest that students' attitudes are quite malleable, and that individual teachers can have a major effect on both overall science interests and on more specific topic related ones (Bottomley & Ormerod, 1981; Kelly, 1988). This area, however, still received less attention.

In the present study, we examined Slovak students' attitudes toward biology. Biology as a school subject is traditionally separate from other science courses in Slovakia. This study differs from the other research on students' attitudes (e.g. Stark & Gey 1999; Dhindsa & Chung 2003) in that it examines students' attitudes toward biology, not toward science in general. In addition, there is no study that examines students' attitude toward biology in Slovakia either in national or international level. Thus, this is the first study which examined students' attitude toward biology in Slovakia.

Moreover, another feature of this study is that, it promises to fill one of the gaps in the area related to comparing students' attitudes with respect to curricular differences and grades. Therefore, this is a cross-age study of attitudinal changes with respect to learning content between grades 5 – 9 and it contributes to deeper understanding in this area in the related literature.

Purpose of Research

This study was conducted to examine Slovak students' attitudes toward biology with respect to age and gender. The study focuses on the following questions:

1. What are Slovak students' attitudes toward biology lessons?
2. Is there any difference between the mean scores of boys and girls on the six dimensions of the biology attitude questionnaire?
3. Is there any difference between the mean scores of students' of different age classes (or grade levels) on the six dimensions of the biology attitude questionnaire?
4. What implications for biology education can be derived from the results of the study?

METHOD

The study was realized with the elementary school students attending 5th – to – 9th grades. In parallel with the applications in Slovakia, they are attending courses of several fields in biology; the students concentrate on a particular topic in different grades (see Table 1 for more details). This allowed us to evaluate gender differences in particular topics and examine the effect of students' age on attitudinal changes.

Respondents

The data for the current study were obtained from 655 secondary school students (n = 321 girls; 334 boys) attending eight typical elementary schools in Slovakia. Schools were selected from three different regions (all in western Slovakia), expressing similar socioeconomic status. Mean age of the students was 12.99 year. Detailed information about grades and number of students is presented in the Table 1.

Instrument

A 30-item Biology Attitude Questionnaire (BAQ) was used to measure students' attitudes toward biology education (Appendix A). The questionnaire was prepared based on the conditions in Slovakia and according to the related research (Salta & Tzougraki,

2004; Spall et al., 2004). The questionnaire has been prepared according to the biology education application in Slovakia. Thus, the items of the questionnaire reflect the particular topics that students concentrate on different grades. Accordingly, items in the instrument were divided into six dimensions as;

1. Students' interest toward biology lessons (Interest)
2. Students' attitude on the importance of biology for their future career (Career)
3. Students' attitude on the importance of biology lessons (Importance)
4. Students' attitude toward biology teacher (Teacher)
5. Students' attitude toward difficulty of biology lessons (Difficulty)
6. Students' attitude on the use of biology equipment in biology lessons (Equipment)

The questionnaire was independently revised by three biology teachers in order to maintain validity. Selected items were then attached to a five-point Likert scale; ranging from "strongly disagree" to "strongly agree" with "neither disagree nor agree" as the pivotal point of the scale. Positive items were scored from 1 to 5, from "strongly disagree" to "strongly agree," respectively, while negative items were scored in the reverse order.

Analysis

Factorial analysis had been utilized in order to examine the correlation between the items of each dimension. As a result, items revealing low correlation had been excluded. Excluded items were the ones from those dimensions titled, "Teacher", "Equipment" and "Difficulty". Reliability of the remaining 24 items was calculated by means of two different techniques: (a) split-half reliability and (b) reliability of "internal consistency." Guttman split-half coefficient ($\alpha = .84$), Cronbach's alpha for first ($\alpha = .82$) and second half of items ($\alpha = .74$) and Cronbach's alpha for whole test ($\alpha = .87$) showed values that exceed 0.7, which indicate appropriate reliability (Nunnally, 1978). The comparison of the reliability test results with related literature (Misiti, Shringley & Hanson, 1991; Salta & Tzougraki, 2004) also revealed that the scale is satisfactory and has an acceptable reliability.

