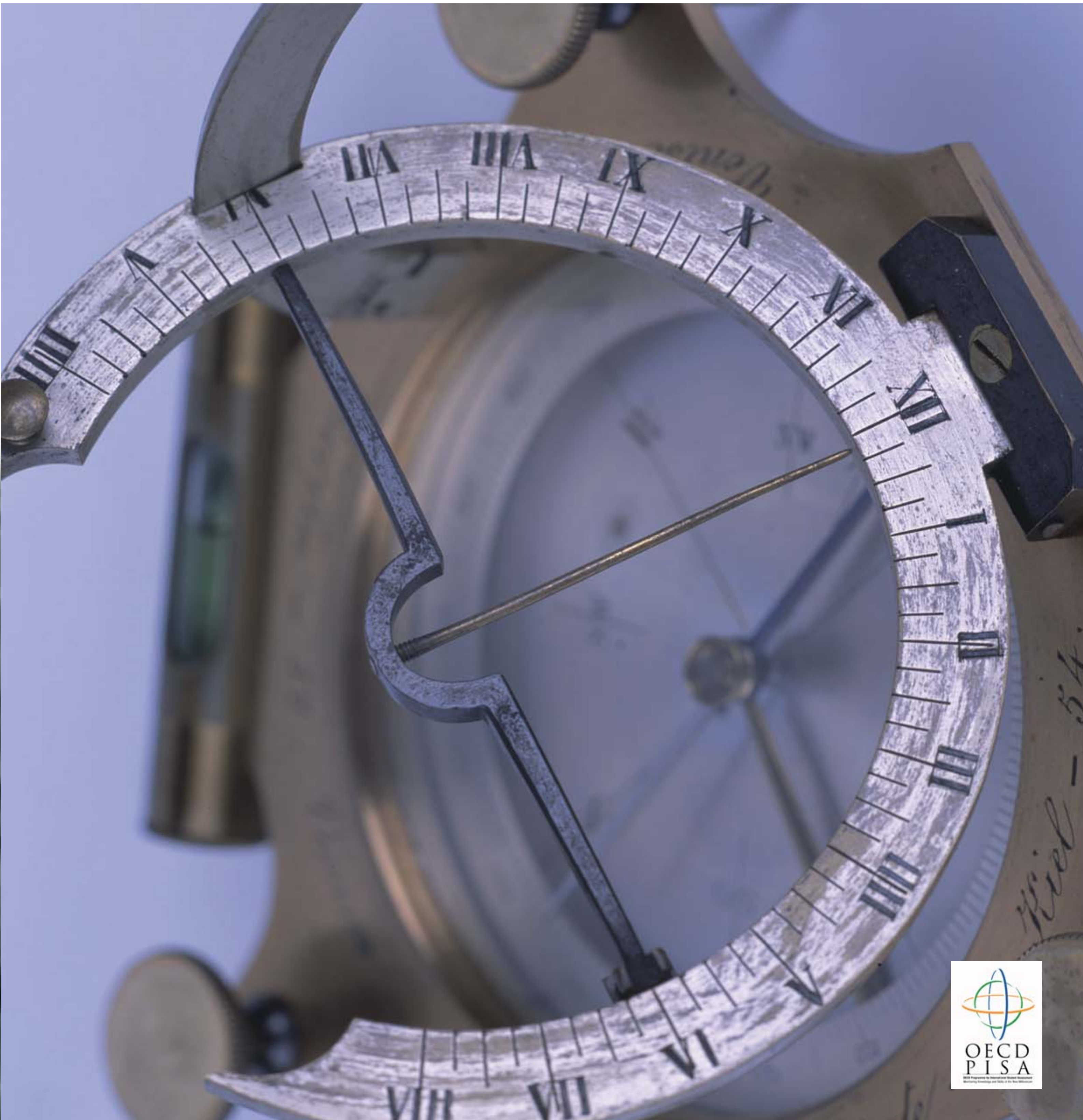
Programme for International Student Assessment

# PISA 2006

Executive Summary

## Today's Education and Tomorrow's Society



OECD PISA

# PISA 2006

## Executive Summary

## Today’s Education and Tomorrow’s Society

Educational Authority
Budapest, 2008

As commissioned by the Ministry of Education and Culture, the organization and administration of the PISA survey as well as the publication of the results are carried out by the Department of Educational Assessment and Evaluation at the Educational Authority. The representative of Hungary on the PISA Governing Board is Dr. Benő Csapó.

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# Foreword

In 2000, PISA ushered in a new era in international comparative studies. Backed by a large international economic organization, the survey was given a firm financial and organizational foundation. It became possible to develop subjects for the surveys for the long term, and the common framework for data collection let us follow the trends and the changes over time. The surveys fit into a broader framework, the system of the OECD education development program. The OECD provides support in many ways for the utilization of these experiences in both research and education policy.

Also, PISA is a breakthrough because it is the first international survey that consistently abandons curriculum based subjects. It does not assess the extent to which students have learned the school curriculum but rather it studies if 15-year-olds possess the basic knowledge required for their further development and their personal success in an advanced social environment and at the workplace. So it compares the performance of schools and education systems not to their own goals but rather it measures the whole society's ability to convey and improve knowledge.

It follows from this principle that defining the subjects for the surveys requires further analysis: only systematic scientific work can describe usable knowledge, identify the social requirements for knowledge and take the question of personal development into account. The scientific working groups working on the development of the PISA content framework did an excellent job in this respect, too. They integrated the results of the cognitive revolution that happened in the second half of the past century into the first assessment cycles, whereas in the latter cycles the focus is on discovering behaviour and the drives for learning as well as on the analysis of motivation and attitudes.

The PISA surveys have to meet two main criteria: they must be scientifically authentic and relevant for educational policy at the same time. Scientific authenticity is ensured by the fact that the world's most distinguished scholars participate in both the working groups planning and administering the survey and in the expert groups responsible for the given areas. Given the enormous resources, the vast scope that covers the bigger (and the wealthier) part of the world, the close attention of the scientific community, educational politics and mass communication, it is a must for these surveys to be the best of their kind in every respect and to use the best available knowledge and the most advanced methods.

Beside the three main subject areas each cycle contains an additional assessment, a technical-methodological solution, which has never been used before in similar surveys. Such was the examination of learning strategies and self-regulated learning in 2000, the survey – carried out using novel, embedded techniques – of complex problem-solving skills in 2003 and of the attitudes towards science in 2006. It was an original idea in 2006 also that science knowledge was tested using computers, though unfortunately Hungary did not participate in this optional program.

Quite naturally, no innovative, pioneering principles are free from conflicts and contradictions. Sometimes interpreting the results and drawing the conclusions pose a serious challenge to the expert community and educational policy in the participating countries. However, the majority of the revealed connections can be interpreted easily, their messages can be explicitly translated into action programs, whereas those results that are unexpected and difficult to interpret may inspire further, more detailed research.

The surveys hold up a mirror to the participating countries. This mirror, however, is based on extremely complex principles, figuring out the secrets of its operation requires special expertise. So it is inevitable that those results will become widely known which can be summed up in a few clear-cut facts and numbers. But it is important to note that PISA provides much more for the participating countries.

This executive summary gives an overview of the results of the third PISA survey. As such, it cannot discuss all the exciting details of the assessment, upcoming analyses will deal with this. The most easily interpretable and definitely meaningful data are the average score points for a country's students. These brought no surprises for us in 2006, but are demanding, ever more strongly, changes and measures for improvement.

This detailed assessment has confirmed that our students are average performers in science and perform below the international average in mathematics. Now we had to face for the third time that in reading we rank at the bottom third among developed countries. Again, it is a recurring message that we belong to those group of countries in which students' performance is determined the most by their home background, where between-school differences are the biggest and where these differences mainly reflect the socio-cultural differences between students. While our weaknesses in knowledge level can only be addressed in the long-run, we could find solutions that produce results already in the short term for the latter, that is for containing selection within the school system.

It is never convenient to encounter problems. But our PISA scores can also have a positive interpretation. The surveys have shown that with hard work we can do a lot to improve the performance of our educational system. Some Nordic countries have climbed from the middle ranks to the top within one generation, while some Asian countries have made even greater progress, starting from the very bottom and ending up at the top.

Those countries where the PISA results revealed similar problems and impelled intervention can be even better examples to us. In Germany, for example, the publication of the first, not really pleasing results echoed across the nation, and then inspired serious, long-term action programs: the founding of academic knowledge centres and new research and development institutions as well as the launching of large-scale development projects indicates that negative results do not necessarily have paralyzing effects.

I do hope that the same message arriving now for the third time will reach the stimulus threshold in Hungary as well, resulting in a wider cooperation to push our educational system out of stagnation. With this optimistic attitude, I commend this executive summary to the attention of all stakeholders.

*Benő Csapó*

Member of the PISA Governing Board

# The PISA survey in general

## The PISA survey

The Programme for International Student Assessment, or as it is more commonly known, the PISA assessment was launched at the end of the 1990s by the Organisation for Economic Co-operation and Development (OECD) representing the most advanced economies. Hungary became a member country in 1996.

PISA is a monitoring test series which measures the competencies of 15-year-old students in three areas (mathematics, science and reading literacy). It is a triennial survey administered collaboratively by the OECD member countries and a growing number of partner countries. The first survey was conducted in 2000, the next in 2003 and the last in 2006, but the focus areas were different every time. In 2000, the survey focused on reading, in 2003 on mathematics competencies, and in 2006 on science performance. In 2009, again the focus will be on reading literacy.

The target population of PISA is made up of 15-year-old students, who are nearing the end of compulsory education age in most participating countries, they have one to three years to complete formal schooling. At this level, schooling rates in most OECD countries are still close to 100%.

As it is commissioned by an organization with a clear economic orientation, the primary goal of the PISA survey is to examine the knowledge which can be applied to real life problems. The assessment focuses on knowledge that is relevant to the given domain and is built up from the content knowledge and skills acquired in school. It measures the extent to which students can use their reading literacy skills to understand and interpret texts in everyday life situations or the extent to which they are able to realize, understand, interpret and solve mathematical or scientific problems when they face them.

Questionnaires about the family and educational background of the students also constitute a regular part of the assessment. With the help of these, the factors affecting student performance can be studied allowing a multiple-context interpretation of the results.

From time to time the three key subject areas of PISA are complemented by assessing other cross-curricular competencies. Such was the assessment of general problem-solving competencies in PISA 2003.

### Organizational background

The PISA program is supervised by the OECD Secretariat based in Paris. The main policy priorities are determined by the PISA Governing Board, a committee comprising of the delegates of the member countries and observers. On the level of the participating countries, it is the National Project Manager (NPM) and the national centre (NC) they lead that are responsible for the administration of the survey. In Hungary, this centre is the Department of Assessment and Evaluation at the Educational Authority, which is made up of the same group of experts that – under different names like KÁOKSZI and suliNova Kht. – had carried out all the PISA surveys in our country.

### Technical background

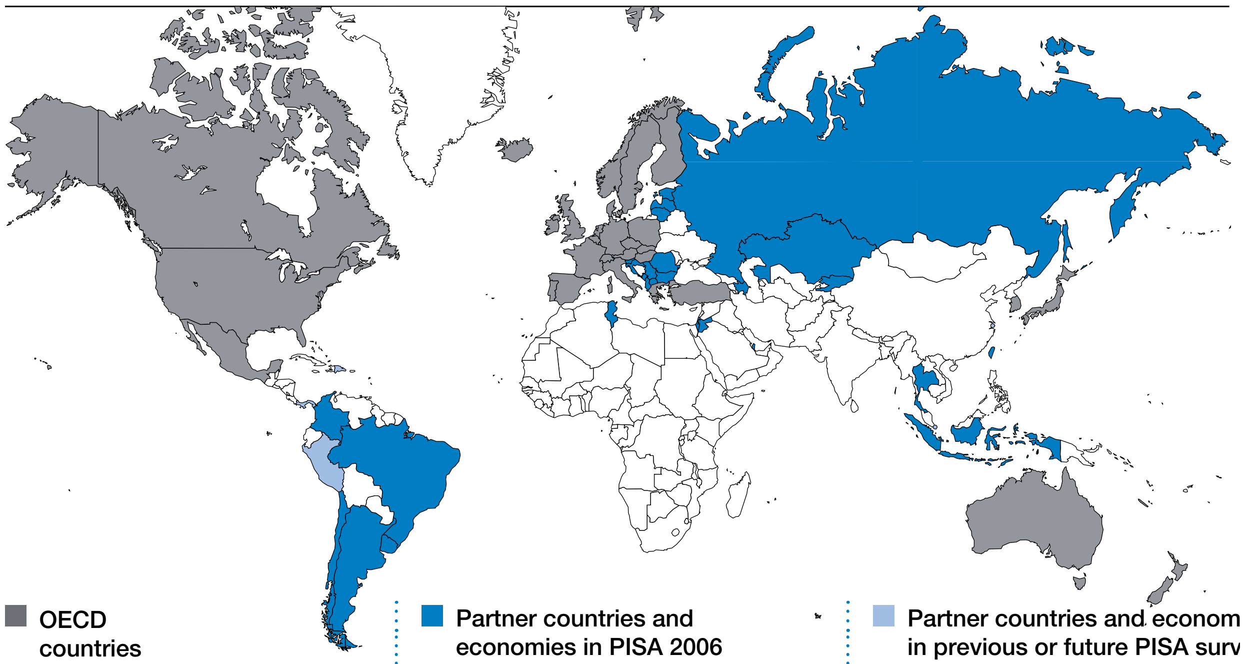
The technical background for the PISA survey can be divided into four parts: the features of the test to be completed; the sample, or the student population to be surveyed; the linguistic and cultural diversity of participants; the processes to be applied during the administration.

PISA is mainly a pencil and paper based assessment. The students selected to do a two-hour (four times 30-minute) test. The test can contain questions about the students' attitudes towards the given knowledge domain. It takes another 20 to 30 minutes to complete a background questionnaire which asks questions about the student's opinion, values and ambitions, and also collects data about their home and school environment.

The survey has to be administered in a minimum of 150 schools in each country. Participating schools are selected at random and then 35 students are selected in each with random sampling again. This means that in each participating country a minimum of 5250 children are surveyed. 57 countries participated in PISA 2006 (see Figure 1). In the current 2009 cycle, 31 OECD countries and 35 partner countries are participating.

The 2006 assessment cycle, which has focused on science, is currently being completed. This report, containing only the most important facts from the results and a primary analysis of the survey, is a part of this cycle. Detailed, thematic analyses will be published in a national report volume coming out this spring. PISA will come full circle with the 2009 assessment cycle focusing on reading literacy. Then we will have the opportunity to study  how much and in which direction students' reading performance have changed in nine years.

Countries participating in the PISA survey are shown in Figure 1.



**OECD countries**

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Iceland
Ireland
Italy
Japan
Korea
Luxembourg
Mexico
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

**Partner countries and economies in PISA 2006**

Argentina
Azerbaijan
Brazil
Bulgaria
Chile
Colombia
Croatia
Estonia
Hong Kong-China
Indonesia
Israel
Jordan
Kyrgyzstan
Latvia
Liechtenstein
Lithuania
Macao-China
Montenegro
Qatar
Romania
Russian Federation
Serbia
Chinese Taipei
Thailand
Tunisia
Uruguay

**Partner countries and econom in previous or future PISA surv**

Dominican Republic
Macedonia
Moldova
Panama
Peru
Shanghai-China
Singapore
Trinidad and Tobago

Figure 1. | A map of PISA countries

# Science

## The cognitive framework of the survey

Advanced scientific knowledge and familiarity with technology is more and more important in the life of 21st-century people. It helps the individual to understand scientific phenomena, to solve everyday problems and, last but not least, to participate in society. Because the individual as a citizen has to make responsible decisions more and more frequently the level of their scientific knowledge and technology is far from indifferent. One of the goals of PISA is to find those indicators that can precisely characterize the reading literacy, mathematical competencies and scientific thinking of 15-year-old students. A triennial survey of these three areas can provide governments with information about how future citizens are prepared to meet the challenges of life.

