PISA 2006

Estonian results

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Estonia's Success in the PISA 2006 Survey
Tõnis Lukas, Minister of Education and Research

Estonian students' performance surprised the world and us as well

Our students exceeded the average OECD result significantly in all three PISA 2006 areas. It is a pleasure to admit that in terms of acquired baseline skills, our students were in the second place in scientific literacy, ninth in mathematical literacy (third in Europe) and twelfth in reading literacy (seventh in Europe). This means that most students in Estonia have acquired at least the baseline level of skills and the work with less capable students has been successful. Another important result was that the effect of the socio-economic background of our students did not have a significant impact on their performance.

What are the possible reasons for our success?

I would first like to say that Estonians have highly valued education already for centuries. If we try to explain the possible reasons for our success, then we cannot ignore our recent history. We know that some of the decisions made have been unpopular among teachers and met with reluctance, but this survey shows that on the whole our major and minor educational reforms have been successful.

Shortly I would like to point out the possible reasons for our success:

- **students** – most of our young people are mature and responsible;
- **teachers** – Estonian teachers have been able to teach skillfully and consistently, they have adapted to changing requirements and understood the needs of modern society.
- Estonian students have been studying according to the **national curriculum** adopted in 1996, which was slightly adjusted in 2002. Already the TIMSS results in 2003 demonstrated that our national curriculum corresponds to contemporary requirements and the PISA survey confirmed once again that it can be relied on.
- I would also like to point out the high level of **teacher training** and the **authors of textbooks**. Even during the Soviet occupation years most of our textbooks were written by Estonian authors.
- Certainly the **external assessment** of learning outcomes; the criteria-based external evaluation and focusing on the internal evaluation of schools;
- the **decentralised educational system** – our schools are relatively autonomous institutions when compared to many other countries; adopted ideas of the inclusive education;
- high student involvement in out of school activities etc.

The PISA survey showed that excellent results can be achieved even when financial resources are limited. We have chosen the right path and made several correct decisions. I would like to thank our teachers, students and their parents, all the educated people and all of us – this is a great achievement by a small nation.

1. FACTS ABOUT ESTONIA AND ITS EDUCATION

- **Estonia,** officially the **Republic of Estonia** is a country in Northern Europe. It is bordered to the north by Finland, to the west by Sweden, to the south by Latvia, and to the east by the Russian Federation. The territory of Estonia covers 45,227 km². Estonia is larger for example than Slovenia, Holland or Switzerland.

- Estonia's population ranks amongst the smallest in the world: as of January 2008, an estimated 1 340 935 people live in Estonia, density of only 30 people per sc km.
- Estonian is one of the world's smallest cultural languages to include contemporary terminology for all major fields of life; it belongs to the Finno-Ugric language family, which also includes Finnish and Hungarian.
- Although school history knows educating since 12 – 13th century, Estonians still have to count year 1686 as a start of a public school system, because just then as a result of national policy, education was given also for common people.[1] Boys and girls studied together.
- The Tartu University was founded by the Swedish King Gustav II Adolphus in 1632. [2]
- The first primer in Estonian was published in 1575 by Swedish bishop Joachim Jhering.[3]
- In 1630 the first gymnasium was opened in Tartu. Study language was German.[4]
- During russification at the end of 1880 and at the beginning of 1890 the study language was Russian in public and private schools.[5]
- The first kindergarten in Estonia was opened in 1840 in Tallinn. The first Estonian-language kindergarten was founded in Tartu in 1905.
- In 1917 the Minister of Education of Russia gave the leave to teach in mother tongue in all type schools. This means that Estonian schools could teach in Estonian.[6]
- Since 1969 the study books have been free for students.[7]
- Since 2006 the pupils from grade 1 – 9 in all basic schools can receive a free hot meal.
- Children who turn 7 years of age by 1 October of the current year are obliged to attend school. Students are obliged to attend school until they acquire basic education or attain 17 years of age.
- Basic school includes years 1 – 9 and is treated as a single structure. For the purposes of national curriculum, the single structure is divided into three stages: I stage – years 1 – 3; II stage – years 4 – 6; III stage – years 7 – 9.

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[1] The B.G. Forselius society. http://www.forselius.ee/?Ajaloost_%2F_History

2 System of education. http://www.einst.ee/factsheets/factsheets_uus_kuju/system_of_education.htm

3 Vahtre, S. Eesti ajalugu. Tallinn, 1994, lk 61.

4 Liim, A. Haridusinstitutsioonid Eestis keskajast kuni 1917.aastani. Tartu, 1999, lk 79.

5 Rannap, H. Eesti kooli ja pedagoogika kronoloogia. http://www.hm.ee/index.php?03310

6 Rannap, H. Eesti kooli ja pedagoogika kronoloogia. http://www.hm.ee/index.php?03310

7 Rannap, H. Eesti kooli ja pedagoogika kronoloogia. http://www.hm.ee/index.php?03310

THE PISA SURVEY – INTRODUCTION

PISA (PROGRAMME FOR INTERNATIONAL STUDENT ASSESSMENT) three-yearly international study to measure the knowledge and skills of 15-year-olds, an age at which students in most countries are nearing the end of their compulsory time in school. PISA is organized by the Organization for Economic Cooperation and Development (OECD).

- The goal of this international program: to assess student performance and to collect data on the student, family, school factors that help to explain differences in the performance.
- All PISA survey cycles assess student literacy in three cognitive domains: reading, science and mathematics. However, within each cycle, the focus is on one assessment area while the others are regarded as minor domains.
- The PISA literacy concept is mainly concerned with the extent to which students can apply their knowledge to real world issues. It measures how well they understand concepts, master processes and are able to apply their skills in a variety of situations.
- PISA assesses the students in their own school environment. The sample is drawn from the 15-year-old student population, regardless of their grade.
- The OECD Programme for International Student Assessment (PISA) was administered in Estonian schools for the first time in April 2006.
- More than 400,000 students in **57 countries** participated in PISA 2006 (30 OECD countries and 27 partner counties) representing a total of 32 million 15-year-old students worldwide.

There were 19,600 students in Estonia representing PISA age group. The randomly selected sample consisted of 4865 students – 2386 females and 2479 males. 24.3 % of the sampled students studied at schools with Russian language of instruction. Overall there were 127 schools with Estonian language of instruction, 38 Russian language schools and 4 mixed schools. 70.8% of the students who participated in the survey were in grade nine. 48.1% of the students were from urban schools.

- PISA 2006 focused on student's competency in science. The survey assessed science knowledge and skills, as well as student attitudes towards science.
- PISA presents the results in two ways. The first one gives the summary of the overall performance of different countries on the science scale in terms of mean scores and the second provides results according to percentage of students at each proficiency level.
- **The number of students with high and low skill levels is an important indicator in projecting economic growth and social development.** Student scores in science and mathematics are grouped into six proficiency levels (level 6 representing the highest scores and 1 the lowest), reading literacy is measured in five proficiency levels. If the student answers more than a half of the questions on the relevant proficiency level he/she is assigned to the higher level of difficulty.