Cronbach's alpha values were calculated for each dimension, they were between 0.69 to 0.36. Although results can be considered as appropriate (Jegede & Fraser, 1989; Fraser, 1989; Francis & Greer, 1999; Dhindsa & Chung, 2003), dimensions with relatively low reliabilities, "equipment" (0.36), "difficulty" (0.46), have been further examined to avoid misinterpretation of the results. Cronbach's alpha for "interest" ($\alpha =$

0.68), "career" ($\alpha = 0.62$), "importance" ($\alpha = 0.69$) and "teacher" ($\alpha = 0.62$) showed satisfactory reliability.

RESULTS

Students' responses

One-way multivariate analysis of covariance (MANCOVA) was used to examine the effect of gender and age on six dimensions. Scores were defined as dependent variables, age as a covariate and gender as a categorical predictor. It was found that students' attitude toward biology is significantly affected by age ($F_{6,647} = 10.9, p < 0.001$), but not by gender ($F_{6,647} = 1.2, p = 0.3$) (Figure 1). These results remained unchanged even after excluding two dimensions with low reliability (Equipment and Difficulty) from the model. Thus, according to the results, no apparent difference was detected between boys and girls, but there appeared a difference among students with different ages (Table 1 and 2). Furthermore, because age correlates significantly with grade (Pearson $r = .904, p < 0.001$), it can be concluded that, students from various grades have different attitudes.

Students' responses to the questionnaire are evaluated with respect to six dimensions as follows:

Interest

Two-way univariate analysis of variance (ANOVA) had been used to determine particular factors affecting students' interest toward biology. Results revealed that both gender ($F_{1,645} = 8.6, p = 0.003$) and grade ($F_{4,645} = 23.62, p < 0.0001$) are significant factors: Girls and younger students displayed greater interest toward biology lessons compared to boys and elders. There had also been found a significant correlation between gender and grade ($F_{4,645} = 2.32, p = 0.056$). Tukey's Honestly

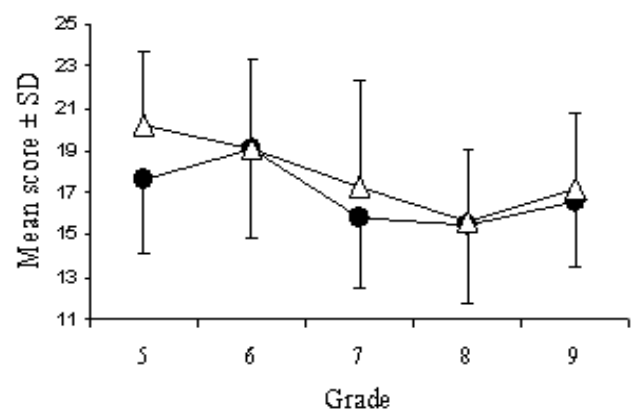


Figure 1. Boys' (solid circles) and girls' (triangles) interest toward biology.

Significant Difference (HSD) post hoc test revealed that fifth (learning botany) and seventh grade girls (learning human biology) showed higher mean score than boys ($p < 0.05$) (Figure. 1).

As far as the frequencies were concerned, it was concluded that, 45% of students was fond of biology, while a significant proportion (21%) did not know. The distribution of positive responses given by the students from different grades were not random ($\chi^2 = 21.6$, $df = 4$, $p < 0.001$), but positive responses were more cumulated in 5th and 6th graders relative to others. A majority of the students (57%), however, do not want to have biology lessons more frequently. Although 16% of the respondents stated that they hate biology lessons, the nature and biology subjects have not been found as "strange" by 68% of respondents. One of the most striking results of this dimension is that, most of the students (83%) enjoy working with living organisms during lessons. As far as the grades are concerned, biology lessons seemed as the most popular among younger students, interest decreases as the grade increases (Figure 2). Therefore, responds for this dimension can be evaluated as that, Slovak students are interested in biology lessons and the interest decreases

as they get older. In addition, Slovak students' attitude toward interest in biology lessons differs with gender; girls reveal more interest. Moreover, all items of this dimension significantly and positively correlates with each other, whilst highest mean score (mean = 3.98, SD = 1.2) was found for the item which deals with students' interest of using live animals and plants in lectures.