Consequently, unlike many other surveys, PISA does not assess scientific knowledge in itself, but how well their education system can prepare students for giving proper answers to the most important questions and problems that concern them. To mention but a few examples: it does matter how much students are familiar with health or environment protection issues or how good their reasoning, deductive and opinion-making skills are.

Before defining the goals of the PISA survey more precisely, first it is practical to clarify the following questions: which areas of science and technology 21st-century people are required to know and understand? About what questions they should be able to form opinions? And what competencies do they need? The content framework of the PISA scientific survey summarizes these requirements.

### Defining the knowledge domains

When defining the knowledge domains for the measurement several aspects should be considered. On the one hand, it is important that the knowledge material to be measured should cover a relatively wide spectrum of science and should be relevant for participating in society as a citizen. On the other hand, it should represent all those values that are created or have been created by science and technology in our universal civilization.

By mixing the various requirements, PISA have introduced a new concept, the concept of *scientific literacy,* which is defined as follows (OECD 1999, 2000, 2003a, 2006).

> *Scientific literacy is the capacity of the individual to possess scientific knowledge and use that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues. The individual understands the characteristic features of science as a form of human knowledge and enquiry, and shows awareness of how science and technology shape our material, intellectual and cultural environments. He or she, as a reflective citizen, has willingness to engage in science-related issues and with the ideas of science.*

Before the development of the instruments, the framework defines the interpretative domain for the four major aspects of the tasks.

- the possible contexts in which tasks are embedded
- the competencies students need apply to complete the tasks
- the knowledge domains involved
- the possible student attitudes towards the context of the tasks

| | Personal (Self, family and peer groups) | Social (The community) | Global (Life across the world) |
|---|---|---|---|
| Health | Maintenance of health, accidents, nutrition | Control of disease, social transmission, food choices, community health | Epidemics, spread of infectious diseases |
| Natural resources | Personal consumption of materials and energy | Maintenance of human populations, quality of life, security, production and distribution of food, energy supply | Renewable and nonrenewable, natural systems, population growth, sustainable use of species |
| Environment | Environmentally friendly behaviour, use and disposal of materials | Population distribution, disposal of waste, environmental impact, local weather | Biodiversity, ecological sustainability, control of pollution, production and loss of soil |
| Hazard | Natural and humaninduced, decisions about housing | Rapid changes (earthquakes, severe weather), slow and progressive changes (coastal erosion, sedimentation), risk assessment | Climate change, impact of modern warfare |
| Frontiers of science and technology | Interest in science's explanations of natural phenomena, sciencebased hobbies, sport and leisure, music and personal technology | New materials, devices and processes, genetic modification, transport | Extinction of species, exploration of space, origin and structure of the universe |

Table 1. | PISA 2006 science context

### The context of test questions

The context used for text questions is not limited to school life but they are also related to students' or their family's life (personal level), their community (social level) and the life across the world (global level).

Table 1 illustrates with examples the context framework of the survey. The life situations belonging to the three major contexts (personal, social and global) are framed within various application areas such as health, natural resources, environment, hazards and the frontiers of science and technology.

It was an essential requirement that the contexts used for questions should be relevant to students' interests and lives.

### Science competencies

Competency is the central concept of the PISA survey. It is primarily the extent of possessing the individual competencies that determines if an individual can successfully solve scientific problems and tasks. In the PISA 2006 science survey the following competencies were given priority.

Identifying scientific issues

- Recognizing issues that are possible to investigate scientifically
- Identifying keywords to search for scientific information
- Recognizing the key features of a scientific investigation

Explaining phenomena scientifically

- Applying knowledge of science in a given situation
- Describing or interpreting phenomena scientifically and predicting changes
- Identifying appropriate descriptions, explanations, and predictions

Using scientific evidence

- Interpreting scientific evidence and making and communicating conclusions
- Identifying assumptions, evidence and reasoning behind conclusions
- Reflecting on the societal implications of science and technological developments.

### Scientific knowledge

Compared to the previous two science assessment cycles, it was an important novelty in the content framework of PISA 2006 that within scientific knowledge it differentiates the science domains, which cover the major fields of biology, chemistry, physics, earth science and technology, from knowledge about science.

#### Knowledge of science domains

Physical systems
- Structure of matter (e.g. particle model, bonds)
- Properties of matter (e.g. changes of state, thermal and electrical conductivity)
- Chemical changes of matter (e.g. reactions, energy transfer, acids/bases)
- Motions and forces (e.g. velocity, friction)
- Energy and its transformation (e.g. conservation, dissipation, chemical reactions)
- Interactions of energy and matter (e.g. light and radio waves, sound and seismic waves)

Living systems
- Cells (e.g. structures and function, DNA, plant and animal)
- Humans (e.g. health, nutrition, disease, reproduction, subsystems [such as digestion, respiration, circulation, excretion, and their relationship])
- Populations (e.g. species, evolution, biodiversity, genetic variation)
- Ecosystems (e.g. food chains, matter, and energy flow)
- Biosphere (e.g. ecosystem services, sustainability)

Earth and space systems
- Structures of the Earth systems (e.g. lithosphere, atmosphere, hydrosphere)
- Energy in the Earth systems (e.g. sources, global climate)
- Change in Earth systems (e.g. plate tectonics, geochemical cycles, constructive and destructive forces)
- Earth's history (e.g. fossils, origin and evolution)
- Earth in space (e.g. gravity, solar systems)

Technology systems
- Role of science-based technology (e.g. solve problems, help humans meet needs and wants, design and conduct investigations)
- Relationships between science and technology (e.g. technologies contribute to scientific advancement)
- Concepts (e.g. optimisation, trade-offs, cost, risk, benefit)
- Important principles (e.g. criteria, constraints, cost, innovation, invention, problem solving)

Knowledge of science domains chosen for the survey meet the following requirements:
- They are relevant to real-life situations.
- They are enduring.
- They are appropriate to the developmental level of 15-year-olds.

#### Knowledge about science

Knowledge about science includes the students' understanding of the general principles of science and technology.

Scientific enquiry

- Origin (e.g. curiosity, scientific questions)
- Purpose (e.g. to produce evidence that helps answer scientific questions, such as current ideas, models and theories to guide enquiries)
- Experiments (e.g. different questions suggest different scientific investigations, design)
- Data (e.g. quantitative [measurements], qualitative [observations])
- Measurement (e.g. inherent uncertainty, replicability, variation, accuracy/precision in equipment and procedures)
- Characteristics of results (e.g. empirical, tentative, testable, falsifiable, self-correcting)

Scientific explanations

- Types (e.g. hypothesis, theory, model, scientific law)
- Formation (e.g. existing knowledge and new evidence, creativity and imagination, logic)
- Rules (e.g. logically consistent, based on evidence, based on historical and current knowledge)
- Outcomes (e.g. new knowledge, new methods, new technologies, new investigations)

### Attitudes towards science

Their attitudes towards these two branches of science play an important role in students' interest in science and technology. Students are certainly more motivated if science education discusses problems that personally affect them. Beside motivation, another important goal is to develop responsibility and social sensitivity, that is sensitivity to issues in the community and society, with regards to scientific problems. Science education reaches its real goal when it nurtures such people who are aware of the important and unanswered questions of science and at the same time are actively interested in finding the answers to these questions.

PISA 2006 examined students knowledge about science in the following three areas.

Interest in science

- Indicate curiosity in science and science-related issues and endeavours
- Demonstrate willingness to acquire additional scientific knowledge and skills, using a variety of resources and methods
- Demonstrate willingness to seek information and have an ongoing interest in science, including consideration of science-related careers

Support for scientific enquiry

- Acknowledge the importance of considering different scientific perspectives and arguments
- Support the use of factual information and rational explanations
- Express the need for logical and careful processes in drawing conclusions

Responsibility towards resources and environments

- Show a sense of personal responsibility for maintaining a sustainable environment
- Demonstrate awareness of the environmental consequences of individual actions
- Demonstrate willingness to take the action to maintain natural resources

The PISA 2006 science assessment made a novel attempt to measure students' attitude. Not only did student questionnaires include questions about, for example, what students think about science, but test tasks also had questions attached that asked their opinion about the context of the given task.

### Proficiency levels and questions

PISA applies an easy-to-understand criterion to assigning students to levels: each student is assigned to the highest level for which he or she would be expected to answer correctly the majority of assessment questions. Thus, for example, in an assessment composed of questions spread uniformly across Level 3 (with difficulty ratings of 484.1 to 558.7 scale points) all students assigned to that level would expect to get at least 50% of questions correct.

In the PISA 2006 science competency assessment six proficiency levels were defined.

In 2007, following a detailed analysis of the questions from the main study, the international PISA Science Expert Group, which guided the development of the science framework and questions, identified Level 2 as the baseline proficiency level, at which students begin to demonstrate the science competencies that will enable them to participate effectively and productively in life situations related to science and technology.

To reach Level 2 requires competencies such as identifying key features of a scientific investigation, recalling single scientific concepts and information relating to a situation, and using results of a scientific experiment represented in a data table as they support a personal decision.

Students with below 334.9 score points on any of the science competencies are classified as below Level 1. That is, such students – representing 5.2% of students on average across OECD countries – are unable to demonstrate science competencies required by the easiest PISA tasks. A short description of Level 1 is shown in Figure 2, and the requirements listed there suggest that such a low level of science competency can be regarded as putting students at a serious disadvantage for full participation in society and the economy.

The majority of PISA survey questions are not published because their secret status ensures that trends can be examined in the changes of the performance of the countries. There is, however, a group of questions that are made public at the end of the assessment cycle by the PISA Consortium in order to facilitate the understanding of the survey.

The description of the proficiency levels is shown in Figure 2, left of the proficiency scale. The percentage of students meeting the listed requirements for the particular proficiency levels in both the OECD countries and in Hungary are also shown. At the right hand side of the figure you can see the description of the questions related to the three published units along an identically divided difficulty scale. It also shows which question belongs to which proficiency level. Beside the description of the questions the numbers represent the percentage of students in both the OECD countries and in Hungary who could answer the particular questions correctly. The complete text of the three units, the questions and their scoring guides as well as their significant characteristics are described in the brochure enclosed to this volume.

## Why is PISA science assessment new to Hungarian students?

After the democratic transition in the Hungarian political system, parallel with a change in social needs, foreign language communication, knowledge and competencies in informatics and social sciences came into focus in education policy. In today's society, however, scientific knowledge and the use of that knowledge in everyday situations are becoming important again. This trend is reinforced by such global questions and problems like energy supply, environmental issues or the healthy way of life. This is why the results of the PISA survey assessing science competencies as well as examining the connection between PISA and nationwide educational practice are of special importance in Hungary.

| Level description | OECD | Hungary |
|---|---|---|
| At Level 6, students can consistently identify, explain and apply scientific knowledge and knowledge about science in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They clearly and consistently demonstrate advanced scientific thinking and reasoning, and they demonstrate willingness to use their scientific understanding in support of solutions to unfamiliar scientific and technological situations. Students at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that centre on personal, social or global situations. | OECD: 1.3% | Hungary: 0.6% |
| 708 | | |
| At Level 5, students can identify the scientific components of many complex life situations, apply both scientific concepts and knowledge about science to these situations, and can compare, select and evaluate appropriate scientific evidence for responding to life situations. Students at this level can use well-developed inquiry abilities, link knowledge appropriately and bring critical insights to situations. They can construct explanations based on evidence and arguments based on their critical analysis. | OECD: 9.0% | Hungary: 6.9% |
| 633 | | |
| At Level 4, students can work effectively with situations and issues that may involve explicit phenomena requiring them to make inferences about the role of science or technology. They can select and integrate explanations from different disciplines of science or technology and link those explanations directly to aspects of life situations. Students at this level can reflect on their actions and they can communicate decisions using scientific knowledge and evidence. | OECD: 29.3% | Hungary: 27.8% |
| 589 | | |
| At Level 3, students can identify clearly described scientific issues in a range of contexts. They can select facts and knowledge to explain phenomena and apply simple models or inquiry strategies. Students at this level can interpret and use scientific concepts from different disciplines and can apply them directly. They can develop short statements using facts and make decisions based on scientific knowledge. | OECD: 56.7% | Hungary: 58.9% |
| 484 | | |
| At Level 2, students have adequate scientific knowledge to provide possible explanations in familiar contexts or draw conclusions based on simple investigations. They are capable of direct reasoning and making literal interpretations of the results of scientific inquiry or technological problem solving. | OECD: 80.8% | Hungary: 85.0% |
| 409 | | |
| At Level 1, students have such a limited scientific knowledge that it can only be applied to a few, familiar situations. They can present scientific explanations that are obvious and that follow explicitly from given evidence. | OECD: 94.8% | Hungary: 97.3% |
| 335 | | |

| Example question | OECD | Hungary |
|---|---|---|
| GREENHOUSE, question 5, is an example of Level 6 and of the competency explaining phenomena scientifically. In this question, students must analyse a conclusion to account for other factors that could influence the greenhouse effect<br>709 | OECD: 18.9% | Hungary: 17.2% |
| GREENHOUSE, question 4, centres on the competency using scientific evidence and asks students to identify a portion of a graph that does not provide evidence supporting a conclusion. Students must locate a portion of two graphs where curves are not both ascending or descending and provide this finding as part of a justification for a conclusion.<br>659 | OECD: 34.5% | Hungary: 31.0% |
| PHYSICAL EXERCISE, question 5. Using their knowledge about the human organ systems, students must explain why intensive exercise leads to an increased rate of breathing. To develop the explanation, they need to link the pieces of their specific knowledge in an explanation. | OECD: 45.2% | 583 |
| GEENHOUSE, question 3. For the competency using scientific evidence it presents a good example for Level 3. In question 3, students must interpret evidence, presented in graphical form, and deduce that the combined graphs support a conclusion that both average temperature and carbon dioxide emission are increasing.<br>529 | OECD: 53.9% | Hungary: 50.0% |
| GRAND CANYON, question 3, is at Level 2 for the competency explaining phenomena scientifically. This question requires students to know the fact that freezing water expands and thus may influence the weathering of rocks.<br>451 | OECD: 67.6% | Hungary: 73.4% |
| GRAND CANYON question 5 is near the boundary between Levels 1 and 2. Students are required to know that when the seas recede they may reveal fossils of organisms deposited at an earlier age.<br>411 | OECD: 75.8% | Hungary: 83.8% |
| PHYSICAL EXERCISE, question 3. Students must have knowledge of the science fact that active muscles get an increased flow of blood and that fats are not formed when muscles are exercised.<br>386 | OECD: 82.4% | Hungary: 90.8% |

Figure 2. | Proficiency levels and proficiency scale – science

On the basis of a comparison of the PISA cognitive framework with the frameworks and practice of Hungarian science education we can conclude the following:

- The most important and declared goals of PISA and science education in Hungary are in accordance with each other. The practical implementation of these goals in national education, however, is still something that needs to be done.
- A comparison of subject areas reveals that the scope of knowledge in PISA is narrower than what is taught in science-related subjects in Hungarian education. It contains those knowledge areas only that are suitable for the survey and can be placed in the listed contexts. So we can claim that students in our education system have the opportunity to acquire all knowledge elements required for answering the questions in PISA. It may be an issue, however, that, by the time they are 15, Hungarian students do not acquire certain contents in such depth and within such a system as is required by PISA (for example, it does matter if a 15-year-old student is in their 8th or 9th grade or in their foreign language preparatory grade in secondary education).
- Though there are slight differences in how PISA and Hungarian curricular documents (even NAT 2006) define competency this fact in itself should not be a problem when students solve the tasks. At the same time, we have to note that the curricular reform, which started with the first NAT, is still very far, in everyday educational practice, from what we can call competency based education. In current practice, the first and the third competency domains (identifying scientific issues; making conclusions using scientific evidence) are mostly pushed into the background.
- Assessing students' attitudes towards science in PISA is an unusual element compared to national surveys. Hungarian national education can learn a lot from analyzing the results of the attitudes towards science data.
- Question types used in PISA are missing from national surveys as the National Assesment of Basic Competencies (Országos kompetenciamérés) currently does not assess science competencies. The instrument is unusual because tasks are context-embedded and thus complex. From a content perspective, 15-year-old Hungarian students may have difficulties with the tasks measuring knowledge and competency elements in regards to knowledge about science (eg. identifying scientific issues, identifying explanations, applicability of a given research method).