OVERVIEW OF THE PISA 2006 RESULTS

Among participating countries:

☺ ☺ ☺ Estonian students ranked fifth on the science scale in world and second in Europe

☺ Estonian students ranked thirteenth on the reading scale in world and eighth in Europe

☺ Estonian students ranked fourteenth on the mathematics scale in world and seventh in Europe

The high scores can be explained with the fact that most of the students in Estonia have achieved the baseline level at which students begin to demonstrate skills and competencies necessary for future development.

Table 1. Overview of the PISA 2006 results

Science scale			Mathematics scale			Reading scale		
Countries	Mean	St. Error	Countries	Mean	St. Error	Countries	Mean	St. Error
Finland	563	(2.0)	Chinese Taipei	549	(4.1)	Korea	556	(3.8)
Hong Kong-China	542	(2.5)	Finland	548	(2.3)	Finland	547	(2.1)
Canada	534	(2.0)	Hong Kong-China	547	(2.7)	Hong Kong-China	536	(2.4)
Chinese Taipei	532	(3.6)	Korea	547	(3.8)	Canada	527	(2.4)
Estonia	**531**	**(2.5)**	Netherlands	531	(2.6)	New Zealand	521	(3.0)
Japan	531	(3.4)	Switzerland	530	(3.2)	Ireland	517	(3.5)
New Zealand	530	(2.7)	Canada	527	(2.0)	Australia	513	(2.1)
Australia	527	(2.3)	Macao-China	525	(1.3)	Liechtenstein	510	(3.9)
Netherlands	525	(2.7)	Liechtenstein	525	(4.2)	Poland	508	(2.8)
Liechtenstein	522	(4.1)	Japan	523	(3.3)	Sweden	507	(3.4)
Korea	522	(3.4)	New Zealand	522	(2.4)	Netherlands	507	(2.9)
Slovenia	519	(1.1)	Belgium	520	(3.0)	Belgium	501	(3.0)
Germany	516	(3.8)	Australia	520	(2.2)	**Estonia**	501	(2.9)
United Kingdom	515	(2.3)	**Estonia**	**515**	(2.7)	Switzerland	499	(3.1)
Czech Republic	513	(3.5)	Denmark	513	(2.6)	Japan	498	(3.6)
Switzerland	512	(3.2)	Czech Republic	510	(3.6)	Chinese Taipei	496	(3.4)
Macao-China	511	(1.1)	Iceland	506	(1.8)	United Kingdom	495	(2.3)
Austria	511	(3.9)	Austria	505	(3.7)	Germany	495	(4.4)
Belgium	510	(2.5)	Slovenia	504	(1.0)	Denmark	494	(3.2)
Ireland	508	(3.2)	Germany	504	(3.9)	Slovenia	494	(1.0)
Hungary	504	(2.7)	Sweden	602	(2.4)	**OECD average**	**492**	**(0.6)**
Sweden	503	(2.4)	Ireland	501	(2.8)	Macao-China	492	(1.1)
OECD average	**500**	**(0.5)**	**OECD average**	**498**	**(0.5)**	Austria	490	(4.1)
Poland	498	(2.3)	France	496	(3.2)	France	488	(4.1)

Denmark	496	(3.1)	United Kingdom	495	(2.1)	Iceland	484	(1.9)
France	495	(3.4)	Poland	495	(2.4)	Norway	484	(3.2)
Croatia	493	(2.4)	Slovak Republic	492	(2.8)	Czech Republic	483	(4.2)
Iceland	491	(1.6)	Hungary	491	(2.9)	Hungary	482	(3.3)
Latvia	490	(3.0)	Luxembourg	490	(1.1)	Latvia	479	(3.7)
United States	489	(4.2)	Norway	490	(2.6)	Luxembourg	479	(1.3)
Slovak Republic	488	(2.6)	Lithuania	486	(2.9)	Croatia	477	(2.8)
Spain	488	(2.6)	Latvia	486	(3.0)	Portugal	472	(3.6)
Lithuania	488	(2.8)	Spain	480	(2.3)	Lithuania	470	(3.0)
Norway	487	(3.1)	Azerbaijan	476	(2.3)	Italy	469	(2.4)
Luxembourg	486	(1.1)	Russian Federation	476	(3.9)	Slovak Republic	466	(3.1)
Russian Federation	479	(3.7)	United States	474	(4.0)	Spain	461	(2.2)
Italy	475	(2.0)	Croatia	467	(2.4)	Creece	460	(4.0)
Portugal	474	(3.0)	Portugal	466	(3.1)	Turkey	447	(4.2)
Creece	473	(3.2)	Italy	462	(2.3)	Chile	442	(5.0)
Israel	454	(3.7)	Creece	459	(3.0)	Russian Federation	440	(4.3)
Chile	438	(4.3)	Israel	442	(4.3)	Israel	439	(4.6)
Serbia	436	(3.0)	Serbia	435	(3.5)	Thailand	417	(2.6)
Bulgaria	434	(6.1)	Uruguay	427	(2.6)	Uruguay	413	(3.4)
Uruguay	428	(2.7)	Turkey	424	(4.9)	Mexico	410	(3.1)
Turkey	424	(3.8)	Thailand	417	(2.3)	Bulgaria	402	(6.9)
Jordan	422	(2.8)	Romania	415	(4.2)	Serbia	401	(3.5)
Thailand	421	(2.1)	Bulgaria	413	(6.1)	Jordan	401	(3.3)
Romania	418	(4.2)	Chile	411	(4.6)	Romania	396	(4.7)
Montenegro	412	(1.1)	Mexico	406	(2.9)	Indonesia	393	(5.9)
Mexico	410	(2.7)	Montenegro	399	(1.4)	Brazil	393	(3.7)
Indonesia	393	(5.7)	Indonesia	391	(5.6)	Montenegro	392	(1.2)
Argentina	391	(6.1)	Jordan	384	(3.3)	Colombia	385	(5.1)
Brazil	390	(2.8)	Argentina	381	(6.2)	Tunisia	380	(4.0)
Colombia	388	(3.4)	Colombia	370	(3.8)	Argentina	374	(7.2)
Tunisia	386	(3.0)	Brazil	370	(2.9)	Azerbaijan	353	(3.1)
Azerbaijan	382	(2.8)	Tunisia	365	(4.0)	Qatar	312	(1.2)
Qatar	349	(0.9)	Qatar	318	(1.0)	Kyrgyzstan	285	(3.5)
Kyrgyzstan	322	(2.9)	Kyrgyzstan	311	(3.4)	United States	322	(2.9)

Statistically significantly higher than Estonia	Not statistically significantly higher than Estonia	Statistically significantly lower than Estonia

SCIENTIFIC LITERACY OF ESTONIAN STUDENTS IN COMPARISON TO OTHER COUNTRIES

Assessment scales in science

The definition of scientific literacy consists of four aspects: context, knowledge, skills and attitudes. In addition to the overall combined science scale, students were also assessed on the basis of various knowledge domains.