Career

An univariate ANOVA showed that students' attitudes toward career in biology has been affected by grade ($F_{4, 645} = 21.6$, $p < 0.0001$) and gender ($F_{1,645} = 5.4$, $p = 0.02$): interest in biology career decreased with increasing grade and girls showed greater interest for career in biology compared to boys (Figure 2).

As far as the responses for this dimension were concerned, only 9 % of them would like to be a biologist in the future. Furthermore, older students displayed a significantly higher tendency for refusing biology career (Pearson $\chi^2 = 10.9$, $df = 4$, $p < 0.05$). Interestingly, one fifth (20%) of the students stated that they like to watch films about nature and therefore they would like to think about making a career in biology.

Table 1. Descriptive statistics for the 3 dimensions of the Biology Attitude Questionnaire

Grade (subject)	Interest				Career				Importance			
	M		SD		M		SD		M		SD	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Grade 5 (Botany)	17.6	20.2	3.5	3.5	13.5	15.5	3.4	3.9	18.7	19.9	2.8	2.6
Grade 6 (Zoology)	19.1	19.1	4.2	4.9	12.8	13.9	4.2	4.3	18.2	18	3.4	4.2
Grade 7 (Human Biology)	15.8	17.3	3.3	5	10.9	12.3	3.8	4.1	15.3	17.6	3.9	4.7
Grade 8 (Earth sciences and palaeontology)	15.5	15.6	3.7	3.5	11	10.7	3	3.7	16.6	16.4	3.7	3.2
Grade 9 (General biology and Ecology)	16.6	17.2	3.1	3.6	11.5	11	3.6	3.4	16.6	16	2.8	2.3

Table 2. Descriptive statistics for the 6 dimensions of the Biology Attitude Questionnaire

Grade (subject)	Teacher				Difficulty				Equipment				N	
	M		SD		M		SD		M		SD		Boys	Girls
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls				
Grade 5 (Botany)	12.5	13.4	2.2	1.5	12	12.2	6.2	1.9	11.54	11.55	2.6	2.1	54	45
Grade 6 (Zoology)	12	12.1	2.8	2.4	11	10.9	2.5	2.8	11	11.6	2.5	2.4	87	77
Grade 7 (Human Biology)	10.3	10.7	2.5	3.1	9	9.7	2.6	3.7	10.5	11.1	2.4	2.9	49	58
Grade 8 (Earth sciences and palaeontology)	10.7	11	2.8	2.5	9	9	2.8	2.9	10.9	10.4	2.3	2	109	89
Grade 9 (General biology and Ecology)	12.5	12.5	1.8	1.8	10.7	10.9	2.7	2.3	9.9	9.9	2.3	2.3	35	53

Twenty seven percent of the students stated that biology knowledge will be important for their career. Items of this dimension were significantly and positively correlated with each other. Detailed inspection of each item showed that lowest scores were obtained for the items that deal with taking their biology teacher as a model for the future life and wishing to be a biologist (mean = 1.8 and 1.9, SD = 1.08 and 1.24, respectively). *T-test* results showed no statistically significant difference between these means; instead a correlation coefficient between these two items was the highest relative to others (Pearson $r = 0.5$). And so, this result suggests that, student' attitude toward taking biology teacher as a model to be a biologist coincides. In other words, students' biology teacher may be one of the

items for motivating students' interest in career in biology. We propose that differences in students' ideas toward biologist and biology teachers should be investigated in more details.

Importance

An univariate ANOVA showed that grade ($F_{4, 645} = 16.39, p < 0.0001$) significantly affect students' attitudes toward the importance of biology. According to frequencies, almost half of students agreed that biology is important. As grade increased, on the other hand, percentages decreased (Pearson $\chi^2 = 10.5, df = 4, p = 0.03$) (Figure 2). Similarly, about half of the students agreed on the item that, they need biology knowledge.