## Results

### The Finns – one step ahead of the rest of the world

It was now the third PISA survey in which the Finnish educational system won the recognition of the world. After their excellent performance in reading and mathematics, the students of the Scandinavian country proved in the science assessment as well that their knowledge levels are outstanding in all educational domains. The "Finnish miracle" – as it is often called – cannot be explained by the high requirements, high-quality textbooks and teacher training or the well-equipped schools only. In Finland education is a high-prestige national agenda, where schools and teachers are not only trusted but also supported, both morally and financially, by the society.

In the Far-Eastern countries science education is traditionally strong. PISA 2006 reinforced this. The only surprise here was that this time it was not Japan (531) or Korea (522) that came out on top but Hong Kong (542), which had been reintegrated into China.

From the Anglo-Saxon countries, Australia (527), currently the home country of the PISA survey[1], and the neighbouring New Zealand (530) excelled. Science education in Canada has improved significantly in the past twelve years. The first signs of this improvement appeared in the 1999 TIMSS-R(epeat) assessment, which analyzed the trends in the performance of eighth-graders. The results of PISA 2006 will convince educational officials that things are going in a good direction in Canada.

In the Central-European region Slovenia (519) and the Czech Republic (513) were the only countries to perform above the OECD average. Hungarian students repeated their 2000 and 2003 results, their 504 score points are numerically higher than the mean score of the OECD countries (500), but statistically it is not different.

Countries in Southern Europe and Latin America as well as the countries of the former Yugoslavia and the successor states of the former Soviet Union performed below the average. The biggest surprise was the poor performance of Norway, which otherwise spends a lot on education. The poorest European performers were Romania and Montenegro, where the results will most probably shock the public.

The surprise country in the 2006 assessment cycle was Estonia. It was the first time that the Baltic state participated in the survey and it immediately scored a remarkable 531 points in science. It is easy to predict that this high score result will generate a lot of interest towards the country in the coming future.

Germany seems to have found an effective response to the shock caused by the PISA 2000 results. Their 516 score points in science prove that within a short period of time, in six years (which is not much in education), noticeable progress can be achieved. Germany scored 487 points in science in 2000, and 502 in 2003.

Table 2. | Multiple comparisons of mean performance on the science scale

| Countries | Mean | S. E. | Range of rank | | | |
|---|---|---|---|---|---|---|
| | | | OECD-countries | | All countries/ economics | |
| | | | Upper rank | Lower rank | Upper rank | Lower rank |
| Finland | 563 | (2,0) ▲ | 1 | 1 | 1 | 1 |
| Hong Kong-China | 542 | (2,5) ▲ | | | 2 | 2 |
| Canada | 534 | (2,0) ▲ | 2 | 3 | 3 | 6 |
| Chinese Taipei | 532 | (3,6) ▲ | | | 3 | 8 |
| Estonia | 531 | (2,5) ▲ | | | 3 | 8 |
| Japan | 531 | (3,4) ▲ | 2 | 5 | 3 | 9 |
| New Zealand | 530 | (2,7) ▲ | 2 | 5 | 3 | 9 |
| Australia | 527 | (2,3) ▲ | 4 | 7 | 5 | 10 |
| Netherlands | 525 | (2,7) ▲ | 4 | 7 | 6 | 11 |
| Liechtenstein | 522 | (4,1) ▲ | | | 6 | 14 |
| Korea | 522 | (3,4) ▲ | 5 | 9 | 7 | 13 |
| Slovenia | 519 | (1,1) ▲ | | | 10 | 13 |
| Germany | 516 | (3,8) ▲ | 7 | 13 | 10 | 19 |
| United Kingdom | 515 | (2,3) ▲ | 8 | 12 | 12 | 18 |
| Czech Republic | 513 | (3,5) ▲ | 8 | 14 | 12 | 20 |
| Switzerland | 512 | (3,2) ▲ | 8 | 14 | 13 | 20 |
| Macao-China | 511 | (1,1) ▲ | | | 15 | 20 |
| Austria | 511 | (3,9) ▲ | 8 | 15 | 12 | 21 |
| Belgium | 510 | (2,5) ▲ | 9 | 14 | 14 | 20 |
| Ireland | 508 | (3,2) ▲ | 10 | 16 | 15 | 22 |
| **Hungary** | 504 | (2,7) ● | 13 | 17 | 19 | 23 |
| Sweden | 503 | (2,4) ● | 14 | 17 | 20 | 23 |
| Poland | 498 | (2,3) ● | 16 | 19 | 22 | 26 |
| Denmark | 496 | (3,1) ● | 16 | 21 | 22 | 28 |
| France | 495 | (3,4) ● | 16 | 21 | 22 | 29 |
| Croatia | 493 | (2,4) ▼ | | | 23 | 30 |
| Iceland | 491 | (1,6) ▼ | 19 | 23 | 25 | 31 |
| Latvia | 490 | (3,0) ▼ | | | 25 | 34 |
| United States | 489 | (4,2) ▼ | 18 | 25 | 24 | 35 |
| Slovak Republic | 488 | (2,6) ▼ | 20 | 25 | 26 | 34 |
| Spain | 488 | (2,6) ▼ | 20 | 25 | 26 | 34 |
| Lithuania | 488 | (2,8) ▼ | | | 26 | 34 |
| Norway | 487 | (3,1) ▼ | 20 | 25 | 27 | 35 |
| Luxembourg | 486 | (1,1) ▼ | 22 | 25 | 30 | 34 |
| Russian Federation | 479 | (3,7) ▼ | | | 33 | 38 |
| Italy | 475 | (2,0) ▼ | 26 | 28 | 35 | 38 |
| Portugal | 474 | (3,0) ▼ | 26 | 28 | 35 | 38 |
| Greece | 473 | (3,2) ▼ | 26 | 28 | 35 | 38 |
| Israel | 454 | (3,7) ▼ | | | 39 | 39 |
| Chile | 438 | (4,3) ▼ | | | 40 | 42 |
| Serbia | 436 | (3,0) ▼ | | | 40 | 42 |
| Bulgaria | 434 | (6,1) ▼ | | | 40 | 44 |
| Uruguay | 428 | (2,7) ▼ | | | 42 | 45 |
| Turkey | 424 | (3,8) ▼ | 29 | 29 | 43 | 47 |
| Jordan | 422 | (2,8) ▼ | | | 43 | 47 |
| Thailand | 421 | (2,1) ▼ | | | 44 | 47 |
| Romania | 418 | (4,2) ▼ | | | 44 | 48 |
| Montenegro | 412 | (1,1) ▼ | | | 47 | 49 |
| Mexico | 410 | (2,7) ▼ | 30 | 30 | 48 | 49 |
| Indonesia | 393 | (5,7) ▼ | | | 50 | 54 |
| Argentina | 391 | (6,1) ▼ | | | 50 | 55 |
| Brazil | 390 | (2,8) ▼ | | | 50 | 54 |
| Colombia | 388 | (3,4) ▼ | | | 50 | 55 |
| Tunisia | 386 | (3,0) ▼ | | | 52 | 55 |
| Azerbaijan | 382 | (2,8) ▼ | | | 53 | 55 |
| Qatar | 349 | (0,9) ▼ | | | 56 | 56 |
| Kyrgyzstan | 322 | (2,9) ▼ | | | 57 | 57 |

▲ Statistically significantly above the OECD average

● Not statistically significantly different from the OECD average

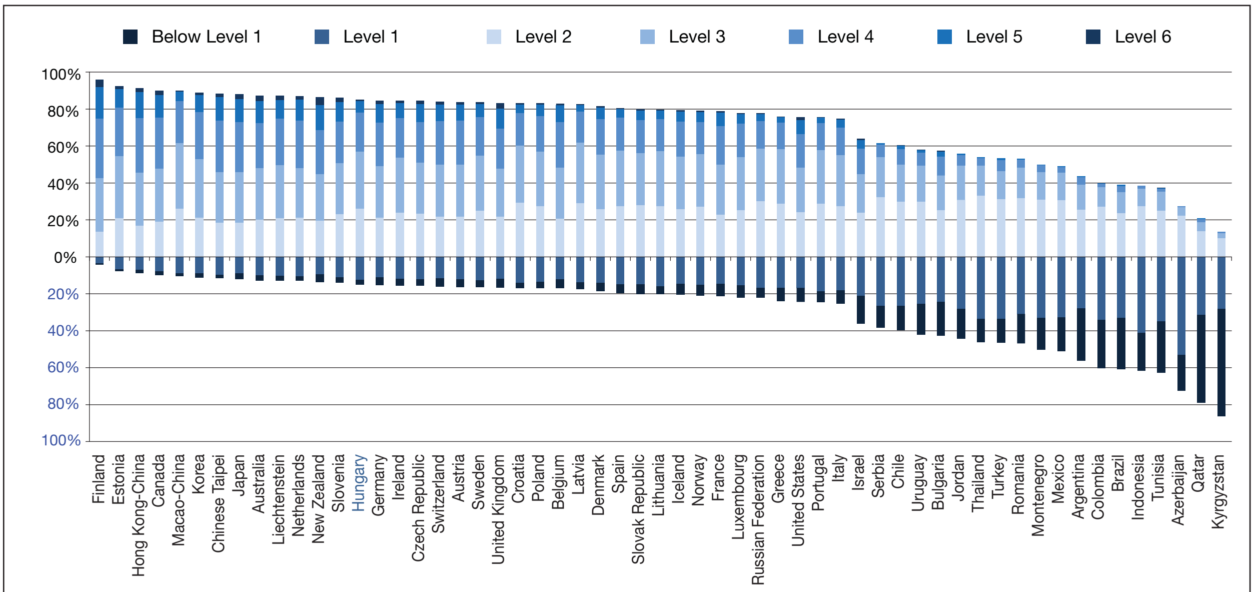
▼ Statistically significantly below the OECD average

[1] The previous cycles of PISA was organized by a consortium under the conduct of the australian-based ACER (Australian Council for Educational Research).

We have emphasized several times that the PISA survey is not a competition among nations, but an instrument that helps policy makers in the participating countries understand the current state, the weaknesses and strengths of their national education system, as well as how the changes introduced either in response to previous results or irrespective of them manifest themselves in the results. In spite of this, the PISA 2006 international report contains figures which rank the countries according to their mean score points, just like in Table 2. However, it rather functions as a means to dispel the misconceptions about ranking. It is so because standard errors from sampling (see the third column in the chart) make it impossible to establish the exact ranking, only ranking ranges can be established. Columns 4–7 show those highest and lowest rankings between which the given countries performed among OECD member countries and the participating 57 countries, respectively. On this basis, Hungary reached the 19th-23rd positions among the 57 participating countries, and the 13rd-17th positions among the OECD countries. If we compare the performance of the countries in pairs (which is an approach different from what is shown in Table 2) we can claim that Hungarian students were outperformed by their Czech counterparts and by the students of those countries that are listed above the Czech Republic. The performance of Switzerland, Austria, Belgium, Ireland, Sweden, Poland and Denmark (that is, countries which performed in line or above the OECD average) were statistically equivalent to our country's. The performance of France and the countries that are listed below France are statistically lower than the science scores of Hungary.

## Science education in Hungary is balanced

The rapidly growing demand for highly skilled workers has created a global competition for talent. While basic competencies are generally considered important to implement new technology, high-level competencies are critical for creating new technology and innovation. For countries near the technology frontier, this implies that the share of highly educated workers in the labour force is an important determinant of economic growth and social development because highly skilled individuals create innovations in various areas (organization, marketing, design and so forth) that benefit all. Research has also shown that the effect of the skill level one standard deviation above the mean in the International Adult Literacy Study on economic growth is about six times larger than the effect of the skill level one standard deviation below the mean (Hanushek and Woessmann, 2007).




*Source: OECD PISA 2006 database, Table 2.1a.*

Figure 3. | Percentage of students at each proficiency level on the science scale

It is noteworthy that the proportion of top-performers cannot be predicted from a country's mean performance. For example, Korea is among the best performing countries on the PISA science test, in terms of students' performance, with an average of 522 score points, while the United States performs below the OECD average, with a score of 489. Nevertheless, the United States and Korea have almost identical percentage of students at Level 6.

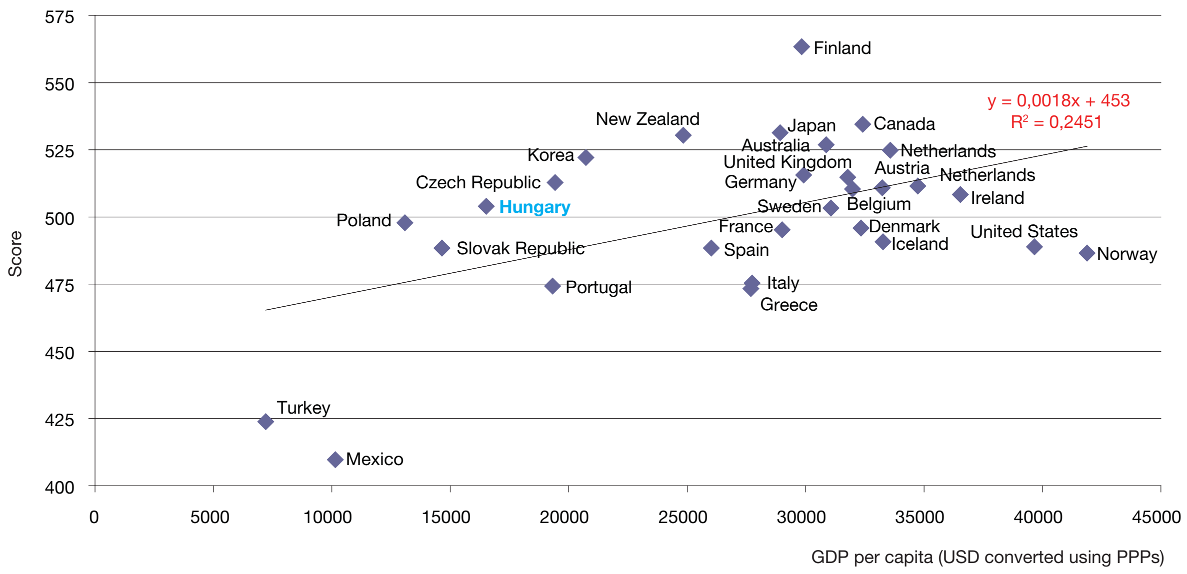
We can get a more detailed picture of students' science competencies if we examine the distribution of student performance across proficiency levels (Figure 3). After analyzing the tasks, the science expert group of PISA 2006 established that students at Level 2 and above demonstrate the science competencies that are essential for succeeding in society. The science competencies of those at Level 1 or below are so low that they should be regarded as a high-risk group as far as their ability to participate fully in society is concerned. To make comparisons simpler, the figure shows the percentage of students' across levels aligned to Level 2. The length of the column below the axis beside 0% indicates the percentage of those dropping behind, while the height of the column above it stands for the percentage of those who were prepared by public education, to different degrees though, for solving everyday science problems. The Figure arranges the countries in order according to their ability to provide their students with the minimal required science competencies (that is, what percentage of them perform at Level 2).