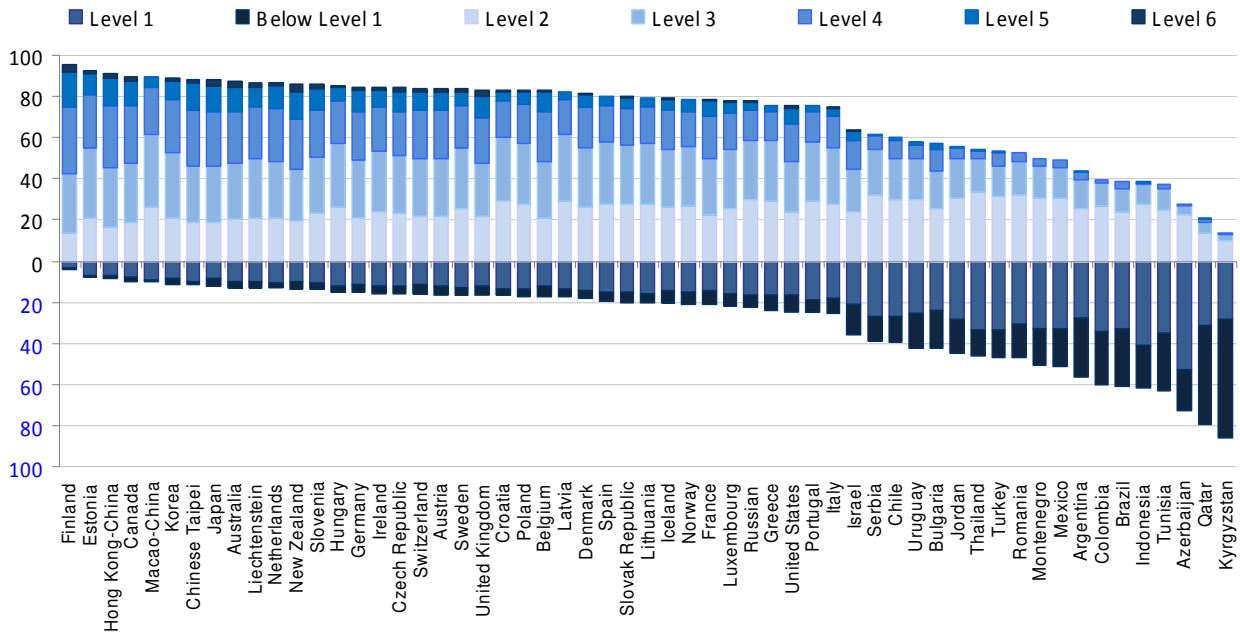
- Students were assessed in two knowledge domains: knowledge of science (knowledge of the natural world, understanding of fundamental scientific concepts and theories) and knowledge about science (scientific enquiry and scientific explanations). The content areas covered under knowledge of science were "Physical systems," "Living systems" and "Earth and space systems."
- The overall student performance of different countries was assessed in terms of mean scores.
- Students were assessed on the following science competency scales: identifying scientific issues, explaining phenomena scientifically, using scientific evidence. The ranking of countries has been given on a six level proficiency scale.
- PISA gathered data on students' attitudes and engagement with science. Countries were not ranked on the basis of attitudes and values, only generalisations were made.

The mean score performance of Estonian students and the percentage of Estonian students at each proficiency level compared to other countries

Only the differences that are statistically significant are considered when the average performance of different countries is compared. Estonia ranked fifth and its performance was statistically significantly below the performance of just Finland and Hong Kong – China. When statistical significance is considered, the probability of a country's performance ranking in a certain interval is 95%. This means that the probability of Estonia ranking between third to eighth places is 95% (Table 1; Table 3)

The general score on the combined science scale makes it possible to associate the performance of students with conceptually justified proficiency levels, considering the abilities of students (Table 2, table 3).

Figure 1 shows that Estonia ranks second after Finland on the scale of scientific proficiency levels (between zero level – Levels 1 and 2). The high rank of Estonia can be explained with the fact that the majority of students in this country have acquired knowledge on the level two. Moreover, the number of students at a very low proficiency is considerably smaller when compared to other countries.



Countries are ranked in descending order of percentage of 15-year-olds at Levels 2, 3, 4, 5 and 6.
Source: OECD PISA database 2006, Table 2.1a.

Figure 1. The percentage of students at each proficiency level on the science scale

If a student scored less than required for Level 1, it did not mean that he or she had no scientific skills that could be measured in PISA. What it showed was that such students were unable to apply their scientific abilities in the simpler contexts offered in the PISA survey**. At Level 2, students started to demonstrate science competencies that would enable them to participate actively in life situations related to science and technology.** Level 2 is considered the level for relevant literacy. These students are able to demonstrate scientific knowledge at a level that allows them to cope in everyday situations associated with science and technology. 19.2% of students in OECD countries scored below Level 2 on the combined science scale. The share of students at low levels was the smallest in Finland (4.1%) and **Estonia (7.7%)** (Table 2).

Table 2. The Estonian results by the science proficiency levels in the PISA 2006 survey

Levels	Points	ESTONIA	OECD average
Level 6	**More than 707.9** score points	**1,4**	**1,4**
Level 5	**From 633.3 to 707.9** score points	**10,1**	**7,4**
Level 4	**From 558.7 to 633.3** score points	**26,2**	**18,7**
Level 3	**From 484.1 to 558.7** score points	**33,7**	**25,1**
Level 2	**From 409.5 to 484.1** score points	**21**	**24,2**
Level 1	**From 334.9 to 409.5** score points	**6,7**	**16,3**
Below Level 1	**Below 334,9 score points**	**1**	**6,9**

Source: OECD PISA database 2006

The percentage of students at low levels in the neighbouring countries was as follows: 16.4% in Sweden, 17.4% in Latvia, 20.3% in Lithuania and 22.2% in Russia.
The share of students at high proficiency levels (Levels 5 a) was 9% on average across OECD countries. More than 20% of students achieved Levels 5 or 6 in Finland and **11.5%** of students achieved the same levels in **Estonia.**

Table 3. Comparison of the Estonian students` performances on the different scales

Assessment scale		Rank of Estonia based on average performance			Rank of Estonia based on proficiency levels	
		Mean score	All countries	Europe	All countries	Europe
Combined science scale		531	5	**2**	**2**	**2**
Competencies	Identifying scientific issues	516			**2**	**2**
	Explaining phenomena scientifically	541			**2**	**2**
	Using scientific evidence	531			**2**	**2**
Knowledge	Knowledge of science	523	11	**4**		
	Earth and space systems	540	**2**	**2**		
	Living systems	540	3	**2**		
	Physical systems	535	4	**2**		
Mathematics		515	14	5	9	4
Reading		501	13	8	8	3

Source: OECD PISA database 2006

Estonian student performance of different science competencies

Table 4 gives an overview of the division of Estonian students according to proficiency levels in the different assessment areas of science. The table shows that 1% of Estonian students did not reach Level 1 on the combined science scale. It is worth reminding here that the same result was also achieved in the international TIMSS 2003 survey. The TIMSS 2003 science survey showed that 99% of students exceeded the so-called low level in Estonia. This was the best result among all participating countries.