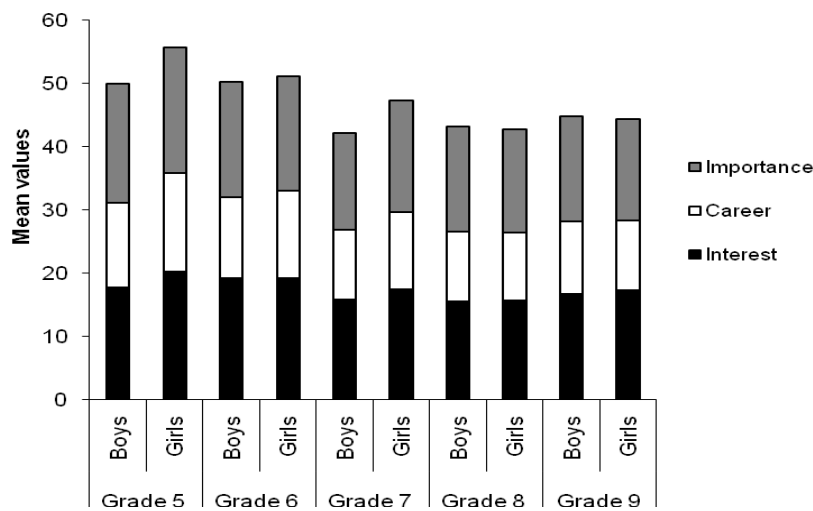


Figure 2. Student responses by gender and grade; dimensions: importance, career, interest.

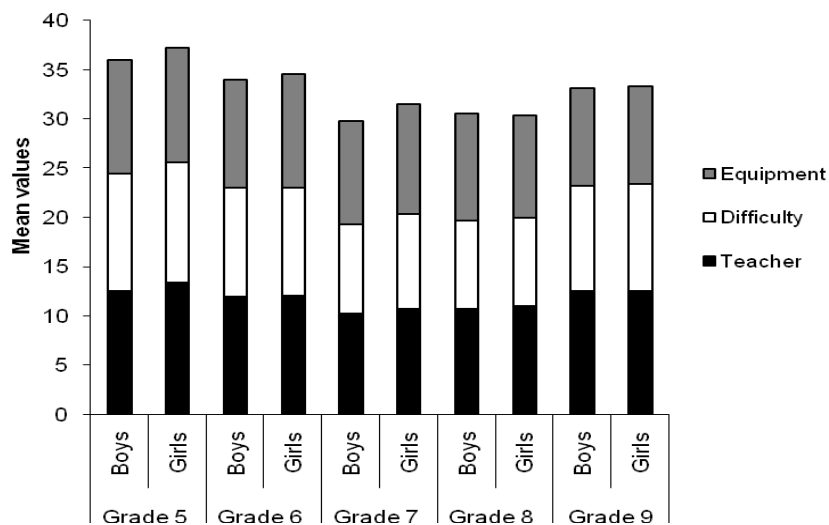


Figure 3. Student responses by gender and grade; dimensions: equipment, difficulty, teacher.

Negative attitudes for this item, on the other hand, had been found for older students (Pearson $\chi^2 = 10.2$, $df = 4$, $p < .05$); more than 50 % of the 9th grade students, for example, showed negative attitudes. Moreover, although 47% of the students agreed that learning biology improves the quality of life, 33 % of them stated that they do not know the answer. All items of this dimension were significantly and positively correlated with each other. Evaluation of the means showed that the highest score was obtained for the item which asks about the necessity of biology knowledge for understanding of other courses (mean = 4.1, SD = 0.1), and that of the lowest was belong to the item which states that, biology is helpful to develop conceptual skills (mean = 2.9, SD = 1.3). Therefore, Slovak students attitude toward the importance of biology can be summarised as that, they believe in the importance of knowledge of biology (perhaps for science), but according to them, biology is not one of the essential issued of their own lives.