The proportion of top-performers can be described by the aggregate percentage of students performing at Level 5 and 6. 9.0% of students in the OECD countries belong here. In Finland, 20.9% of the students perform at Levels 5 and 6. The national authorities in Finland attribute the high proportion of top-performers in part to a major development program for fostering excellence in science education (Luma) that was progressively implemented between 1996 and 2002. Other outcomes attributed to this program have been the rising higher education enrolment in science and technology, increased cooperation between teachers, a greater focus on experimental learning and the establishment of specialized classes or streams in schools which specialize in mathematics and science.

Other countries with large proportions of students in the highest two proficiency levels are New Zealand (17.6%), Japan (15.1%) and Australia (14.6%), as well as the partner economies Hong Kong-China (15.9%) and Chinese Taipei (14.6%). These countries are best placed to create a pool of talented scientists. In contrast, countries with few students in the top two levels may face future challenges in doing so. Overall, Figure 2 suggests that the pool of 15-year-olds who are highly proficient in science is distributed very unevenly across countries. Of the 57 countries, nearly one-half (26) have 5% or fewer of their 15-year-olds reaching Level 5 or Level 6, whereas six countries have at least 15% with high science proficiency.

Of course, the global pool of scientifically qualified labour also depends on the size of countries. Populous nations like the United States and the Russian Federation may still have large numbers of scientists in absolute terms, even if the rather modest numbers of young people proficient at Levels 5 and 6 may in the future cause that a smaller proportion of individuals will choose scientific careers. However, the variability in percentages in each country with high science proficiency suggests a difference in countries' abilities to staff future knowledge-driven industries with home-grown talent.

In this Figure, Estonia, Hungary, Latvia, Croatia and Macao-China are ranked several positions closer to the top than what could be expected on the basis of their mean performance in science. In these countries, the balance of science education is kept by the fact that the number of students dropping behind is low, just like the number of top-performers; the vast majority belongs to the middle third of the distribution, that is to Levels 2, 3 and 4. The performance of Estonia excels among these countries because they were the ones to come closest to Finland with their low percentage of those dropping behind. The Estonians made it clear right after the declaration of their independence that they see education as a sector of strategic importance and worthy of long-term investment. The results justify this decision, and the heavy investments seem to pay off already.




*Source: OECD PISA 2006 database, Tables 2.1c and 2.6.*

Figure 4. | Student performance on the science scale and national income

The state of science education in Hungary is less worrying than that of reading literacy and mathematics. The percentage of those dropping behind is relatively low (15% as opposed to the more than 20% in reading and mathematics), and their performance is better than students with such levels of proficiency in other countries, raising their achievement is not hopeless. In another group of countries, including France, Austria, the Czech Republic, the United States and Belgium, more students are at the risk of dropping behind despite their country's better mean performance. Although it is also true that in these countries the number of top performers is higher, thus the society and the economy will be able to draw on broader base of professionals.

Within Europe, the results of the Baltic states are the odd ones out. In Serbia and Bulgaria about 40% of students, in Romania and Montenegro about half of them do not reach Level 2. In some Latin American and African countries as well as in the successor states of the former Soviet Union this ratio is in the 70-80% range. We have very little knowledge of the competencies of students below Level 1 as the survey practically contained no questions they could answer. We can only state that their score points are certainly below 334,5. In the OECD countries, 5.2% of students have competency levels worse than Level 1. Among Hungarian students this ratio is considerably better, 2.7%, which is quite good if we consider that such countries are below the OECD average in this respect as Greece, Italy, the United States, Turkey, Portugal, Norway, Luxembourg and Iceland.

At the same time we need to forget about the misconception that we have a student elite which is one of the bests in the world: 95% of Hungarian students had a science score below 646 points. Among the countries surveyed we can find 20 countries/ economies that have much better results in this respect, but there are quite a few among them with an average score worse than that of Hungary.

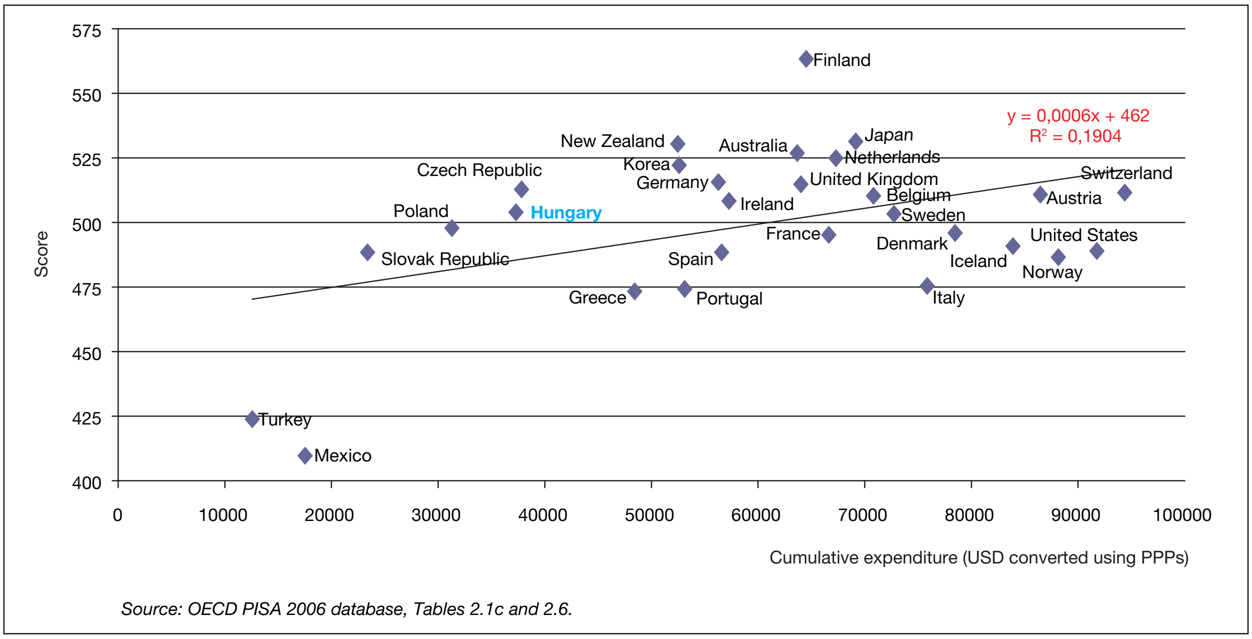



Figure 5. | Student performance on the science scale and spending per student

## Small money, small football

In as much as it is important to take socio-economic background into account when comparing the performance of any group of students, a comparison of the outcomes of education systems needs to be placed in the context of countries' economic circumstances and the resources they can devote to education. Figure 4 displays the relationship between national income as measured by GDP per capita and the average science performance of students in OECD countries, while Figure 5 compares countries' spending per student with their average performance.[2] Countries below the line in the scattered plot performed worse, those above it performed better as it was expected on the basis of their economic circumstances. Hungary is above the line in both comparisons. However, it would be misleading to interpret the figure as if the Hungarian education system were effective in using state spending on education, rather it is because both economic indicators are so low in Hungary when compared to the majority of OECD countries that in relation to these the level of Hungarian education is logically higher.

It is telling that beside Turkey and Mexico, the two least developed economies among the OECD countries, only Slovakia and Poland spent less on education than we did. If we accept the economic principle that education is one of the most profitable business investments, one that contributes to the growth of a country's economic performance through providing skilled labour, then Hungary should urgently increase its spending on education, just like the majority of Far Eastern and English speaking countries as well as Estonia and Finland had already done.

At the same time it needs to be observed that moderate spending per student cannot automatically be equated with poor performance by education systems. Spending on education in the Czech Republic and Japan are 41% and 57%, respectively, of the spending levels in the United States, but while both the Czech Republic and Japan are among the good performers in PISA, the United States performs below the OECD average. While spending on education is a necessary prerequisite for good student performance, it alone is not sufficient to achieve high levels of outcomes.

[2] On the basis of GPD per capita, 24%, on the basis of expenditure per student, 19% of the variation between countries can be explained.

| | Science score | Performance difference between the combined science scale and each scale | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Competencies | | | Knowledge of science | | | |
| | | Identifying scientific issues | Explaining phenomena scientifically | Using scientific evidence | Knowledge about science | Earth and space | Living systems | Physical systems |
| **OECD** | | | | | | | | |
| Australia | 527 | 8 | -7 | 4 | 7 | 3 | -5 | -12 |
| Australia | 511 | -6 | 6 | -6 | -7 | -8 | 11 | 7 |
| Belgium | 510 | 5 | -8 | 6 | 8 | -14 | -8 | -3 |
| Canada | 534 | -3 | -4 | 7 | 3 | 6 | -4 | -5 |
| Czech Republic | 513 | -12 | 15 | -12 | -14 | 13 | 12 | 21 |
| Denmark | 496 | -3 | 5 | -7 | -3 | -9 | 9 | 7 |
| Finland | 563 | -8 | 3 | 4 | -6 | -9 | 11 | -4 |
| France | 495 | 4 | -14 | 16 | 12 | -33 | -5 | -13 |
| Finland | 563 | -8 | 3 | 4 | -6 | -9 | 11 | -4 |
| France | 495 | 4 | -14 | 16 | 12 | -33 | -5 | -13 |
| Germany | 516 | -6 | 3 | -0 | -4 | -5 | 8 | 0 |
| Greece | 473 | -5 | 3 | -8 | -2 | 4 | 1 | 1 |
| **Hungary** | 504 | -21 | 14 | -7 | -12 | 9 | 5 | 29 |
| Iceland | 491 | 3 | -3 | 0 | 2 | 12 | -9 | 3 |
| Ireland | 508 | 8 | -3 | -2 | 4 | -0 | -3 | -4 |
| Italy | 475 | -1 | 4 | -8 | -4 | -1 | 12 | -3 |
| Japan | 531 | -9 | -4 | 13 | 0 | -1 | -5 | -1 |
| Korea | 522 | -3 | -11 | 16 | 4 | 11 | -24 | 8 |
| Luxembourg | 486 | -3 | -3 | 5 | 2 | -16 | 12 | -12 |
| Mexico | 410 | 12 | -3 | -7 | 3 | 2 | -8 | 5 |
| Netherlands | 525 | 8 | -3 | 1 | 5 | -7 | -15 | 6 |
| New Zealand | 530 | 6 | -8 | 6 | 9 | -1 | -2 | -15 |
| Norway | 487 | 3 | 9 | -14 | -6 | 10 | 10 | 5 |
| Poland | 498 | -15 | 8 | -4 | -7 | 3 | 11 | -1 |
| Portugal | 474 | 12 | -5 | -2 | 7 | 5 | 1 | -12 |
| Slovak Republic | 488 | -13 | 13 | -11 | -10 | 15 | 11 | 15 |
| Spain | 488 | 0 | 2 | -4 | 0 | 5 | 9 | -12 |
| Sweden | 503 | -5 | 6 | -7 | -5 | -5 | 8 | 14 |
| Switzerland | 512 | 3 | -4 | 7 | 3 | -9 | 1 | -5 |
| Turkey | 424 | 4 | -1 | -7 | 1 | 1 | 2 | -8 |
| United States | 489 | 3 | -3 | -0 | 3 | 15 | -2 | -4 |
| United Kingdom | 515 | -1 | 2 | -1 | 2 | -10 | 11 | -6 |
| **Partners** | | | | | | | | |
| Argentina | 391 | 4 | -5 | -6 | 6 | -7 | -0 | -8 |
| Azerbaijan | 382 | -30 | 30 | -38 | -27 | 18 | 15 | 50 |
| Brazil | 390 | 8 | -0 | -12 | 3 | -15 | 13 | -6 |
| Bulgaria | 434 | -7 | 10 | -17 | -8 | 9 | 11 | 2 |
| Chile | 438 | 6 | -6 | 1 | 5 | -10 | -4 | -5 |
| Chinese Taipei | 532 | -24 | 13 | -1 | -7 | -3 | 17 | 13 |
| Colombia | 388 | 14 | -9 | -5 | 8 | -18 | -4 | -10 |
| Croatia | 493 | 0 | -1 | -3 | 1 | 4 | 5 | -0 |
| Estonia | 531 | -16 | 9 | -0 | -8 | 9 | 8 | 4 |
| Hong Kong-China | 542 | -14 | 7 | 0 | -1 | -17 | 15 | 3 |
| Indonesia | 393 | -0 | 1 | -8 | -6 | 8 | -2 | -7 |
| Israel | 454 | 3 | -10 | 6 | 13 | -37 | 5 | -11 |
| Jordan | 422 | -13 | 16 | -17 | -13 | -1 | 28 | 11 |
| Kyrgyzstan | 322 | -1 | 12 | -34 | -14 | -7 | 8 | 27 |
| Latvia | 490 | -1 | -3 | 1 | 2 | 4 | -8 | 5 |
| Liechtenstein | 522 | 0 | -6 | 13 | 4 | -9 | 2 | -7 |
| Lithuania | 488 | -12 | 7 | -1 | -6 | -1 | 15 | 2 |
| Macao-China | 511 | -21 | 9 | 1 | -6 | -5 | 14 | 7 |
| Montenegro | 412 | -11 | 5 | -5 | -5 | -0 | 18 | -5 |
| Qatar | 349 | 3 | 7 | -25 | -6 | 0 | 12 | 8 |
| Romania | 418 | -9 | 7 | -11 | -6 | -12 | 8 | 10 |
| Russian Federation | 479 | -17 | 4 | 1 | -4 | 2 | 10 | -0 |
| Serbia | 436 | -5 | 5 | -11 | -5 | 5 | 14 | -0 |
| Slovenia | 519 | -2 | 4 | -3 | -9 | 15 | -2 | 12 |
| Thailand | 421 | -8 | -1 | 2 | 0 | 9 | 11 | -14 |
| Tunisia | 386 | -2 | -2 | -4 | 4 | -33 | 6 | 7 |
| Uruguay | 428 | 1 | -5 | 1 | 3 | -31 | 5 | -7 |

Each scale is 20 or more score points higher than the combined science scale
Each scale is between 10 and 19.99 score points higher than the combined science scale
Each scale is between 0 to 9.99 score points higher than the combined science scale

Each scale is 20 or more score points lower than the combined science scale
Each scale is between 10 and 19.99 score points lower than the combined science scale
Each scale is between 0 to 9.99 score points lower than the combined science scale

Table 3. | Comparison of performance on the different scales in science

## Weaknesses and strengths

One of the strengths of PISA 2006 is that it allows the examination of students' science competencies and also the science knowledge domains. Understanding the comparative strengths of their students in different science competencies and knowledge domains can inform policy makers and help direct development of strategies. Behind the results of each country there lies a different structure of knowledge as educational systems differ in their traditions, preferences or their deficiencies. The mean score points of each country are resultants of these shifts in emphasis. Table 3 shows the different levels of knowledge and competencies that together make up the knowledge structure of each country as well as the weaknesses and strengths that can describe countries' knowledge of science.