Table 4. Percentage of Estonian students at each level of proficiency on the different science scale

Assessment scales	% of students						
	Below Level 1	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Combined science scale	1	6,7	21	33,7	26,2	10,1	1,4
Explaining phenomena scientifically	1	6,5	20,2	29,5	**27,1**	**12,9**	**2,9**
Identifying scientific issues	1,1	7,8	**24,6**	**36,9**	23,9	5,5	0,3
Using scientific evidence	**1,9**	**8,2**	20,3	30,7	25,2	11,6	2,2

Source: OECD PISA database 2006

Student performance in different knowledge domains

Students were assessed in two knowledge domains: knowledge of science (knowledge of the natural world, understanding of fundamental scientific concepts and theories) and knowledge about science. The first of these can be divided into the following content areas: "Physical systems", "Living systems" and "Earth and space systems". Knowledge about science is scientific enquiry and scientific explanation (Table 5).

Table 5. The mean score of Estonian students in different knowledge domains and its rank among other countries

	LIVING SYSTEMS	PHYSICAL SYSTEMS	EARTH AND SPACE SYSTEMS	KNOWLEDGE ABOUT SCIENCE
1	Finland 574 points	Finland 560	Finland 554	Finland 558
2	Hong Kong – China 558	Chinese Taipei 545	**Estonia 540**	Hong Kong – China 542
3	**Estonia 540**	Hong Kong – China 546		New Zealand 539
4		**Estonia 535**		Canada 537
5				Australia 533
6				Japan 532
7				Holland 530
8				Korea 527
9				Liechtenstein 526
10				Chinese Taipei 525
11				**Estonia 523**

Source: OECD PISA database 2006

DEPENDENCE OF ESTONIAN MEAN SCORE ON GENDER AND LANGUAGE OF INSTRUCTION

Gender differences are barely noticeable in student performance in OECD countries on the general PISA science scale.

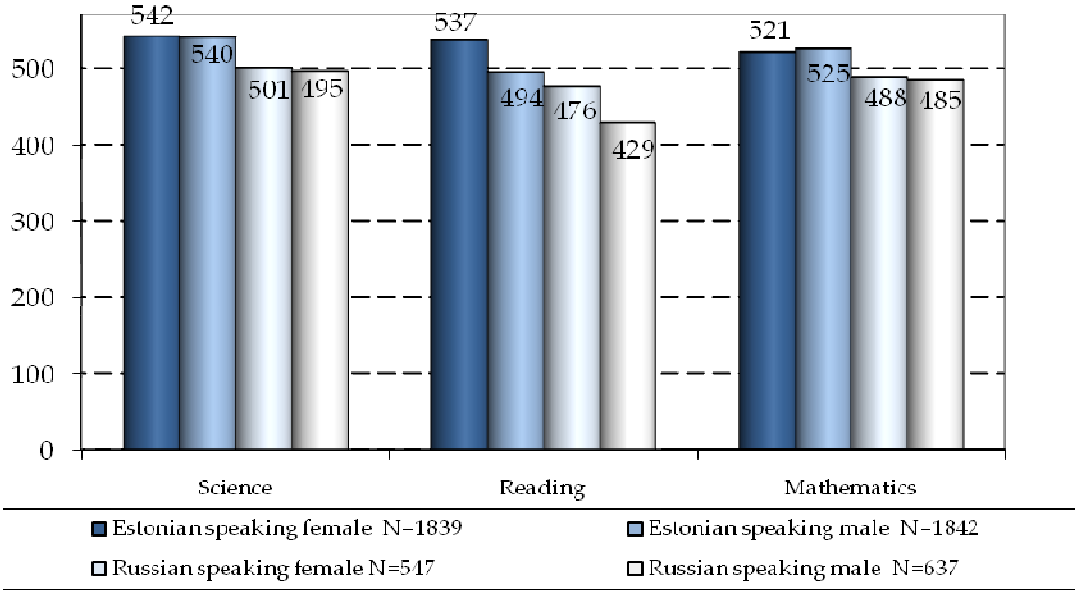


Figure 2. Dependence of the mean score of Estonian students on gender and language of instruction in science, mathematics and reading

A statistical analysis of the results shows that in Estonia, females are stronger in reading. Also, a statistically significant difference appears between the mean scores achieved by students in Estonian and Russian language schools.

INTEREST OF ESTONIAN STUDENTS IN SCIENCE IN COMPARISON TO OTHER COUNTRIES

PISA survey also assessed students' attitudes. Attitudes are seen as key components of an individual's science competency and include individual's beliefs, motivation and sense of self-efficacy. PISA 2006 gathered data on students' attitudes in four areas:

- support for scientific enquiry,
- self-belief as science learners,
- interest in science,
- responsibility towards resources and environments.

These areas were selected because they give an overview of students' general attitudes towards science, personal belief in learning science, scientific attitudes and values and responsibility for national and international scientific issues.

Results of the PISA survey showed that:

- **Estonian students value science and support scientific enquiry.** 94% of Estonian students agreed that science is important for understanding the natural world. However, whilst an average of 92% of students on the international level agreed that advances in science and technology usually improve people's living conditions, only 74% of Estonian students agreed with this. It is important to note that less students said that they would apply scientific knowledge after leaving school (59% on average across OECD countries, 65% in Estonia) or as an adult (64% on average across OECD countries, 60% in Estonia).
- **Estonian students believe they are able to do scientific tasks, however it depends on the task.** For instance 71% of students in Estonia (76% on average across OECD countries) would be able to explain why earthquakes occurred more frequently in some areas than in others.
- **Students in Estonia are interested in learning science, but only a few of them expect to have a science-related career in the future.** Most of students in OECD countries said that they were interested in learning science. 62% of Estonian students agreed that science was useful for further studies, but the percentage of students who see themselves engaged in science in the future is lower here than the average across OECD countries: only 14% of students in Estonia (21% on average across OECD countries) would like to spend their life doing advanced science and 26% of students in Estonia (37% on average across OECD countries) would like to work in a career involving science.
- **Estonian students feel responsibility for environmental issues.** The PISA 2006 student questionnaire asked students how they felt about selected environmental issues. Students' awareness of environmental issues varied considerably according to the issue: 84% of students in Estonia (73% on average across OECD countries) were aware of the consequences of clearing forests for other land use; 73% (60% on average across OECD countries) were aware of acid rain, etc.

