

RELEVANT SCIENCE EDUCATION IN THE EYES OF GRADE NINE STUDENTS

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Abstract

Students are motivated to learn, if the science content is interesting, connected with their everyday life and useful for their lives and future developments. The main goal of this study is to investigate what Estonian grade nine students are interested to learn in science lessons, how these interests are related with students' opinions about their future career choices and attitudes towards school science. Nine categories about students' interests towards science and eight factors about students' future careers are identified. For compare students' interests and future career choices or interests and attitudes towards school science correlation analyses are undertaken. Six hundred and seventy five grade nine students from 25 schools are asked to answer the ROSE (*The Relevance of Science Education*) international questionnaire. The results of the study show gender based differences towards science learning. Girls are interested in issues that are connected with their health and outlook. Boys like to study more about the things, which happen in society. The results show also important connections between students' interests and their future career choices.

Introduction

Several international studies have shown that school science has become more unpopular and irrelevant among students (Holbrook, 2003, 1998; Osborne & Collins, 2001; Sjøberg & Schreiner, 2002). Students are motivated to learn if the science content is interesting, useful for their lives and future developments and connected with their everyday life (Osborne *et al.*, 2003; Dawson, 2000). Reasons for this gap have been considerably studied. The last international ICASE 2003 World Conference in Science and Technology Education held in Penang, Malaysia recognized the critical need to increase relevance in science and technology education through three main areas: relevance to the perceived needs and interests of the student; relevant to industry, or student careers and relevant to the needs of society, or the culture (ICASE, 2003).

For the current study, the most important area is relevance to student. By relevance is meant something what is interesting for student. Interest is usually referred to as a preference to engage in some types of activities or issues rather than others (Gardner & Tamir, 1989). Interest is also considered to have correlation with attitudes towards science and therefore interest has an emotional aspect (Hong *et al.*, 1998). But interest is not synonymous with variables like satisfaction or enjoyment (Gardner & Tamir, 1989). Interest can be measured towards subjects, topics, activities or motives (Gardner & Tamir, 1989; Hong *et al.*, 1998). In the current study, interest is measured towards science subjects, such as physics, chemistry, biology, earth science and health science.

Students' interests and perceptions of school science have been investigated for many years. Several studies have been carried out to investigate students' interests towards science subjects and/or topics focusing on gender or age differences (Lamanauskas *et al.*, 2004; Colley & Comber, 2003; Teppo & Rannikmäe, 2003; Sjøberg, 2002; Osborne & Collins, 2001; Dawson, 2000; Jones *et al.*, 2000; Stark, 1999; Hong *et al.*, 1998; Gardner & Tamir, 1989).

Students' attitudes towards science are usually measured against the backdrop of a "generalized science" without defining what science is, or what it means to know or do science (Zacharia *et al.*, 2004). In the current study, science is taken to mean different science subjects (biology, chemistry, earth and health science) that are taught separately in Estonian schools, whereas attitudes towards school science were measured against "general science". Students' attitudes, or views towards school science have been investigated by several researchers (Matthews, 2004; Osborne & Collins, 2001; Jones *et al.*, 2000; Gardner & Tamir, 1989; Hofstein *et al.*, 1986; Yager & Yager, 1985; Yager & Bonnstetter, 1984).

The students of today will soon become our politicians, teachers, business leaders, parents, etc. They need to make decisions regarding developments in technology and all other fields of science (Mattern & Schau, 2002). The concern in European Union is to ensure an increase in the science related workforce and to get more students choosing science & technology related careers (European Commission, 2004). At the same time, the popularity towards science learning at school has fallen.

Methodology

Sample

The research was carried out during the 2002/2003 school year with grade nine students. The target group of students was 15-16 years of age. This is, in Estonia, the last year students attend lower secondary school, and it is the end of compulsory schooling. Nine grade is the year where important educational and future career choices are made.

At the beginning of the 2002/2003 school year there were about 14 535 9th grade students in 526 Estonian-speaking schools (Statistical Office of Estonia, 2004). From these 25 Estonian-speaking secondary or basic schools were randomly chosen from the database of Estonian Ministry of Education. The aim of the selection was to obtain a representative sample of Estonian grade nine students.

In March 2003, the ROSE questionnaires were sent to the science teachers in each of the 25 participating schools. The schools themselves selected one class of ninth grade students for the research. This sample of 675 (340 girls and 335 boys) Estonian grade nine students was taken to be representative of Estonian students.

Instrument

ROSE (The Relevance of Science Education) is an international comparative project with the objectives of collecting data on students' experiences, interests, priorities, images and perceptions that are of relevance for their learning of science & technology (S&T) and their attitudes towards these subjects (Sjøberg & Schreiner, 2002).

The ROSE instrument consists of eight parts: A, C, E - "What I want to learn about", B - "My future job", D - "Me and the environment", F - "My science classes", G - "My opinions about science and technology", H - "My out-of-school experiences", I - "Myself as a scientist", J - "How many books are there in your home?" - in total comprising 250 items, all answered on a 4-point Likert-type scale (except parts I and J) (Sjøberg & Schreiner, 2002). In the current

study, the analysis was undertaken based on the three parts of the ROSE instrument: students' interests towards science, their attitudes of school science and opinions about future career.