In the first column following the name of the country we can see the science score achieved. The following seven scales show the performance difference between the mean scores of the combined science scale and the three competencies and four knowledge of science scales. The individual cells of the table are colour coded, as noted in the legend, according to the differences from the country's overall science score. The results inform countries about where their science education may need to be strengthened. The relative strengths in competencies follow the same sequence that is used when dealing with science problems: first identifying the problem, then applying knowledge of scientific phenomena, and finally interpreting and using the results. Traditional science teaching, like ours, often concentrates on the middle process, explaining phenomena scientifically, which requires familiarity with key science knowledge and theories. Yet without being able first to recognize a science problem and then to interpret findings in ways relevant to the real world, students are not fully scientifically literate. A student who has mastered a scientific theory but who is unable to weigh up evidence, for example, will make limited use of science in adult life. In this context, countries with students relatively weak in identifying scientific issues or using scientific evidence may need to consider the ways in which they acquire these competencies and through them scientific problem-solving skills, while those weak in explaining phenomena scientifically may need to focus more on the mastery of scientific knowledge.

One general point of interest in Table 3 is that students in several of the ten countries with the highest science scores are particularly strong in using scientific evidence. The mean score of these ten countries in using scientific evidence is 539 points, compared to 533 for science overall. Conversely, the ten weakest countries have either lower or similar mean scores in using scientific evidence to their science scores overall, the difference between the two mean scores being 14 points. This suggests that the ability to interpret and use scientific evidence is more closely related to a high level of science competency within a country.

In the case of Australia, the value -12 in the column "Earth and space" means that Australian students scored 12 points lower (515 points) on this scale than overall (527 points). On the scale "Identifying scientific issues" the value 8 refers to the fact that within their knowledge structure this competency is a relative strength.

## Differences between knowledge domains

The PISA 2006 science framework covers two knowledge domains – knowledge about science and knowledge of science. The second domain can be further divided into the content areas "Physical systems", "Living systems" and "Earth and space systems". (The content area "Technology systems" cannot be analyzed separately as insufficient amount of questions were included in the test from this area.)

In some countries there is a significant difference between the students' performance in the two knowledge domains. France shows the largest difference in favour of knowledge about science (29.2 score points). French educational authorities attribute their students better performance in this domain to the fact that the French curriculum focuses on scientific argumentation, data analysis and experiments. Other countries with a relative strength in the knowledge about science domain include Belgium (16.6 score points), Japan

(14.6 score points), the Netherlands (10.7 score points), Australia (10.8 score points) and Luxembourg (7.2 score points). All of these countries, except for Luxembourg, performed remarkably well in the test.

There are also countries in which students perform better in the knowledge of science domain. Among OECD countries the largest differences are observed in the Czech Republic (29.2 score points), Hungary (26.2 score points) and the Slovak Republic (24.1 score points). These three countries are located in close proximity to each other in Eastern Europe and share similar traditions in science education, in which science is taught with a focus on the accumulation and reproduction of theoretical knowledge in scientific disciplines, with much less emphasis on acquiring scientific thinking. For the Czech Republic, the ways in which students learn about the phenomena and their explanations, rather than discovering scientific phenomena themselves, has been documented through an extensive video study, Teaching Science in Five Countries: Results from the TIMSS 1999 Video Study (Roth et al., 2006). In the majority of Eastern European countries – Poland (11.9 score points), Slovenia (16.9 score points), Estonia (15.4 score points), Serbia (11.2 score points) and Lithuania (10.7 score points) – we can observe the same with slightly smaller differences.

### Differences in emphasis

Student performance in the knowledge of science domain can be further distinguished in terms of the content areas. This analysis shows significant performance differences within countries, which provide important insights into curricular patterns in countries. Korea, for example, scores 530 and 533 points on the “Physical systems” and “Earth and space systems” scales, but only 498 points on the “Living systems” scale. Why is there such a surprisingly large difference? And why at the expense of biology? The answers to these questions are most probably found in the Korean curriculum.

This section presents for each of the three content areas groups of countries where students are relatively strong or weak compared to the other science content scales. The emphasis here is not on the content area ranking of the countries. In the analysis, those content areas were considered weakness or strength for each country where there was a difference of at least 10 score points on a content area mean score relative to the overall mean scores.

The table shows that among the OECD countries the relative strength on the “Physical system” scale is the most pronounced (29 score points) in Hungary but we can find bigger score differences in the Czech Republic (21 points) and Slovakia (15 points) as well. The latter two countries have a common history and are similar to each other in that as well that they performed significantly better in each of the three content areas than their overall mean score. Countries with relatively weak performance in this content area include New Zealand, France, Luxembourg, Australia, Portugal and Spain.[3]

On the “Earth and space systems” scale Slovakia (15 score points), the United States (15), the Czech Republic (13), Iceland (12), Slovenia (15) and Korea (11) performed better than their overall mean score. France and Israel show expressly low (-33 and -37 score points, respectively) relative performance in this area, and Belgium (-14), the United Kingdom, Finland (-10) and Hong Kong (-17) also performed below their respective science mean score.

22 countries showed relatively strong performance in the remaining content area, “Living systems”. Among them, Jordan stands out with outperforming its overall mean score by 28 score points, while only three countries – Korea (-24), the Netherlands (-15) and Iceland (-9) – performed expressly lower than that.

[3] In this section, when we speak of “relatively good” or “relatively bad” performance in a certain country we talk about the strength or weakness of only one of the content areas within the given country. It does not mean that they were necessarily strong or weak on absolute terms as well in that area.

### They do not love it but still they know it

In Hungary, physics and chemistry are the most unpopular subjects but our students still performed best in the content area “Physical systems”. Their 533 score points are not only outstanding when compared to the overall Hungarian mean score but it is also in international comparison: there was only one country in Europe and three in the world (Taiwan, Hong Kong and Finland) that performed better.

### The eternal Achilles’ heel

Whenever results of national and international science surveys have been analyzed in Hungary in the past forty years, the main conclusion was that Hungarian students’ theoretical knowledge about experiments and measurements as well as their practical experience is far beyond what students in most countries of the world can acquire. PISA 2006 is no exception. The vast majority of students do not encounter the theory and the practice of measurements to the desirable degree. The negative consequences of this are predictable for the area of both knowledge and competencies. To separate the knowledge about measurements and scientific examination, the cognitive framework of PISA 2006 defined an individual knowledge domain and called it knowledge of science. Hungarian students scored 492 score points on this scale, which is not only 12 points lower than their overall mean score but ranks us among the poor performers in the OECD group as well.

Identifying scientific issues includes all those competencies that assume stable knowledge as far as the characteristics of measurements and experiments go. The assumption is supported by facts as the countries where knowledge about science is good in comparison with the overall mean of the test (Australia, Belgium France, Iceland, Ireland, the Netherlands, New Zealand, Portugal, Switzerland, Turkey, the United States and Mexico) students have the competencies related to measurement and experimentation. It is apparent that fundamental differences in educational philosophy explain this phenomenon.

Quite naturally, this correlation holds in the negative range as well, that is those countries that perform relatively poorly in identifying scientific issues have achieved lower results in the knowledge about science domain. It is not difficult to observe that the countries of the former Socialist block make up the group of countries where either because of its prestige or for other reasons theoretical and knowledge-based education was preferred. The negative side effects of which are noticeable in the case of the otherwise excellent performer Czech and Estonian, the average performing Polish and Hungarian as well as the low-performing Azeri, Russian, Lithuanian, Romanian, Montenegrin and Slovakian students. It is not a surprise that Hungarian students performed very poorly (483 score points) in this part of the test, outperforming only Greek, Italian and Mexican students in this competency among the OECD countries.

Table 3 gives an accurate diagnosis of the problems of Hungarian science education. Hungarian students are usually successful in solving those questions which require them to explain physical or chemical phenomena using their theoretical knowledge, while they have difficulties in providing or identifying the design and process of a scientific experiment.

### Males or females?

The PISA assessment is different from most previous surveys since it requires the simultaneous use of several different competencies for successful performance, and to understand and complete the tasks. Of course, students need to have the required factual knowledge but they also need good reading skills, logical thinking, the ability to connect different pieces of information scattered throughout the question, that is all those competencies by which they can identify everyday problems in the questions and can convert them into the well-known world of laws and concepts in a given area of science.

Girls are better in reading than boys. In those areas, which mostly require logic and abstraction, like mathematics, usually boys perform better. We would expect that in science, where problem solving requires logical thinking, reading literacy and factual knowledge simultaneously, the differences between boys and girls level off. Girls can, for a certain degree, compensate for their average logical skills with better understanding the question. The poorer reading skills of boys are offset by their better abstraction and inferring skills. And the results support this theory.

In Hungary, the mean score of boys is 6 score points higher than that of girls but this difference is not significant. There is no substantial difference between boys and girls in the proportion of those dropping behind, it is nevertheless surprising that a greater percentage of girls reached Level 5 (8.4 percent compared to 5.2 for boys).

The understanding and solving of problems requires different levels of abstraction skills in each of the three content areas. The understanding of “Living systems” is the easiest as this constitutes the bigger part of the tangible world around us. On OECD average, there is no significant difference between boys and girls in this area: boys (504 score points) score 4 points higher than girls (500 score points). In the area “Earth and space systems” the difference increases to 17 score points (girls 491 points, boys 508 points) on OECD average, and in 30 countries 26 shows statistically relevant differences. Interestingly enough, the gap between Hungarian girls and boys is only half of the international value (girls 516 points, boys 508 points). In the content area “Physical systems”, which is the most abstract of the three, the difference between the knowledge of boys and girls reaches 26 score points (girls 487 points, boys 513 points). This gap is substantial and statistically significant across the OECD countries, except for Turkey where, probably because of cultural traditions, it is only 2 points. In Hungary, which proved to be very strong in this area, the advantage of boys was 36 score points. The 550 score points for boys and 514 points for girls are world-class in an international comparison.

# Reading literacy

## A definition of reading literacy

Reading literacy focuses on the ability of students to use written information in situations they encounter in their life. In PISA, reading literacy is defined as *"understanding, using and reflecting on written texts, in order to achieve one's goals, to develop one's knowledge and potential and to participate in society"*. This definition goes beyond the traditional notion of decoding information and literal interpretation of what is written towards more applied tasks.

The concept of reading literacy in PISA is defined by three dimensions: the format of the reading material, the type of reading task or reading aspects, and the situation or the use for which the text was constructed.

The first dimension, the text format, classifies the reading material or texts into continuous and non-continuous texts. Continuous texts are typically composed of sentences that are, in turn, organized into paragraphs. These may fit under larger structures such as sections, chapters and books. Non-continuous texts are organized differently from continuous texts; they require a different reading approach and can be classified according to their format (chart, table, diagram).

The second dimension is defined by the three reading aspects. Some tasks required students to retrieve information – that is, to locate single or multiple pieces of information in a text. Other tasks required students to interpret texts – that is, to construct meaning and draw inferences from written information. The third type of task required students to reflect on and evaluate texts – that is, to relate written information to their prior knowledge, ideas and experiences.

The third dimension, the situation or context, reflects the categorization of texts based on the author's intended use, the relationship with other persons implicitly or explicitly associated with the text, and the general content. The situations included in PISA and selected to maximize the diversity of content included in the reading literacy assessment were reading for private use (personal), reading for public use, reading for work (occupational) and reading for education.[1]

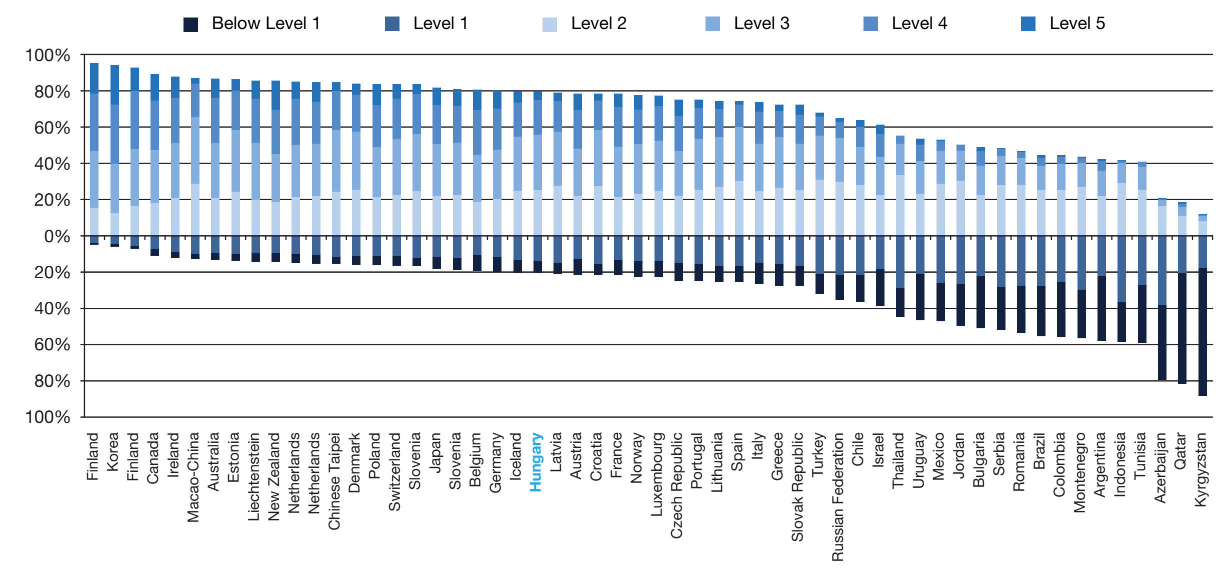
Since reading was the focus of the PISA 2000 survey, the framework and instruments for measuring reading literacy were fully developed at that stage, and an OECD mean score of 500 points was established for PISA 2000 as the benchmark against which reading performance has since been measured. In PISA 2003 and PISA 2006, when the focus shifted to mathematics and then science, the area of reading was given smaller amounts of assessment time than in PISA 2000 with 60 instead of 210 minutes devoted to reading, allowing an update on overall performance rather than the kind of in-depth analysis of knowledge and skills shown in the PISA 2000 report[2]. In PISA 2000, student performance in reading was reported separately for each of the three aspects described above. In PISA 2003 and PISA 2006, however, smaller amounts of testing time for reading only allow reading to be reported on a single combined scale.

[1] A full description of the conceptual framework underlying the PISA assessment of reading literacy is provided in Assessing Scientific, Reading and Mathematical Literacy: A Framework for PISA 2006 (OECD, 2006a).