It was also surveyed whether students enjoyed learning science. **On average, 67% of students across OECD countries and 78% of students in Estonia said that they enjoyed acquiring new knowledge in science.** 69% of Estonian students said they were interested in learning human anatomy, but there was less interest in astronomy (64%), chemistry (49%), physics (53%) and botany (49%). Only 43% of students wanted to know what is required for scientific explanations. 50% of students in Estonia liked to read about science, but only 40% said that they enjoyed resolving scientific problems.

In summary about science results:

☺ **Estonian students' knowledge about earth and space systems, living and physical systems.**
☺ **Students value science.**

☹ **Students' knowledge about science (scientific enquiry and scientific explanation).**
☹ **Students would not like to work in a career involving science.**

EFFECTS OF STUDENTS' AND SCHOOLS' SOCIO-ECONOMIC BACKGROUND ON STUDENT PERFORMANCE

In PISA the relationship between performance and socio-economic background was examined on three levels:

- What can be predicted about the performance of every student in the country if their socio-economic background is known?
- What can be predicted about a student's performance in this particular school?
- What can be predicted about the average performance of the school when the student's background is known?

The results show that in all countries, within-school differences are considerably bigger than between-school differences. On average across OECD countries, 33% of all variation in student performance was between schools. In Finland less than 5% of the overall performance variation among OECD countries lay between schools. In Iceland and Norway, this indicator was less than 10% and in Estonia 15.9%. Estonia belongs among countries where performance is largely independent of the school. **Parents in these countries can rely on the high and consistent performance standards followed in all schools of the education system and they have less reason for concern when selecting a school for their children.**

Performance in science and the impact of socio-economic background

When we look at the impact of the socio-economic context on performance in science, then it is particularly clear in the case of Canada, Finland, Japan, Korea, Hong Kong-China, Estonia and Macao-China that students have achieved excellent performance in science and the impact of the socio-economic and cultural backgrounds is lower than the international average. **Estonia belongs among the countries where the link between the socio-economic background and performance is weak.**

In summary about effects of students' and schools' socio-economic background on student performance:

☺ **Estonia belongs among the countries where the link between the socio-economic background and performance is weak.**

☺ **Estonia belongs among the countries where the percentage of students and performance on the science, reading and mathematics scales, by level of cultural possessions at home is high.**

☺ **Estonia belongs among the countries where the percentage of students and performance on the science, reading and mathematics scales, by level of mothers' education is high (mothers with completed upper secondary education, ISCED Level 3).**

When Estonia is compared to other countries, the average impact of the school's economic, social and cultural status on the students' performance is also insignificant. The impact of the school is the smallest in Finland and Iceland.

SCHOOL ENVIRONMENT AND ORGANISATION

The questions that students and school principals were asked fell into three categories:

- learning opportunities, efficient use of time, measuring performance on the level of classes, approaches to teaching and differentiation traditions;
- internal climate of the school and class, focus on performance, school autonomy and educational management, evaluation methods and data, involvement of parents and staff development;
- school size, number of students and teachers, the e-infrastructure of schools and quality of study materials, experience, training and remuneration of teachers.

In order to assess the academic selectiveness of educational systems, school principals were asked about the extent in which they consider different criteria upon admitting students. On average across OECD countries, 47% of students aged 15 are admitted to schools on the basis of residence. This indicator was 42% for Estonia. Students' academic record was the second important criteria in OECD countries (27%). The share of this criterion in Estonia was 44%. On average across OECD countries, 19% of schools proceed from the need of students to study according to a certain programme; the relevant percentage in Estonia is 9%.

- On average across OECD countries, 65% of 15-year-olds were enrolled in schools where performance data was tracked over time by an administrative authority. The survey showed that this exceeded 90% in many countries and 80% in Estonia.
- On average across OECD countries, 43% of 15-year-olds were enrolled in schools where students' performance data was used in the evaluation of teacher performance. School principals reported that this percentage was 86% in Estonia, but only 14 in Finland.
- On average across OECD countries, 59% of 15-year-olds were enrolled in schools where principals reported that the school took sole responsibility for appointment of teachers. This was 95% in Estonia.
- Schools take significant responsibility for their methods of disciplining students, selection of textbooks and admittance policies. On average across OECD countries, 82%, 80% and 74% of students respectively were enrolled in schools where it was reported that the schools mainly take responsibility for the above. The relevant indicators in Estonia were 95%, 72% and 85%.
- On average across OECD countries, 3% (also 3% in Estonia) of 15-year-olds were enrolled in schools where one or more science teacher positions were vacant.

☺ Estonia belongs among the countries where schools' autonomy is high.

MATHEMATICS PERFORMANCE OF ESTONIA IN PISA 2006 IN COMPARISON TO OTHER COUNTRIES

Mathematical literacy

PISA uses a concept of mathematical literacy related to students' capacity to analyse, reason and communicate effectively as they pose, solve and interpret mathematical problems in a variety of situations involving quantitative, spatial, probabilistic or other mathematical concepts. This means that the PISA concept of mathematical literacy differs somewhat from the traditional understanding of school mathematics. When schools generally teach and assess mathematical content out of context, then PISA tests look at everything within context. Therefore, mathematical literacy means the so-called functional learning of mathematics, acquiring knowledge in a certain context, for a certain purpose.

Estonian results in mathematical literacy

Table 6. Percentage of students at each proficiency level on the mathematics scale

Countries	Below Level 1		Level 1		Level 2		Level 3		Level 4		Level 5		Level 6	
	%	S.E.*	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.
Estonia	**2,7**	**(0,5)**	**9,4**	**(0,8)**	**21,9**	**(0,9)**	**30,2**	**(1,0)**	**23,3**	**(1,1)**	**10,0**	**(0,6)**	**2,6**	**(0,4)**
Chinese Taipei	3,6	(0,6)	8,3	(0,7)	14,3	(0,9)	19,4	(0,7)	22,4	(0,8)	20,1	(0,9)	11,8	(0,8)
Finland	1,1	(0,2)	4,8	(0,5)	14,4	(0,7)	27,2	(0,7)	28, 1	(0,8)	18,1	(0,8)	6,3	(0,5)
Hong Kong-China	2,9	**(0,5)**	6,6	**(0,6)**	14,4	(0,8)	22,7	(1,1)	25,6	(0,9)	18,7	(0,8)	9,0	(0,8)
Russian Federation	9,1	(0,9)	17,6	(1,1)	27,0	(1,4)	24,2	(0,9)	14,7	(1,0)	5,7	(0,6)	1,7	(0,3)
Latvia	6,4	(0,6)	14,3	(0,9)	26,3	(0,9)	29,0	(1,0)	17,4	(1,1)	5,5	(0,5)	1,1	(0,3)
Lithuania	7,8	(0,6)	15,2	(0,8)	25,1	(1,0)	25,1	(1,1)	17,8	(0,8)	7,3	(0,8)	1,8	(0,4)