Teacher

A univariate ANOVA showed that grade is the only factor (ANOVA, $F_{4, 645} = 21.1$, $p < 0.0001$) that affects Slovak students' attitudes toward teacher (Figure 3). This relationship, however, seems to be non-linear: while a negative attitude was observed for the 7th and 8th grade students, 5th, 6th and 9th graders displayed a positive attitude.

According to *the* responses given to this dimension, students have positive opinions for their teachers, most of them (71%) like their biology teacher, 62% of them agreed that their teacher motivates them and 78% of them agreed that teacher' judgement on them does not depend on the scores they get. Lower percentages observed especially for 7th and 8th grades were caused by relative higher percentages of "don't know" responses for this dimension. Although the results of this dimension display a *general* picture about the attitude of Slovak students toward biology teachers, results are subject to change for each individual teacher. Testing the attitude of students toward teachers, one-way ANOVA resulted with significant differences between mean scores obtained for each individual teacher ($F_{9,645} = 17.1$, $p < 0.0001$). This indicates that, students' views about teachers differ for each teacher. Moreover, teacher characteristic has a strong effect on students' attitudes; mean scores ranged from 9.7 to 14.1 (15 was the maximum). As a result, this may imply that, individual character of a teacher is one of the important variables to be considered during students' attitudes. All three items from this dimension correlated significantly and both means (3.7 - 3.9) and correlation coefficients (0.29 - 0.39) were of similar value. Therefore, students' attitude toward teacher is related with being motivated

by their teachers and not being disregarded even in the case of taking low marks.

Difficulty

Grade (ANOVA, $F_{4, 645} = 20.5$, $p < 0.0001$) was found as to be the only factor that influences Slovak students' attitudes toward difficulty of biology (Figure 3). Seventy two percent *of* the students defined biology as one of the easier subjects. Distribution of students who defined biology as "easy", on the other hand, was not random (Pearson $\chi^2 = 54.52$, $df = 4$, $p < 0.001$). Sixth grade (learning zoology) and 9th grade students (learning ecology) defined biology as an easy subject, those of 7th (learning human biology) and 8th grades (learning geology /palaeontology), on the other hand, defined it as "harder" compared to other courses and half of the 5th grade students defined biology as "difficult". Moreover, 77 % of the students stated that, they do like the way biology lectures are given in their school. Therefore, the most pronounced result of this item is that, although majority of the Slovak students find biology as an easy course, difficulty rating differs by grade.

Equipment

The two-way ANOVA displayed that grade level ($F_{4,645} = 7.5$, $p < 0.0001$) has a significant effect on the Slovak students' attitudes toward the use of biology equipment. Gender, on the other hand, does not have a significant affect ($F_{4,645} = 0.72$, $p = 0.4$). A majority of the students (72%) stated that they use pictures and drawings during the lectures, but they do not use picture and drawings to prepare for exams. Positive and significant correlation was found between the items of this dimension.

DISCUSSION AND CONCLUSIONS

One of the most pronounced results of the study is that, age is the major factor that impacts students' attitude toward biology for all dimensions. Gender, on the other hand, is found to be effective only for some dimensions. Thus, in general terms, Slovak students have a positive attitude toward biology lessons and biology lessons were most popular among younger students and girls. Students' interest in biology lessons differs with gender; girls have more interest in biology. But the degree of interest decreases as the students get older. The most pronounced reason for students' interest, on the other hand, is that, they are interested in dealing with live animals and plants during biology lessons. The majority of the students believe in the importance of knowledge of biology, but the results displayed that, students do not treat of biology