Analysis of data

The data from the ROSE instrument was analysed in three parts:

- 1) For students' interests (A; C, and E) all 108 items were divided into five main categories based on the science curriculum content (physics, earth science, biology, chemistry and health science). This was done because science subjects are taught separately in Estonian schools. According to this, four additional categories were formed, in which items were cross curriculum domains and discussed in different disciplines through the whole schooling.
- 2) Students' opinions about their future career choices (part B) were analysed by factor analyses, which indicated eight factors for describing grade nine girls and boys future priorities.
- 3) Students' attitudes towards school science (part F) were analysed item by item so as to compare gender differences between girls and boys.

For determining statistically significant differences of the results, the Independent Samples T-test was used for comparing girls' and boys' answers. The correlation analysis was made to determine the significant relations between the three aforementioned domains. The data was analysed using the SPSS (Statistical Programme for the Social Sciences) program.

Results and discussion

Students' interests towards science

There are stereotypical differences between girls' and boys' interests towards science learning. According to the results from Table 1, the statistically significant gender differences between girls and boys appear towards physics, biology, chemistry, health science, environmental protection and mystery domains. It is seen that girls are more interested to learn about biology (2,61), health science (2,97) and mystery (3,00), than boys. On the other hand boys like to study more about physics (2,60) and technology (2,70). The biggest gender differences appear in the health science (0,58) and technology (-0,63) domains. Several studies (Lamanauskas *et al.*, 2004; Colley & Comber, 2003; Dawson, 2000) have also affirmed the tendency that boys have significantly higher preferences in physics and/or technology, while girls like to study more about biology and/or geography.

The most uninteresting domains both for 9th grade boys and girls are chemistry, environmental protection and science & scientists. Chemistry is uninteresting based on students' opinions because it is quite difficult and boring for them and therefore they don't want to learn about it (Osborne & Collins, 2001). Lamanauskas *et al.*, (2004) studied Latvian and Lithuanian 11 and 12 grade students and showed also that chemistry is the least popular subject.

Environmental protection is a cross curriculum domain in Estonia and is taught through all subjects. Therefore environmental topics can this be considered able being studied extensively by grade nine students (also heard from media) and by now they have less interest towards this. Science & scientists as a domain is not taught as a subject in Estonian schools. Students

do not know about the nature of science because it is not taught in chemistry, physics or biology lessons.

Table 1. Categorization of 9th grade students' interests towards science

Categories	Mean*		Total Mean N=675	G-B difference	T-test p
	Girls N=340	Boys N=335			
1. Physics (astronomy, optics, electricity)	2,49	2,60	2,55	-0,11	0,01**
2. Biology (general biology, botany, zoology)	2,61	2,40	2,51	0,21	<0,001***
3. Earth science	2,38	2,38	2,38	0,00	0,95
4. Chemistry	2,09	2,29	2,19	-0,20	<0,001***
5. Health science	2,97	2,39	2,68	0,58	<0,001***
6. Technological appliances and processes	2,07	2,70	2,39	-0,63	<0,001***
7. Science and scientists	2,29	2,34	2,32	-0,05	0,34
8. Environmental protection	2,17	2,28	2,23	-0,11	0,03**
9. Mystery, horror, inexplicable phenomena	3,00	2,52	2,76	0,48	<0,001***

* Likert style responses ranging from “not interested” to “very interested” ranked from 1 to 4.

** Significant difference at the 0,05 level of confidence

*** Significant difference at the 0,01 level of confidence

Students' future careers

At the end of grade nine, students make decisions about their future studies. Most students continue to study in secondary schools, fewer decide to go to vocational schools to learn any technological speciality. Therefore it is important and useful to find out about grade nine students future career orientation and the possible relationship with interests towards science learning.

Factor analysis was undertaken to group items from the part of the questionnaire on “My future job”. Principal component analysis (varimax rotation) resulted in eight common factors with eigen values over 1, which all together explain ~62% of the variance. An overview of the eight factors, questionnaire items and percentages of variance is represented in Table 2.

Table 2. The results of the factor analysis

Name of the factor	Questionnaire items	Loadings	% of variance
1. Self-development priority	• Working with something I find important and meaningful	0,715	17,09%
	• Working with something that fits my attitudes and values	0,707	
	• Developing or improving my knowledge and abilities	0,587	
	• Making my own decisions	0,557	