Source: OECD PISA database 2006

* Standard error

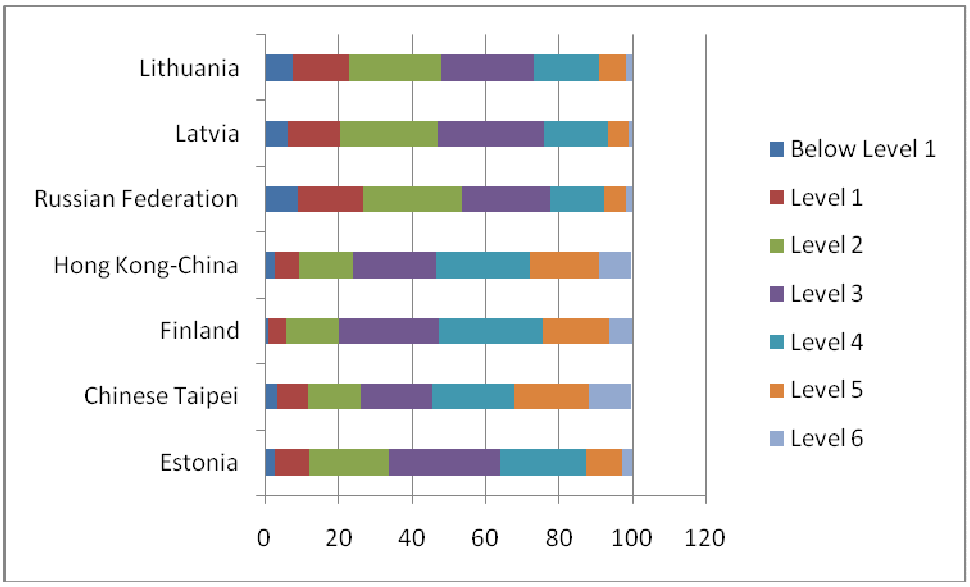
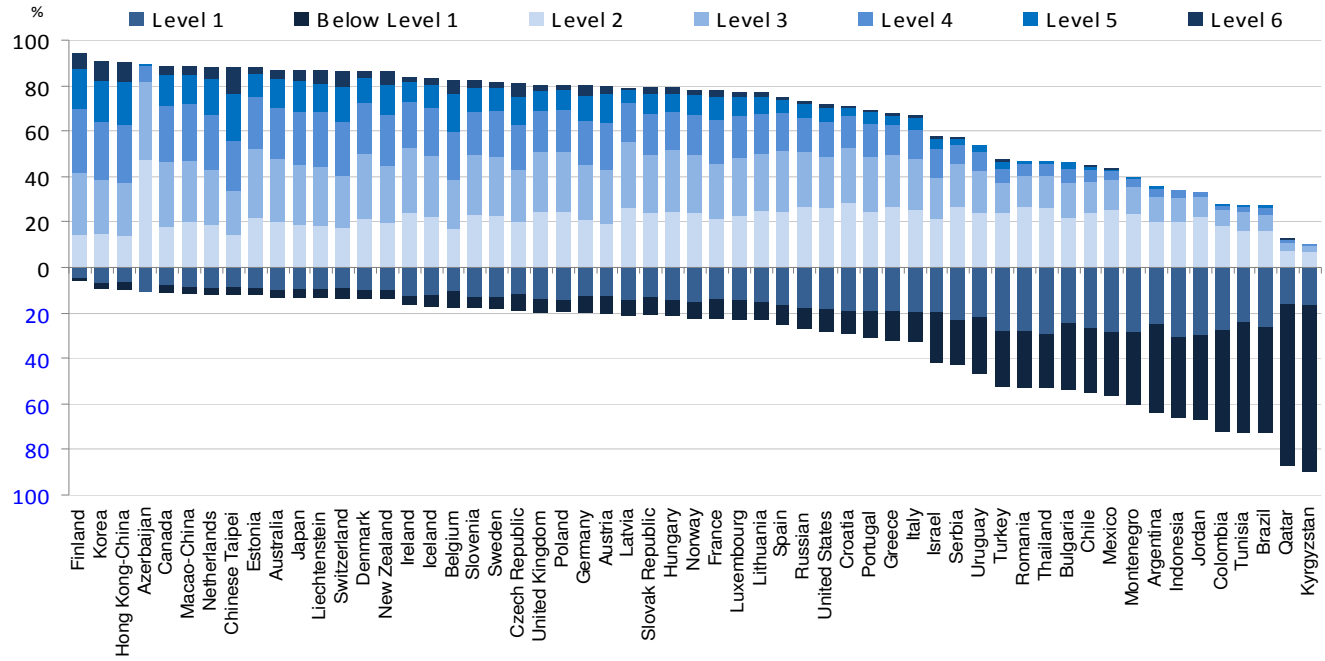


Figure 3. Percentage of students of TOP-countries and Estonian neighbour countries at each proficiency level on the mathematics scale

12.5% of students in Estonia reached **at least Level 5** (students who are able to solve difficult tasks). This percentage puts us slightly below the average across OECD countries **(13.4%).** However, it must be added that other countries originating from the same cultural space as Estonia are significantly behind us: Lithuania 9.1%, Russia 7.4%, and Latvia 6.6% (Figure 7). Such European countries as France, United Kingdom, Slovakia, Poland, Luxembourg, Norway, Hungary, Italy, Spain, Portugal, Greece, etc., are also behind Estonia with their scores. The percentage of students on Level 5 or 6 higher than in Estonia are in the following countries: Sweden, Iceland, Slovenia, Denmark, Germany, Austria, Australia, Canada, Czech Republic, Liechtenstein, New Zealand, Holland, Belgium, Switzerland and Asian countries. In total, Estonian rank among all countries on the basis of this indicator is 21st (16th if Asian countries are not considered).

Level 2 is the so-called baseline level of skills on the PISA survey scale. This is the level from which students are able to demonstrate their skills of using mathematics in a manner necessary in their everyday life in the future. On average across OECD countries, **78.7%** of students exceeded this so-called zero level. The relevant percentage in Estonia was remarkably higher, i.e. **87.9%.** This means that Estonia has been able to give at least elementary mathematical literacy to a relatively large number of students when compared to countries across OECD.



Countries are ranked in descending order of percentage of 15-year-olds in Levels 2, 3, 4, 5 and 6.
Source: OECD PISA database 2006, Table 7.2a.

Figure 4. Percentage of students at each level of proficiency on the mathematics scale

Only the scores that are statistically significant are differentiated. The PISA survey showed that:

- The mean scores of four countries were statistically significantly above the scores of all PISA 2006 countries in mathematics. They were OECD countries Finland and Korea and OECD partner countries Chinese Taipei and Hong Kong-China.
- Estonia belongs to the third group of countries that scored higher than the OECD average. The differences in the scores of different countries in this group were bigger than in the previous ones. Besides Estonia, this group also included New Zealand, Belgium, Australia, Denmark, Czech Republic, Iceland, Austria and Slovenia.