knowledge as one of the issues that is necessary and useful in their daily lives. Although majority of the students find biology as “easy”, difficulty rating differs by grade. Teacher characteristics have found to have a significant role on Slovakian students' attitudes toward biology; students take biology teachers as a model for deciding about their career. But, their views about teachers differ according to different teachers. Thus, individual character of a teacher may be one important variable to be work on for the student attitude research. The non-linear differences detected for two dimensions, “interest” and “difficulty”, among different grade levels, suggests that attitudes are likely to be influenced by curricula (subject) than age of students' *per se*. For example, biology has been defined as the most difficult by eighth graders and the subjects they thought are earth sciences and palaeontology. Interestingly, in contrast with Australian students, where earth sciences were significantly more preferred by boys (Dawson, 2000), boys had low interest in the topic. However, a slight increase of interest and decrease in difficulty has been detected among ninth-graders, which may indicate that interest in biology depends on the topic. Zoology (subject of grade six) was found as to be the most interesting for both sexes. This finding, on the other hand, is closely related with children's natural curiosity about living things. This evaluation can also be supported by the results obtained for the dimension titled “Equipment” that, the students were very much interested in the use of live animals during the biology lessons. Thus, we propose that the use of living organisms would be one of the key factors which can increase students' positive attitudes toward biology. This is consistent with Freedman's (1997) and George and Kaplan's (1998) results that, students' had positive attitudes toward practical settings. The effect of teacher, on the other hand, is another variable which seem to be important. Data presented in this study, suggest that teacher can significantly affect students' attitudes toward biology and this outcome, on the other hand, indicates the need, for further research on this factor. “Teacher effect” is also interesting from another point of view: Based on the current data, it seems that biology teacher is not being distinguished from a biologist. The traditional children's view of a scientist, on the other hand, is that a person dresses a white lab coat, works in a laboratory among test tubes, flasks and bottles and (e.g. Chambers, 1983; Schibeci & Sorenson, 1983; Parson, 1997). Unfortunately, there is no data on students' image of a “biologist”. Therefore, further research is needed to understand the students' view about the differences between a “biology teacher”, a “professional biologist” and a “scientist”. If the evaluation that, Slovak students can not distinguish biology teacher from a biologist, is valid, and if they have a negative attitude toward their teacher, then this

may explain why students' attitude toward future career in biology is low.

Educational implications of the study can be summarized as follows. Frequent use of live organism in biology lessons and/or practical works may increase students' interest toward biology. Interest in biology should be developed for boys and older students in particular. Because students showed low interest in career in biology, their interest should be increased perhaps through contact with professional biologists (through science centres) and their ideas about professional biologists and the role of biology knowledge in daily life should be investigated deeply. Biology subjects in the 8th grade should be re-evaluated in terms of learning difficulties and low interest in this topic frequently reported by respondents. Finally, more research should be realised on the subjects like, attitude toward biology teachers and their impact on student's interests and attitudes toward biology. Findings of such studies may significantly contribute to improve biology education in the future.

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Appendix A: Biology Attitude Questionnaire (BAQ)

Students were requested to respond to the following statements on a Likert five point scale.

Interest toward biology

- 1. I like biology more than other subjects
- 7. Nature and biology is strange for me
- 13. I would like to have biology lessons more often
- 19. I hate biology lessons
- 23. The work with living organisms in biology lessons is very interesting

Future career in biology

- 3. I like watching natural history films; I would like therefore make a career in this in this field
- 9. Biology knowledge is necessary for my future career
- 15. My biology teacher is my personal model, I would like to work like he
- 21. My future career is independent from biology knowledge
- 28. I would like to be a biologist

Importance of biology

- 2. Biology helps development of my conceptual skills
- 8. Biology is not important in comparison with other courses
- 14. Biology knowledge is essential for understanding other courses and phenomenon
- 20. Nobody needs biology knowledge
- 27. The progress of biology improves the quality of our lives

Biology teacher

- 4. I like my biology teacher
- 10. Our biology teacher makes us do active work
- 11. Our biology teacher disregard aspiration of students with bad rating

Difficulty

- 24. I have often difficulties to understand what we have learn in biology
- 25. Biology is one of the easiest courses for me
- 30. I like the way how biology is teaching in our school

Equipment

- 5. Our biology teacher makes drawings or uses pictures in each practical works
- 11. We never use any biology equipment
- 29. When I prepare for biology lesson, I bring to mind equipment that we have used in biology