[2] All the 26 reading literacy items included in PISA 2006 were chosen from the 141 reading literacy items included in PISA 2000. These were selected in accordance with the goals defined in the framework, ensuring that the proportion of the various question types were identical in the consecutive surveys.

| Level | Score | Results |
| --- | --- | --- |
| Level 5 (scores higher than 625.6 points)<br>Students proficient at Level 5 on the reading literacy scale are capable of completing sophisticated reading tasks, such as locating and using information that is difficult to find in complex and unfamiliar texts; showing detailed understanding of such texts and inferring which information in the text is relevant to the task; and being able to evaluate critically and build hypotheses, draw on specialized knowledge. They are capable of comparing the contents of the text with their own set of values or interpreting the characters' actions from an objective or subjective point of view. | 626 | In the OECD countries, on average, 8.5% of the students are at Level 5. In Korea, 21.7% of the students are at this level, as are more than 15% of the students in Finland and New Zealand. In contrast, less than 1% of the students in some of the Third World countries (for example, Indonesia, Tunisia) reach Level 5, but there are three European countries – Serbia, Montenegro and, as the only EU member state, Romania – that also belong to this group.<br>In Hungary, 4.7% of students have excellent reading literacy skills, which is significantly lower than the OECD average. |
| Level 4 (scores higher than 552.9 but lower than or equal to 625.6 points)<br>Students proficient at Level 4 on the reading literacy scale are capable of completing difficult reading tasks, such as locating embedded information, dealing with ambiguities and critically evaluating a text. They are capable of finding the relationship between the emotions and actions of a character in a text, interpreting their motivations or form opinions about the stylistic tools used in the text. | 553 | In the OECD countries, on average, 29.2% of students are proficient at Level 4 or above (that is, at Levels 4 and 5). Over one-half of the students in Korea and at least 40% of those in Finland, Canada, New Zealand and the partner economy Hong Kong-China attain at least Level 4. With the exception of Mexico, Turkey, Spain and Greece, at least 20% of students in each OECD country reach at least Level 4.<br>In Hungary, 23.5% are good or excellent in reading. This proportion ranks us in the group of Iceland, Italy, Luxembourg and Slovakia among the OECD countries. |
| Level 3 (scores higher than 480.2 but lower than or equal to 552.9 points)<br>Approximately, this is the proficiency level which is required for successfully finishing high-school studies.<br>Just like at higher levels, students proficient at Level 3 on the reading literacy scale are capable of integrating information from different sources and solving problems of moderate complexity. They can also make links between different parts of a text and demonstrate a detailed understanding of the text in relation to their familiar, everyday knowledge. | 480 | In the OECD countries, on average, 57% of students are proficient at least at Level 3 (that is, at Levels 3, 4 and 5) on the reading literacy scale. In 6 of the 30 OECD countries (Korea, Finland, Canada, Ireland, New Zealand and Australia), and in two partner countries/economies (Hong Kong-China and Liechtenstein), over 65% of 15-year-old students are proficient at least at Level 3. This level is the individual proficiency level at which most students are placed, with 26.3% of students on average in the OECD area.<br>In Hungary, 54.1% of 15-year-old students belong here with average or better reading literacy skills. This is close to, but still below, the OECD average. |
| Level 2 (scores higher than 407.5 but lower than or equal to 480.2 points)<br>Students proficient at this rather low level are capable of completing basic reading tasks, such as locating straightforward information and finding simple relationships in the text. They can only cope with processing simple and clearly structured texts, which require no complex problem-solving. This low skill level makes difficult for them to understand unfamiliar texts, and they are most probably incapable of learning new information on their own. | 408 | Across the OECD, on average, 79.7% of students has the basic reading literacy skills required for solving everyday problems and tasks. In every OECD country except Mexico, Turkey, the Slovak Republic and Greece at least 73% of students are at Level 2 or above.<br>In Finland 95.2% of the students are at Level 2 and above. Other countries with more than 85% of students at Level 2 and above are (in ascending order) New Zealand, Australia, Ireland, Canada, Korea and the partner countries/economies Liechtenstein, Estonia, Macao-China and Hong Kong-China.<br>In Hungary, 16 out of 20 students (79.4%) perform at this level, which is in line with the OECD average. |
| Level 1 (scores higher than 334.8 but lower than or equal to 407.5 points) or below<br>Performance at Level 1 naturally does not mean that these students have no literacy skills, but they are handicapped as they have serious difficulties in using reading literacy as an effective tool to advance and extend their knowledge and skills in other areas. Students performing below 335 score points – that is, below Level 1 – are not likely to demonstrate success on the most basic type of reading that PISA seeks to measure. | 335 | Across the OECD, on average, 12.8% of students perform at Level 1, and 7.4% perform below Level 1, but there are wide differences between countries.<br>In Finland and Korea, less than 6% of students perform at or below Level 1. In all other OECD countries, the percentage of students performing at or below Level 1 ranges from 10.9% (Canada) to 47.1% (Mexico).<br>In Europe, countries with at least 25% of students at or below Level 1 are Bulgaria, Serbia, Romania and Montenegro.<br>In Hungary, 20.6% of students have inadequate reading skills (14% are at Level 1 and 6.5% are below Level 1), which is practically identical to the OECD average. |

Figure 6. | Proficiency levels – reading




*Source: OECD PISA database 2006, Table 7.1a.*

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

# Results

## Levels of reading literacy

As in PISA 2000 and PISA 2003, reading scores in PISA 2006 are reported according to five levels of proficiency, corresponding to tasks of varying difficulty. The establishment of proficiency levels in reading makes it possible not only to rank students' performance but also to describe what students can do. Each successive reading level is associated with tasks of ascending difficulty.

Students' reading skills are analyzed according to the distribution of proficiency levels for every country. The left column in Figure 6 describes the five proficiency levels, while in the right column there are some important statements, made using the data in Figure 7, about the percentage of students at each level and thus about the reading literacy skills of each country. Naturally, beside international data Hungarian data are included in the table as well.

## Mean performances in reading

Countries' performance in reading can also be summarized through countries' mean scores. While level-based analysis has the advantage of providing details that show the distribution of student performance in countries, average performance can describe the current state of reading skills in a country with a single datum. Countries where 15-year-old students achieve high average performance in reading will have a considerable economic and social advantage in the future, when the skill advantage of today's 15-year-olds will manifest itself in more skilled labour.

In PISA 2006, the OECD average score for reading is 492 score points. This score is slightly lower than the average score of 500 for the PISA 2000 assessment, which is partly explained by the fact that Turkey and the Slovak Republic, both performing below the OECD average, joined PISA in 2003. However, among the countries that provided comparable data for both PISA 2000 and PISA 2006, the corrected average performance in PISA 2006 still remains slightly lower with 494 score points.

We look at the mean reading scores of countries participating in PISA 2006 with the help of Table 4. Because the figures are derived from samples, measurement errors may occur (these are indicated in parentheses right after the mean scores, S.E.) and it is not possible to determine a precise rank of the performance of a country among the participating countries. It is, however, possible to determine with 95% likelihood a range of ranks between which the country's rank lies among all the participating countries and the OECD countries, respectively.

> In the case of Australia, the 6 seen in the upper rank and the 9 shown in the lower rank columns mean that the country ranks between the 6th to 9th positions among the 57 countries participating in the PISA 2006 assessment. If we look at pairs of countries, which is an approach different from the one used in Table 4, we can claim that the result of Australia is not significantly different from that of Ireland, Liechtenstein, Poland, Sweden and the Netherlands; it is lower than that of New Zealand and the countries above New Zealand, but it is better than that of Belgium and all those countries that have lower mean scores than Belgium.

The colour coding in Table 4 indicates which countries performed better or worse than the OECD average or which has a score not statistically different from that.

## The top three: Korea, Finland and Hong Kong

In Korea, performance on the reading literacy scale is above that of any other OECD country, even higher than in Finland, which was the top-performer in reading in PISA 2000 and PISA 2003. Korea's country mean, 556 score points, is nearly one proficiency level[3] above the OECD average of 492 score points in PISA 2006. Other OECD countries with mean performances statistically significantly above the OECD average include Hong Kong from the Far East, Finland and Sweden from Scandinavia, Australia, New Zealand and Ireland from among the English-speaking countries as well as Canada, Lichtenstein and the Netherlands.

| Countries | Mean | S. E. | Range of rank: OECD-countries | | Range of rank: All countries/economies | |
|---|---|---|---|---|---|---|
| | | | Upper rank | Lower rank | Upper rank | Lower rank |
| Korea | 556 | (3,8) ▲ | 1 | 1 | 1 | 1 |
| Finland | 547 | (2,1) ▲ | 2 | 2 | 2 | 2 |
| Hong Kong-China | 536 | (2,4) ▲ | | | 3 | 3 |
| Canada | 527 | (2,4) ▲ | 3 | 4 | 4 | 5 |
| New Zealand | 521 | (3,0) ▲ | 3 | 5 | 4 | 6 |
| Ireland | 517 | (3,5) ▲ | 4 | 6 | 5 | 8 |
| Australia | 513 | (2,1) ▲ | 5 | 7 | 6 | 9 |
| Liechtenstein | 510 | (3,9) ▲ | | | 6 | 11 |
| Poland | 508 | (2,8) ▲ | 6 | 10 | 7 | 12 |
| Sweden | 507 | (3,4) ▲ | 6 | 10 | 7 | 13 |
| Netherlands | 507 | (2,9) ▲ | 6 | 10 | 8 | 13 |
| Belgium | 501 | (3,0) ▲ | 8 | 13 | 10 | 17 |
| Estonia | 501 | (2,9) ▲ | | | 10 | 17 |
| Switzerland | 499 | (3,1) ▲ | 9 | 14 | 11 | 19 |
| Japan | 498 | (3,6) ● | 9 | 16 | 11 | 21 |
| Chinese Taipei | 496 | (3,4) ● | | | 12 | 22 |
| United Kingdom | 495 | (2,3) ● | 11 | 16 | 14 | 22 |
| Germany | 495 | (4,4) ● | 10 | 17 | 12 | 23 |
| Denmark | 494 | (3,2) ● | 11 | 17 | 14 | 23 |
| Slovenia | 494 | (1,0) ▲ | | | 16 | 21 |
| Macao-China | 492 | (1,1) ● | | | 18 | 22 |
| Austria | 490 | (4,1) ● | 12 | 20 | 15 | 26 |
| France | 488 | (4,1) ● | 14 | 21 | 18 | 28 |
| Iceland | 484 | (1,9) ▼ | 17 | 21 | 23 | 28 |
| Norway | 484 | (3,2) ▼ | 16 | 22 | 22 | 29 |
| Czech Republic | 483 | (4,2) ▼ | 16 | 22 | 22 | 30 |
| **Hungary** | 482 | (3,3) ▼ | 17 | 22 | 23 | 30 |
| Latvia | 479 | (3,7) ▼ | | | 24 | 31 |
| Luxembourg | 479 | (1,3) ▼ | 20 | 22 | 26 | 30 |
| Croatia | 477 | (2,8) ▼ | | | 26 | 31 |
| Portugal | 472 | (3,6) ▼ | 22 | 25 | 29 | 34 |
| Lithuania | 470 | (3,0) ▼ | | | 30 | 34 |
| Italy | 469 | (2,4) ▼ | 23 | 25 | 31 | 34 |
| Slovak Republic | 466 | (3,1) ▼ | 23 | 26 | 31 | 35 |
| Spain | 461 | (2,2) ▼ | 25 | 27 | 34 | 36 |
| Greece | 460 | (4,0) ▼ | 25 | 27 | 34 | 36 |
| Turkey | 447 | (4,2) ▼ | 28 | 28 | 37 | 39 |
| Chile | 442 | (5,0) ▼ | | | 37 | 40 |
| Russian Federation | 440 | (4,3) ▼ | | | 37 | 40 |
| Israel | 439 | (4,6) ▼ | | | 38 | 40 |
| Thailand | 417 | (2,6) ▼ | | | 41 | 42 |
| Uruguay | 413 | (3,4) ▼ | | | 41 | 44 |
| Mexico | 410 | (3,1) ▼ | 29 | 29 | 41 | 44 |
| Bulgaria | 402 | (6,9) ▼ | | | 42 | 50 |
| Serbia | 401 | (3,5) ▼ | | | 44 | 48 |
| Jordan | 401 | (3,3) ▼ | | | 44 | 48 |
| Romania | 396 | (4,7) ▼ | | | 44 | 50 |
| Indonesia | 393 | (5,9) ▼ | | | 44 | 51 |
| Brazil | 393 | (3,7) ▼ | | | 46 | 51 |
| Montenegro | 392 | (1,2) ▼ | | | 47 | 50 |
| Colombia | 385 | (5,1) ▼ | | | 48 | 53 |
| Tunisia | 380 | (4,0) ▼ | | | 51 | 53 |
| Argentina | 374 | (7,2) ▼ | | | 51 | 53 |
| Azerbaijan | 353 | (3,1) ▼ | | | 54 | 54 |
| Qatar | 312 | (1,2) ▼ | | | 55 | 55 |
| Kyrgyzstan | 285 | (3,5) ▼ | | | 56 | 56 |

▲ Statistically significantly above the OECD average

● Not statistically significantly different from the OECD average

▼ Statistically significantly below the OECD average

Table 4. | Multiple comparisons of mean performance on the reading scale

[3] A difference of one proficiency level on the reading literacy scale corresponds to 72.7 score points.

Except for Poland, Slovenia and Estonia, no country in Central Eastern Europe could reach the OECD average. The poor performances of Bulgaria (402), Serbia (401), Romania (396) and Montenegro (392) even stand out from this crowd as they are more than one competency level below the Czech Republic (483) and Hungary (482). Among OECD countries, the differences are even larger with 147 score points separating the mean scores of the highest and lowest performing countries (Korea and Mexico, respectively) which equals to about two competency levels.

The mean score of Hungarian students in reading literacy is 482 score points. This ranks our country in the 23rd to 30th position range among the 57 countries. If we compare the performance of Hungary to that of individual participating countries we can claim that our 482 score points statistically equal to the performance of Austria, France, Iceland, Norway, the Czech Republic, Latvia, Luxembourg and Croatia, they are lower than that of Macao-China and the countries above it in the table, and statistically significantly better than the performance of Portugal and the countries below it in the ranking.

Although there are large differences in the mean performance between countries, the variation in performance between students within each country is much larger. One of the major challenges faced by education systems is to increase the percentage of students performing well in reading while at the same time minimizing that of poor performers who can be marginalized in society because of their low reading skills. Poor performance in reading is a serious issue of our times because levels of reading literacy have a significant impact on the welfare of individuals, the state of society and the economic standing of countries in the international arena. This can be especially true in the countries of our region which aim to catch up with the more developed economies in Europe.

Inequality in this context can be examined through the performance distribution as seen by the gap in performance between the 5$^{th}$ and the 95$^{th}$ percentiles[4]. Among OECD countries, Finland and Korea show the narrowest distributions in the OECD with this difference equivalent to 265 and 289 score points, respectively, while at the same time these two countries show the strongest overall performance. The Czech Republic, Germany, the United States and Japan have the largest inequalities among their own students with the difference between the highest and lowest performers being 362-364 score points. From this group only Japan performs better than the OECD average despite such a large variation in performance.