Estonia ranked 14th and its result was statistically significantly below the result of just 11 countries. Only four of these 11 are European countries. We ranked fifth among European countries with similar performance. The only countries whose performance is statistically significantly above Estonia were **Liechtenstein, Holland and Finland.**

In summary about mathematics results:

☺ **Almost all Estonian students are proficient at baseline level – they can interpret and recognise situations in contexts that require no more than direct inference; extract relevant information from a single source and make use of a single representational mode; employ basic algorithms, formulae, procedures or conventions etc.**

☹ **Small number of students who are proficient at levels 5 and 6. This means that numerous students are not capable of advanced mathematical thinking and reasoning, they cannot develop and work with models for complex situations, identify constraints and specify assumptions, etc.**

☹ **Results show differences between students of Estonian language schools and Russian language schools.**

READING PERFORMANCE OF ESTONIA IN PISA 2006 IN COMPARISON TO OTHER COUNTRIES

Reading

Reading literacy focuses on the ability of students to use written information in situations which they encounter in their life. Therefore the reading tasks focused on understanding texts, including both coherent traditional texts and diagrams, schemes and multi-layered texts that combined all of the aforementioned means of expression. Questions of different difficulty levels differentiated between five reading proficiency levels.

Estonian results in reading

Table 7. Percentage of students at each proficiency level on the reading scale

Countries	Below Level 1		Level 1		Level 2		Level 3		Level 4		Level 5	
	%	S.E.*	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.
Estonia	**3,4**	**(0,6)**	**10,3**	**(0,7)**	**24,5**	**(0,8)**	**33,9**	**(1,0)**	**21,9**	**(1,0)**	**6,0**	**(0,6)**
Korea	1,4	(0,3)	4,3	(0,7)	12,5	(0,8)	27,2	(1,1)	32,7	(1,3)	21,7	(1,4)
Finland	0,8	(0,2)	4,0	(0,4)	15,5	(0,8)	31,2	(0,8)	31,8	(0,9)	16,7	(0,8)
Hong Kong-China	1,3	**(0,3)**	5,9	**(0,6)**	16,5	(0,8)	31,5	(1,1)	32,0	(0,9)	12,8	(0,8)
Russian Federation	13,6	(1,4)	21,7	(1,0)	30,0	(0,9)	24,0	(1,3)	9,0	(0,7)	1,7	(0,3)
Latvia	6,0	(0,7)	15,2	(1,1)	27,6	(1,2)	29,9	(1,4)	16,7	(1,2)	4,5	(0,5)
Lithuania	8,7	(0,6)	17,0	(0,9)	26,9	(1,1)	27,4	(1,0)	15,6	(1,0)	4,4	(0,5)

Source: OECD PISA database 2006

* Standard error

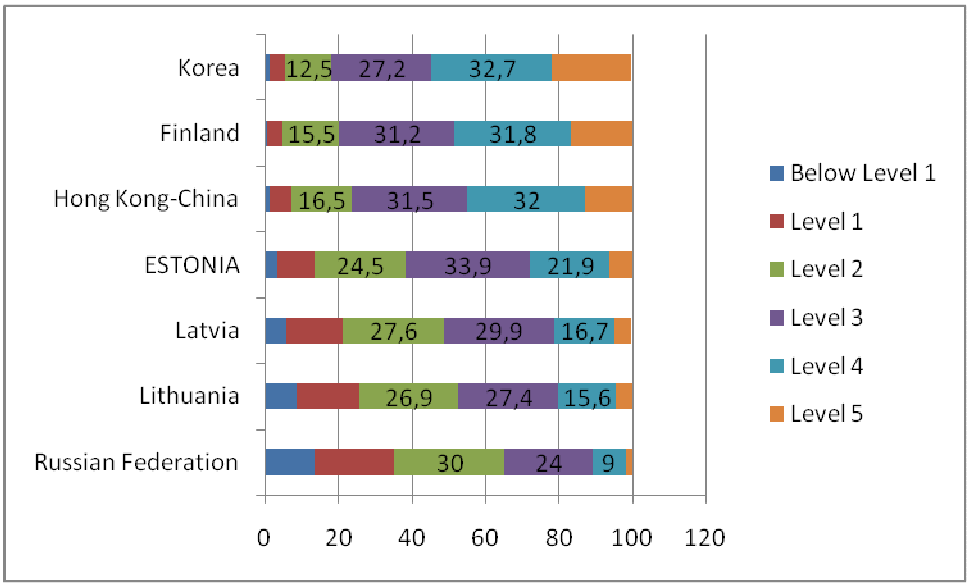


Figure 5. Percentage of students of TOP-countries and Estonian neighbour countries at each proficiency level on the reading scale

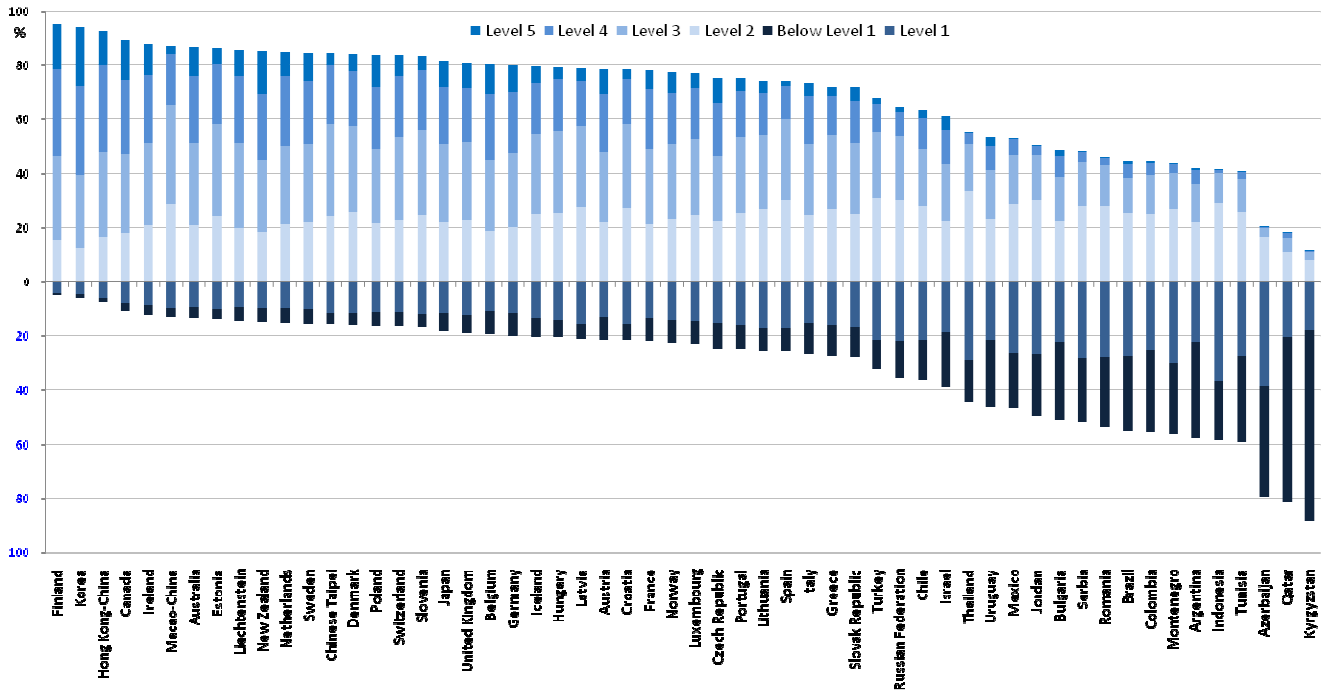


Figure 6. Percentage of students at each level of proficiency on the reading scale
Source: OECD PISA database 2006

- Estonia ranked 13th among OECD countries in reading literacy if we proceed from the number of students who achieved Levels 3, 4 or 5. This means that Estonia belongs among countries whose performance was statistically significantly above the OECD average. The best-scoring countries among the neighbours of Estonia were Finland (2nd place), Poland (9th) and Sweden

(10th). The performance of Latvia, Lithuania and Russia was statistically significantly below the average of all countries (Table 3).