2. Ego-centered priority	<ul style="list-style-type: none"> • Becoming ‘the boss’ at my job • Controlling other people • Becoming famous • Earning lots of money 	0,821 0,804 0,728 0,430	11,14%
3. Creativity priority	<ul style="list-style-type: none"> • Making, designing or inventing something • Coming up with new ideas • Working artistically and creatively in art • Using my talents and abilities 	0,829 0,708 0,663 0,513	8,36%
4. Tools priority	<ul style="list-style-type: none"> • Working with machines or tools • Building or repairing objects using my hands • Gender 	0,868 0,802 0,623	6,75%
5. Nature priority	<ul style="list-style-type: none"> • Working with animals • Working in the area of environmental protection 	0,878 0,861	5,79%
6. Friends and free time priority	<ul style="list-style-type: none"> • Having lots of time for my friends • Having lots of time for my interests, hobbies and activities • Having lots of time for my family • Working with something easy and simple 	0,720 0,711 0,664 0,384	4,85%
7. Other people priority	<ul style="list-style-type: none"> • Helping other people • Working as part of a team with many people around me • Working with people rather than things • Working independently of other people 	0,664 0,635 0,571 -0,512	4,25%
8. Entertainment priority	<ul style="list-style-type: none"> • Working with something that involves lots of traveling • Working at a place where something new and exciting happens frequently 	0,742 0,710	3,76%
Total			61,98%

To determine grade nine students’ future career priorities, the means for girls and boys were calculated for each factor. Table 3 indicates that the most important factor related to future careers in the eyes of grade nine students’ is self-development priority (3,18). The most unimportant factor is nature priority (2,00). Factors “Tools priority” and “Ego-centered priority” are more important for boys than girls. Self-development and entertainment priority are more important for girls than the future career of boys.

Table 3. Girls’ and boys’ priorities towards their future career

Factors	Mean*		Total Mean N=675	G-B difference	T-test p
	Girls N=340	Boys N=335			
1. Self-development priority	3,35	3,00	3,18	0,35	<0,001**
2. Ego-centered priority	2,52	2,70	2,61	-0,18	0,001**
3. Creativity priority	3,00	2,78	2,89	0,22	<0,001**
4. Tools priority	1,78	2,47	2,13	-0,69	<0,001**
5. Nature priority	2,14	1,85	2,00	0,29	<0,001**
6. Friends and free time priority	2,85	2,82	2,84	0,03	0,56

7. Other people priority	2,76	2,47	2,62	0,29	<0,001**
8. Entertainment priority	3,14	2,80	2,97	0,34	0,001**

* Likert style responses ranging from “not important” to “very important” ranked from 1 to 4.

** Significant difference at the 0,01 level of confidence

Relations between students’ interests towards science and future career priorities

To ascertain whether there are statistically significant connections between students’ interests towards science and their future job priorities, correlation analysis was carried out. The following tendencies became evident:

- Students who don’t want to relate their future career with nature aren’t interested in leaning about biology ($r=0,371$, $p<0,001$), environmental protection ($r=0,342$, $p<0,001$) or earth science ($r=0,311$, $p<0,001$).
- Students who are going to use tools in their future job want to learn more about technology related topics ($r=0,482$, $p<0,001$).
- Students who found self-development important for their future career prefer to learn more about biology ($r=0,375$, $p<0,001$) or health science ($r=0,408$, $p<0,001$).

Students’ opinions about school sciences

The results showed that grade nine students have less interest towards chemistry and earth science, more interests towards biology, health science and physics. Therefore, it is important to find out which kind of attitudes students have towards their school sciences and how these relate with their interests.

Table 4. The most and the least agreed statements about grade nine students’ school science

The most agreed statements	Total mean*	The least agreed statements	Total mean*
The things that I learn in science at school will be helpful in my everyday life	2,88	I would like to become a scientist	1,75
School science has taught me how to take better care of my health	2,84	I would like to have as much science as possible at school	1,80
School science has increased my curiosity about things we cannot yet explain	2,78	School science has made me more critical and skeptical	2,18
School science has increased my appreciation of nature	2,74	I like school science better than most other subjects	2,18
I think everybody should learn science at school	2,73	I would like to get a job in technology	2,21

* Likert style responses ranging from “disagree” to “agree” ranked from 1 to 4.

Table 4 shows five of the most and least agreed statements about school science ranged by the total mean for grade nine girls and boys. The results show the importance of learning science

at school. For example, students found that school science will be helpful in their future life (2,88) and everybody should learn science at school (2,73). The results from a Yager & Yager (1985) study indicate that school science is interesting for approximately 50% of 13-years old students, while the tendency shows that the interest drops towards science classes the longer students remain in school.

On the other hand, the results from Table 4 indicate that grade nine students are not intending to relate their future career with science (1,75) neither technology (2,21). This negative attitude can be confirmed with the correlation between students' interests and future career: as less as students relate their future career with science, the less they are interested to learn about science ($r=0,425$, $p<0,001$) or technology ($r=0,339$, $p<0,001$).

Conclusions

The results from the current study indicate the following tendencies:

- 1) There are gender differences between girls' and boys' interests towards science learning. It is evident that girls are more interested in topics, which are connected with their health and inexplicable phenomena; boys want to learn more about physics and technological appliances and processes.
- 2) Connection between students' interests towards biology, earth science or environmental protection and their future career linked with nature is evident.
- 3) Grade nine students realise school science is important and helpful in their everyday life but they don't relate their future careers with science & technology nor want to learn about science.

The results from the current study confirm that science learning is not very popular in the eyes of nine grade students and they don't relate their future careers with science & technology. The results suggest there is a need to better relate science learning with students' everyday life, including social issues, and to promote science and technology related activities.

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