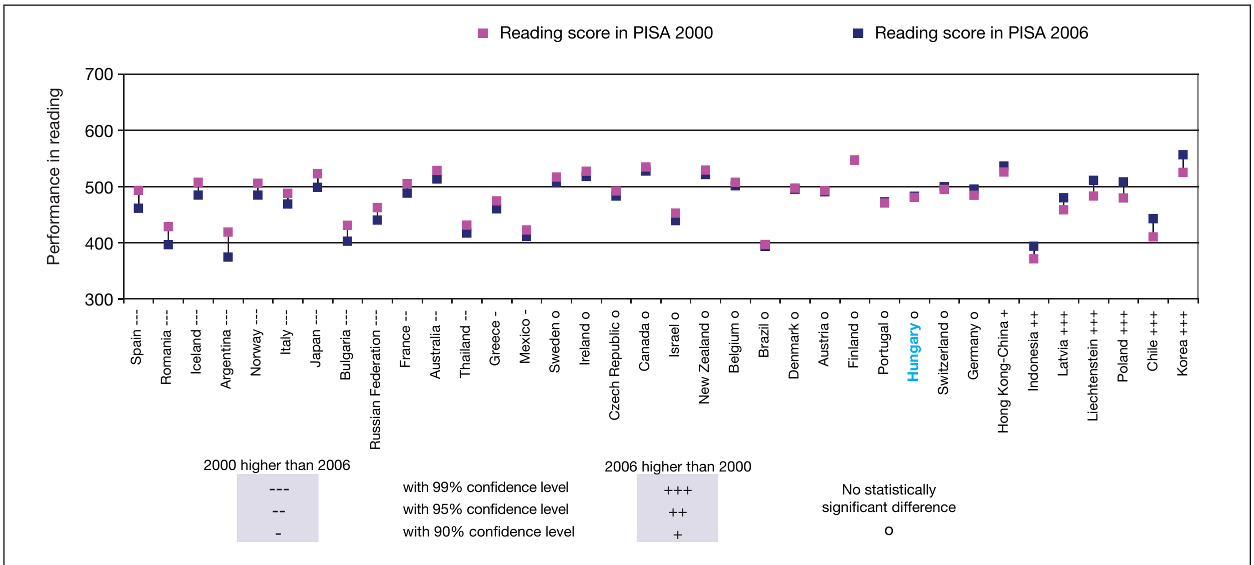
The performance distribution among Hungarian students is "healthier", the gap in performance between the 5$^{th}$ and the 95$^{th}$ percentiles is 305 score points. In comparison with the Czech students, who perform basically identically, we can see that in Hungary the performance of those dropping behind is better than in the Czech Republic (roughly corresponding to the numbers of the Japanese) but the performance of our best students is lower with the same amount than that of Czech students (and equals that of Portugal students who performed lower). We have to realize that while it is important for Hungarian education to improve our talented students it is equally important to decrease the percentage of those dropping behind.

### How student performance in reading has changed?

After a first glimpse of change over time from PISA 2000 to PISA 2003, PISA 2006 offers information about performance trends in reading (Figure 8) of six years term since PISA 2000, when the first full assessment of reading took place.

Across OECD countries, performance in PISA reading has remained broadly similar between 2000 and 2006, despite the fact that both later assessments witnessed a slight decrease in mean performance (498 score points in 2003, and 492 in 2006) from the originally set 500 score points. We can, however, see certain

[4] The n$^{th}$ percentile is the point on the literacy scale below which n percent of the students perform while 100-n percent perform above it. So the 25$^{th}$ percentile is the point on the literacy scale below which the quarter of the students perform while three quarters of them perform above it in reading in a given country.




*Source: OECD PISA database 2006, Table 7.3a.*

Figure 8. | Differences in reading between 2006 and 2000

tendencies in some countries. Figure 8 shows that seven countries have achieved statistically significant improvement: two OECD countries (Korea and Poland) and five partner countries (Chile, Liechtenstein, Latvia, Indonesia and Hong Kong-China).

- Korea increased its reading performance between PISA 2000 and PISA 2006 by 31 score points from an already high level: the country's mean performance was 525 score points in PISA 2000. They achieved this increase mainly by significantly raising performance standards among the better performing students, while the performance at the lower end of the distribution remained essentially unchanged. The Korean authorities attribute the improvement in reading performance to a new curriculum under which essay tests gained much greater emphasis. Furthermore, universities have also introduced and expanded use of essay test scores in admission screenings with opportunities for students to formulate and present their own thoughts and opinions. This has provided additional incentives for better-performing high-school students to enhance their reading and reasoning skills in order to gain access to the university of their choice.
- Hong Kong-China has been another country that has seen a significant increase, by 11 score points since PISA 2000, from an already high level of reading performance, reaching 536 score points in PISA 2006. Here the change was mainly driven by improvements among the lowest performing students, with the 5$^{th}$ percentile rising by 21 score points, which means that they could narrow the gap between their students.
- Poland increased its reading performance by 17 score points between PISA 2000 and PISA 2003 and another 11 score points between PISA 2003 and PISA 2006 and now performs, at 508 score points, for the first time clearly above the OECD average. Between 2000 and 2003, Poland raised its average performance mainly through increases at the lower quarter of the performance distribution. Extensive analyses at the national level have associated this improvement with the reform of the schooling systems in 1999, which now provides more integrated educational structures. Since PISA 2003, performance in Poland has risen more evenly across the performance spectrum.
- The other countries that have seen significant performance increases in reading between PISA 2000 and PISA 2006 – Chile (33 score points between PISA 2000 and PISA 2006), Liechtenstein (28 score points), Indonesia (22 score points) and Latvia (21 score points) – all, with the exception of Liechtenstein, perform significantly below the OECD average.

Nine OECD countries (Spain, Japan, Iceland, Norway, Italy, France, Australia, Greece and Mexico) as well as five partner countries (Argentina, Romania, Bulgaria, Russian Federation and Thailand) saw a decline in their reading performance between PISA 2000 and PISA 2006. It is noteworthy that among the countries with above-average performance levels only Australia has seen a statistically significant decline in their students' reading performance, by 11 score points, which is attributable to a decline at the higher end of the performance spectrum.

Hungary belongs to that group of countries where reading performance has not changed since PISA 2000 (Table 5). There are only two countries, Belgium and Hungary among the 31 that participated in all three assessments, the performance of which remained unchanged in all variables (mean performance, male and female average, gender differences, and the score points of the 6 different percentiles) between 2000 and 2003 and then between 2003 and 2006. The performance of Hungarian students is in fact so identical as if all the three tests had been completed by the very same 5000 children. Changes introduced in the curricula and the schooling system in general have not yet reached the practice of education.

| Assessment | Reading literacy performance |
|---|---|
| PISA 2000 | 480 score points |
| PISA 2003 | 482 score points |
| PISA 2006 | 482 score points |

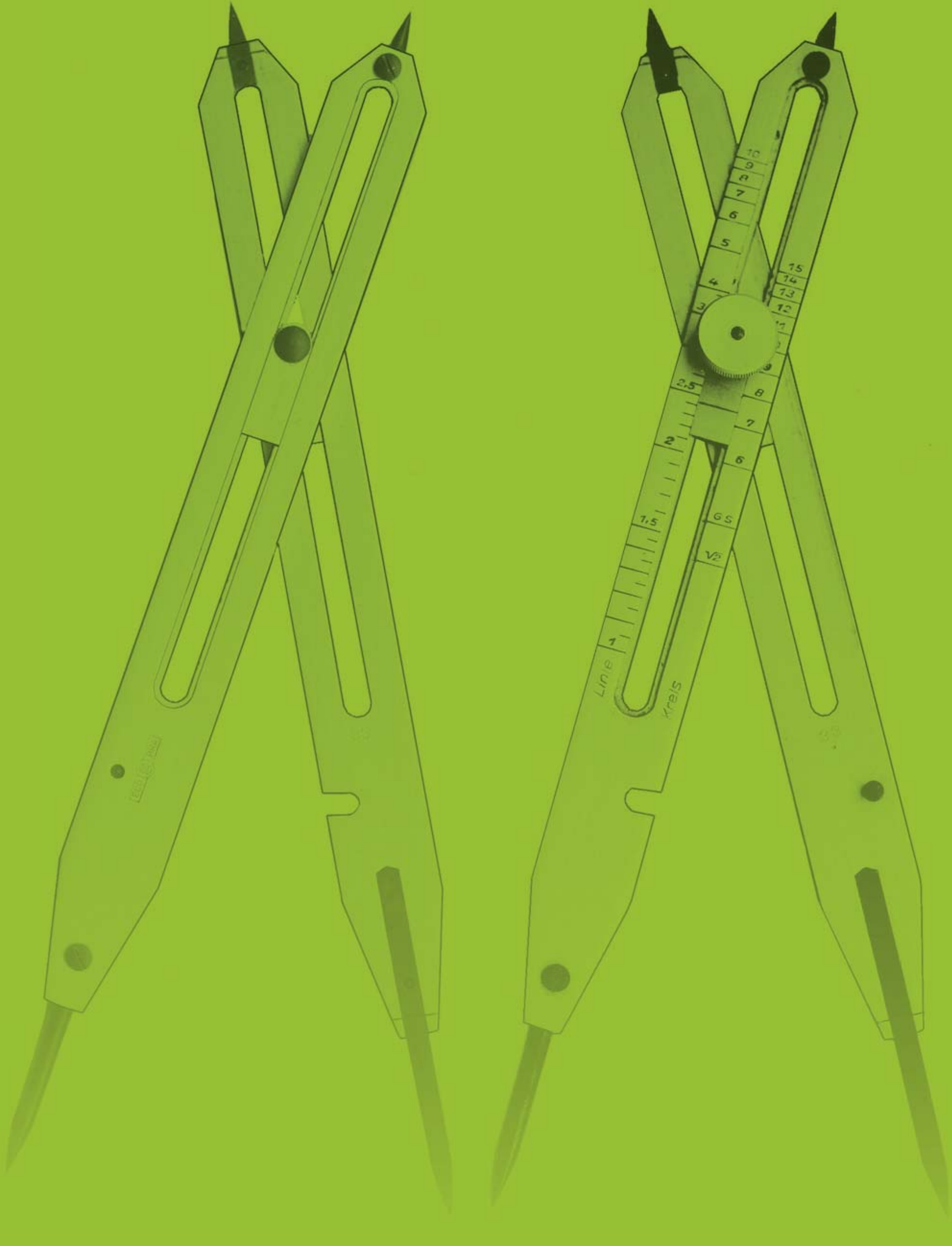
Table 5. | Changes in reading performance in Hungary between 2000 and 2006

### Females are better at reading

In the first two PISA surveys, significant differences in favour of females were observed in all OECD countries, a pattern that is mirrored in the PISA 2006 assessment. Analyses of earlier PISA assessments explain the gender gap as being due to the greater engagement of females with most forms of reading, the fact that they read a greater diversity of material and that they have an increased propensity to use both school and community libraries. Some analysts also argue that the texts and subjects used in schools are more appealing to females.

Among the OECD countries, we can see a slight increase of gender differences from cycle to cycle, 3-3 points between 2000 and 2003 and between 2003 and 2006, respectively.

Geological and cultural differences play an important part in where the largest gender differences in reading are observed. With the exception of Denmark, all Scandinavian countries show large differences between males and females (Finland 50 score points, Norway 46 score points, Iceland 45 score points, Sweden 40 score points) and the same is true for the majority of the more developed nations in Central and Eastern Europe as well (Slovenia 54 score points, Czech Republic 46 score points, Slovakia 42 score points, Poland 40 score points, Hungary 40 score points). The OECD countries with the smallest gender differences are the Netherlands (24 score points), Mexico (26 score points) and Denmark (30 score points).



# Mathematics

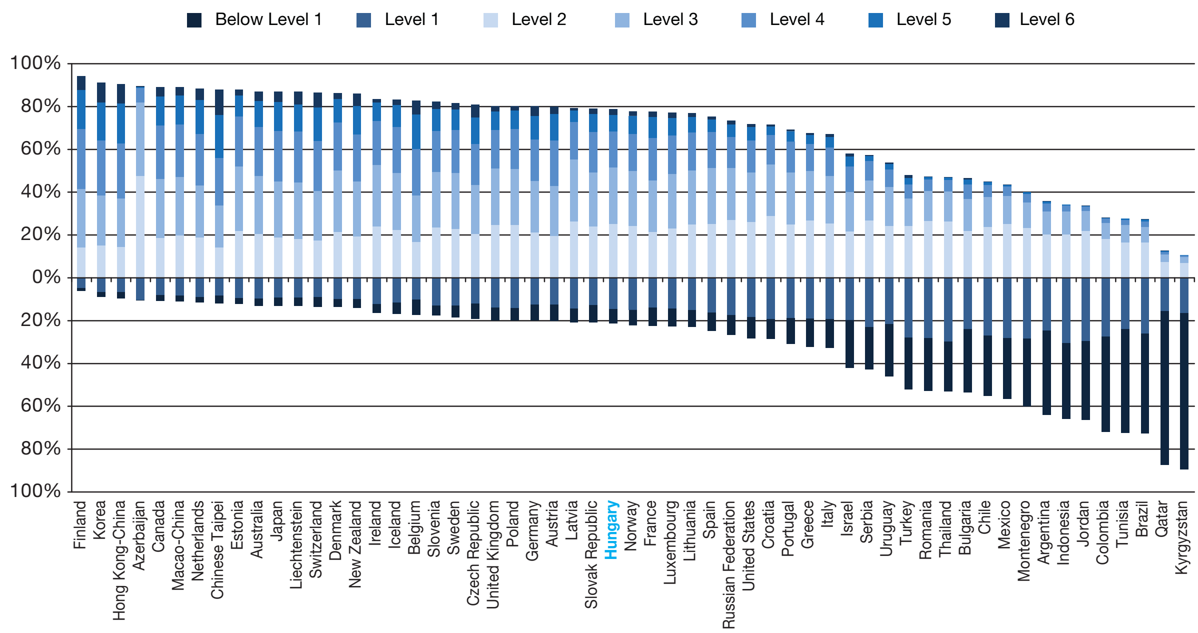
## A definition of mathematical literacy

The mathematics test of the PISA survey focuses on the capacity of students 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.

The publication, Assessing Scientific, Reading and Mathematical Literacy: A Framework for PISA 2006, through which OECD countries established the guiding principles for comparing mathematics performance across countries in PISA, defines mathematical literacy as *"…an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen"* (OECD, 2006a).

Students' mathematics knowledge and skills were assessed according to three dimensions relating to: (1) the mathematical content to which different problems and questions relate; (2) the processes that need to be activated in order to connect observed phenomena with mathematics and then to solve the respective problems; (3) and the situations and contexts that are used as sources of stimulus materials and in which problems are posed.

Mathematics was the focus of the PISA 2003 survey and the PISA 2003 mean for OECD countries was set at 500. This mean score is the benchmark against which mathematics performance in PISA 2006 is compared in this report and will be the benchmark for such comparisons in the future. However, it must be noted that in PISA 2006 the area of mathematics was given a smaller amount of assessment time than in PISA 2003, allowing an update on overall performance rather than the kind of in-depth analysis of knowledge and skills shown in the PISA 2003 report.