- If we consider the number of students whose knowledge reached or exceeded Level 2, then Estonia ranked 8th. This shows that Estonia ranks high where students at very low levels are concerned, but Estonian place in the rank drops immediately (12th) when a slightly higher level is used for comparison. A very high number of students have acquired baseline level of competencies in reading, but the number of students with higher reading skills is smaller.
- 6% of Estonian students achieved the highest – the fifth level in reading and this result gives us the 22nd position. Even though there are relatively few students in Estonia with very low reading literacy skills, and it gives us a rather high position in the rank, we still have room for improvement as far as the reading skills of Estonian students are concerned.

- Females in all countries performed significantly ahead of males in reading. When we compare the results, we can say that Estonian males were about half a year behind females in the development of their reading literacy skills.
- If we look at the results on the basis of the test language, i.e. compare Estonian-language and Russian-language schools, then the difference is quite significant – the performance of Russian-language schools was significantly below the performance of Estonian-language schools.

In summary about reading results:

☺ **Almost all Estonian students are proficient at baseline level – they can make a comparison or connections between the text and outside knowledge; follow logical and linguistic connections within paragraph in order to access and retrieve information; identify the main idea in text; etc.**

☹ **The percentage of students at level 5 is low. This means that our students are not capable of completing sophisticated reading task, such as accessing and retrieving information, inferring which information in the text is relevant to the task; to evaluate critically and build hypotheses; etc.**

☹ **Estonian males were about half a year behind females in the development of their reading literacy skills.**

☹ **Results differ between students of Estonian language schools and Russian language schools are remarkable.**

HOW THE WORLD'S BEST-PERFORMING SCHOOL SYSTEMS COME OUT ON TOP AND SITUATION IN ESTONIA

McKinsey & Company carried out research between May 2006 and March 2007 about top-performing school systems (based on PISA 2003). Its objective has been to understand why the

world's top-performing school systems achieve so much better than most others. We try to point out the characteristics of our educational systems.

Table 8. How the world's best-performing school systems come out on top

Question	Best in world	Situation in Estonia
Getting the right people to become teachers		
What is the average academic calibre of people who become teachers?	Among the top 10% of each cohort	• The initial training of teachers of pre-primary schools is carried out on the first level of higher education or at Master's study. • Generalist teachers, specialist teachers of basic schools and upper secondary schools are trained at the second level of higher education. • Generalist teachers are trained according to the integrated curricula of Bachelor's and Master's study (5 years); other teachers are trained according to the same model in three year Bachelor's study, which is followed by the two-year Master's study. • The national teacher's qualification requirements describe the level of education, professional and/or management required from a teacher.
How is the teaching profession viewed by university students and recent graduates?	One of the top 3 career choices	
How rigorous are selection processes into teacher training?	Rigorous checks designed to assess teaching potential; e.g. teaching practice, literacy, and numeracy tests	
What is the ratio of places on initial teacher education courses to applications?	1 : 10	
How does staring compensation for teachers compare to other graduate salaries?	In-line with other graduate salaries	
Developing effective instructors		
What is the total amount of coaching new teachers received in schools?	>20 weeks	• The regulation establishes the introduction of the on-the-job qualifying phase for students who have graduated since 2004. A junior teacher passes the on-the-job qualifying phase in his or her future work place, completes the support programme of the on-the-job qualifying phase for which a certificate is issued by a university. • In 2006 awarding of professional qualifications was started. • Generally the teachers carry out self-evaluation and visit each others' lessons. • The attestation of teachers according to qualification requirements (4 occupational grades). • According to the Adult Education Act, at least 3 per cent of the salary fund of teachers receiving their salary from the state budget must be used for professional training. The schools make decisions on in-service training according to their needs and development plans. • Since 2000, professional in-service training is compulsory for teachers. The
What proportion of each teachers time is spent on professional development?	10% of working time is used for professional development	
Does each teacher have an exact knowledge of specific weaknesses in their practice?	Yes, as a result of everyday activities occurring in schools	
Can teachers observe and understand better teaching practice in a school setting?	Yes, teachers regularly invite each other into each other's classrooms to observe coach	
Do teachers reflect on and discuss practice?	Yes, through both formal and informal processes in schools	
What role do school leaders play in developing effective instructors?	The best coaches and instructors are selected as leaders	
How much focused, systematic research is conducted into effective instruction and then fed back into policy and classroom practice?	Research budget equivalent to $ 50 per student each year focused on improving instruction	

		framework requirements of teacher's training established the obligation for teachers to pass a minimum of 160 hours of professional training every five years.
Ensuring every student performs well		
What standards exist for what students should know, understand and be able to do?	Clear standards appropriate to system performance	• For each level of education (pre-school, basic education, secondary education) the state establishes requirements, called national standards of education that are set out in the national curricula. • The national curriculum for basic schools and upper secondary schools was completed in 1996; the new version was completed in 2002. • The national curriculum for pre-primary institution was completed in 1999; the new version was completed in 2008.
What system-wide checks exist on the quality of school performance?	All schools are aware of their strengths and weaknesses	• Since 1997 external evaluation of the students learning outcomes has been carried out (national exams and tests). At the end of basic school final examinations are carried out according to common materials and common assessment criteria. • Focusing on the internal evaluation of the schools and kindergartens. The national advising system – to support internal evaluation of schools and kindergartens. • The quality indicators of schools and kindergartens have been worked out.
What action is taken to tackle underperformance?	Effective mechanisms to support all failing students; minimal performance variation between schools	• The following support systems are available in schools: individual curriculum; remedial study for overcoming learning difficulties, speech therapy; learning groups at school after lessons; studying at home and attending lessons of subjects related to skills, if possible; classes for students with behavioural problems; boarding school facilities for children with social problems; support from a special education teacher, social teacher and psychologist.
How is funding and support organized?	Funding and support are focused where it can have most impact	• The financing model of general education (basic schools and upper secondary schools) takes into consideration the needs of individual work for children with special educational needs.

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