*Source: OECD PISA 2006 database, Table 7.2a.*

Figure 9. | Percentage of students at each proficiency level on the mathematics scale

| Level description | Score | Results |
| --- | --- | --- |
| At Level 6 students can conceptualise, generalise, and utilise information based on their investigations and modelling of complex problem situations. They can link different information sources and representations and flexibly translate among them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understandings along with a mastery of symbolic and formal mathematical operations and relationships to develop new approaches and strategies for attacking novel situations. Students at this level can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments, and the appropriateness of these to the original situations. | 669 | In the OECD countries, on average, 3.4% of students are at Level 6. In Korea, 9.1% of the students are at this level, and 6% or more in the Czech Republic, Finland, Belgium and Switzerland. The partner economies, Chinese Taipei and Hong Kong-China have 11.8 and 9.0% of students at this level, respectively. In contrast, 0.1% of the students in Mexico reach Level 6 and in the partner countries Colombia, Tunisia, Indonesia, Kyrgyzstan and Jordan, this is even lower.<br>In Hungary, 2.6% of the students can claim to be excellent in mathematics, which is lower than the OECD average. |
| At Level 5 students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare, and evaluate appropriate problem solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterisations, and insight pertaining to these situations. They can reflect on their actions and formulate and communicate their interpretations and reasoning. | 607 | In the OECD countries, on average, 11% of students are proficient at Levels 5 or 6. With 27.1%, Korea is the OECD country with the highest percentage of students in these two levels. Finland, Switzerland, Belgium and the Netherlands all have more than 20% of students at these levels. With the exception of Mexico and Turkey, at least 5% of students in each OECD country reaches Level 5.<br>In Hungary, 10.3% of students belong to the higher third of the proficiency scale. It is close to, but still below, the OECD average. |
| At Level 4 students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic ones, linking them directly to aspects of real-world situations.<br>Students at this level can utilise well-developed skills and reason flexibly, with some insight, in these contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments, and actions. | 545 | In the OECD countries, on average, 27.8% of students are proficient at Level 4 or above (that is, at Levels 4, 5 and 6). In Korea, Finland and the partner economies Chinese Taipei and Hong Kong-China, the majority of students perform at this level. In Switzerland, the Netherlands, Belgium, Canada, Japan and New Zealand, as well as the partner countries/economies Liechtenstein and Macao-China, over 40% do so. However, in Mexico, Turkey, Greece, Italy, Portugal, the United States and the Latin countries in Southern Europe less than one-quarter of students attain Level 4. In Hungary, 27% of students perform at one of the three highest proficiency levels. |
| At Level 3 students can execute clearly described procedures, including those that require sequential decisions. They can select and apply simple problem solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They can develop short communications reporting their interpretations, results and reasoning. | 482 | In the OECD countries, on average, 50.5% of students are proficient at least at Level 3 (that is, at Levels 3, 4, 5 and 6) on the mathematics scale, and over 67% in the best performing countries. Among Hungarian 15-year-olds, 53.6% of students are at Level 3 or above, which is higher than the OECD average. |
| At Level 2 students can interpret and recognise situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures, or conventions. They are capable of direct reasoning and making literal interpretations of the results. | 420 | In the OECD countries, on average, 73.7% of students are proficient at Level 2 or above. In Finland 90% of students perform at or above this threshold, and in every OECD country except Portugal, Greece, Italy, Turkey and Mexico at least 70% of students are at Level 2 or above.<br>In Hungary, 78.6% of students have those minimal mathematics skills that are required for everyday life and participating in society and the economy. |
| At Level 1 students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli. | 358 | In the OECD countries, on average, 26.3% of students are at risk of dropping behind in society because of their knowledge of mathematics. 16.2% of them perform at Level 1, and 10.1% perform below it. In Finland and Korea, and the partner economy Hong Kong-China, less than 10% of students perform at or below Level 1. In all other OECD countries, the percentage of students performing at or below Level 1 ranges from 10.9% in Canada to 56.5% in Mexico.<br>In Hungary, about the fifth of students (21.2%) do not meet the minimal requirements for mathematical problem-solving skills. |

Figure 10. | Proficiency levels – mathematics

## Results

### Proficiency levels

The framework of mathematics defined six proficiency levels, and gave a brief outline of each level listing those competencies that students performing at the given levels use to solve mathematical problems (Figure 10). Obviously, students at a given level also possess those skills and competencies that students at lower levels have.

Students' mathematical literacy in a given country can be summarized by looking at the distribution of the proficiency levels. The left column in Figure 10 describes briefly the six levels of proficiency, while in the right column there are some important statements, made using the data in Figure 9, about the percentage of students at each level. Naturally, beside international data Hungarian data are included in the table as well. The analysis of proficiency levels can be one of the most important information sources to work out development strategies for each knowledge domain (reading literacy, mathematics, science) because, as opposed to overall performance, it can pinpoint those student groups whose targeted development can increase mean performance in the most efficient and fair way.

### Mean performances in mathematics

The performance of countries can be summarized by a single value, the mean score. The PISA 2003 mean for OECD countries was set at 500 and establishes the benchmark against which mathematics performance in PISA 2006 is compared. For PISA 2006, the OECD average score in mathematics appears, at 498 score points, slightly lower than the score of 500 in PISA 2003, but this difference is not statistically significant.

Because the figures are derived from samples, measurement errors may occur and it is not possible to determine a precise rank of performance in mathematics among the 57 participating countries. As a result Table 6 determines a range of ranks and provides two rankings between which the country's rank lies, with 95% likelihood, among all the participating countries and the OECD countries, respectively.

Based on its performance numbers, the Netherlands ranks between the 5th and 8th positions among the PISA 2006 countries. If we look at pairs of countries, which is an approach different from the one used in Table 6, we can claim that the performance of the Netherlands is statistically identical to that of Switzerland, Canada, Macao-China, Liechtenstein and Japan, significantly lower than that of Korea and the countries above Korea, but clearly better than New Zealand's and the countries below New Zealand.

The colour coding in Table 6 indicates which countries performed better or worse than the OECD average or which has a score not statistically different from it.

### Four countries leading the world

Four countries, Finland and three Far Eastern economies, Korea, Taiwan and Hong Kong-China outperformed all other countries in PISA 2006: they had a mean score 16-18 score points above that of the best-performing country following them and more than half of a proficiency level better than the OECD average of 498 score points.

Countries with green coding (from Taiwan to Slovenia) performed better than the OECD average, while the means of Germany, Sweden, Ireland, France, the United Kingdom and Poland were identical to the OECD average.

The performance of Hungarian students among the 57 countries ranks in the range between the 23rd and 31st positions. If we compare countries in pairs we can state that our students' performance was identical to that of France, the United Kingdom, Poland, Slovakia, Luxembourg, Norway, Lithuania and Latvia. Ireland and all countries above Ireland in the table performed statistically better, while Spain and all countries below Spain in the table performed lower.

The 491 score points Hungary has are slightly lower than the OECD average. If we look at the group of countries that have joined the European Union recently, Hungary is somewhere in the middle. With their above-average performance Estonia, the Czech Republic and Slovenia stand out, while Bulgarian and Romanian students are so far behind in the region that they are one proficiency level below Lithuanian and Latvian students, who have achieved below-average performance in mathematics.

## Inequalities

Among OECD countries, Finland and Ireland show the narrowest distributions between the 5th and 95th percentile in the OECD with this difference equivalent to 266 and 268 score points respectively. From the partner countries, Estonia has similarly good score difference (264 score points).

Quite large differences can be seen in such high performing countries as Austria, Switzerland, Germany and the Czech Republic. The distribution in lower performing countries is narrow because of the relatively low performance of the best students, in Azerbaijan, for example, 90% of the students fall within a range of a mere 153 score points. Hungarian students' performance differences follow the OECD average across practically all percentiles with 90% of our students falling within a range of 300 score points.

| Countries | Mean | S. E. | | Range of rank – OECD-countries – Upper rank | Range of rank – OECD-countries – Lower rank | Range of rank – All countries/economies – Upper rank | Range of rank – All countries/economies – Lower rank |
|---|---|---|---|---|---|---|---|
| Chinese Taipei | 549 | (4,1) | ▲ | | | 1 | 4 |
| Finland | 548 | (2,3) | ▲ | 1 | 2 | 1 | 4 |
| Hong Kong-China | 547 | (2,7) | ▲ | | | 1 | 4 |
| Korea | 547 | (3,8) | ▲ | 1 | 2 | 1 | 4 |
| Netherlands | 531 | (2,6) | ▲ | 3 | 5 | 5 | 8 |
| Switzerland | 530 | (3,2) | ▲ | 3 | 6 | 5 | 9 |
| Canada | 527 | (2,0) | ▲ | 3 | 6 | 5 | 10 |
| Macao-China | 525 | (1,3) | ▲ | | | 7 | 11 |
| Liechtenstein | 525 | (4,2) | ▲ | | | 5 | 13 |
| Japan | 523 | (3,3) | ▲ | 4 | 9 | 6 | 13 |
| New Zealand | 522 | (2,4) | ▲ | 5 | 9 | 8 | 13 |
| Belgium | 520 | (3,0) | ▲ | 6 | 10 | 8 | 14 |
| Australia | 520 | (2,2) | ▲ | 6 | 9 | 10 | 14 |
| Estonia | 515 | (2,7) | ▲ | | | 12 | 16 |
| Denmark | 513 | (2,6) | ▲ | 9 | 11 | 13 | 16 |
| Czech Republic | 510 | (3,6) | ▲ | 10 | 14 | 14 | 20 |
| Iceland | 506 | (1,8) | ▲ | 11 | 15 | 16 | 21 |
| Austria | 505 | (3,7) | ▲ | 10 | 16 | 15 | 22 |
| Slovenia | 504 | (1,0) | ▲ | | | 17 | 21 |
| Germany | 504 | (3,9) | ● | 11 | 17 | 16 | 23 |
| Sweden | 502 | (2,4) | ● | 12 | 17 | 17 | 23 |
| Ireland | 501 | (2,8) | ● | 12 | 17 | 17 | 23 |
| France | 496 | (3,2) | ● | 15 | 22 | 21 | 28 |
| United Kingdom | 495 | (2,1) | ● | 16 | 21 | 22 | 27 |
| Poland | 495 | (2,4) | ● | 16 | 21 | 22 | 27 |
| Slovak Republic | 492 | (2,8) | ▼ | 17 | 23 | 23 | 30 |
| **Hungary** | 491 | (2,9) | ▼ | 18 | 23 | 24 | 31 |
| Luxembourg | 490 | (1,1) | ▼ | 20 | 23 | 26 | 30 |
| Norway | 490 | (2,6) | ▼ | 19 | 23 | 25 | 31 |
| Lithuania | 486 | (2,9) | ▼ | | | 27 | 32 |
| Latvia | 486 | (3,0) | ▼ | | | 27 | 32 |
| Spain | 480 | (2,3) | ▼ | 24 | 25 | 31 | 34 |
| Azerbaijan | 476 | (2,3) | ▼ | | | 32 | 35 |
| Russian Federation | 476 | (3,9) | ▼ | | | 32 | 36 |
| United States | 474 | (4,0) | ▼ | 24 | 26 | 32 | 36 |
| Croatia | 467 | (2,4) | ▼ | | | 35 | 38 |
| Portugal | 466 | (3,1) | ▼ | 25 | 27 | 35 | 38 |
| Italy | 462 | (2,3) | ▼ | 26 | 28 | 37 | 39 |
| Greece | 459 | (3,0) | ▼ | 27 | 28 | 38 | 39 |
| Israel | 442 | (4,3) | ▼ | | | 40 | 41 |
| Serbia | 435 | (3,5) | ▼ | | | 40 | 41 |
| Uruguay | 427 | (2,6) | ▼ | | | 42 | 43 |
| Turkey | 424 | (4,9) | ▼ | 29 | 29 | 41 | 45 |
| Thailand | 417 | (2,3) | ▼ | | | 43 | 46 |
| Romania | 415 | (4,2) | ▼ | | | 43 | 47 |
| Bulgaria | 413 | (6,1) | ▼ | | | 43 | 48 |
| Chile | 411 | (4,6) | ▼ | | | 44 | 48 |
| Mexico | 406 | (2,9) | ▼ | 30 | 30 | 46 | 48 |
| Montenegro | 399 | (1,4) | ▼ | | | 49 | 50 |
| Indonesia | 391 | (5,6) | ▼ | | | 49 | 52 |
| Jordan | 384 | (3,3) | ▼ | | | 50 | 52 |
| Argentina | 381 | (6,2) | ▼ | | | 50 | 53 |
| Colombia | 370 | (3,8) | ▼ | | | 52 | 55 |
| Brazil | 370 | (2,9) | ▼ | | | 53 | 55 |
| Tunisia | 365 | (4,0) | ▼ | | | 53 | 55 |
| Qatar | 318 | (1,0) | ▼ | | | 56 | 56 |
| Kyrgyzstan | 311 | (3,4) | ▼ | | | 57 | 57 |

▲ Statistically significantly above the OECD average

● Not statistically significantly different from the OECD average

▼ Statistically significantly below the OECD average

Table 6. | Range of rank of countries/economies on the mathematics scale

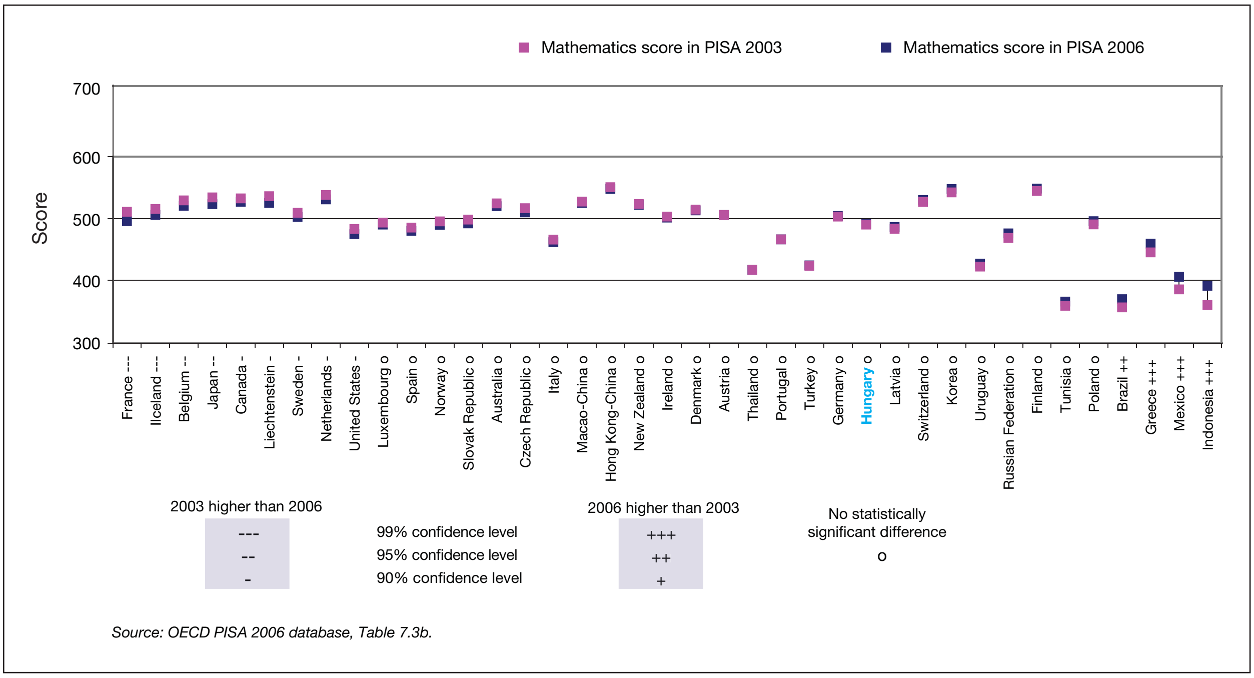



Figure 11. | Differences in mathematics between PISA 2006 and PISA 2003

## How student performance in mathematics has changed?

It is only possible to compare the results of PISA 2006 mathematics with those of PISA 2003, when mathematics was the focus of the survey[1]. Because only two data points are involved any inferences should be made with caution. Across OECD countries as a whole, mathematics performance has remained unchanged between PISA 2003 and PISA 2006, the difference of 2 score points for the OECD average not being statistically significant. However, for a few countries there are notable performance differences.

Two OECD countries, Mexico and Greece, and two partner countries, Indonesia and Brazil, show significantly higher performance in PISA 2006 than in PISA 2003.

- In Mexico mathematics performance was 20 score points higher in PISA 2006 than in PISA 2003 but at 405 score points it is still well below the OECD average. While better performance in reading was attributable to the improving performance of females, in mathematics both males and females saw similar performance increases between the two surveys.
- In Greece, mathematics performance was 14 score points higher in PISA 2006 than in PISA 2003. Most of the increase was driven by changes in the lower and middle range of the performance distribution. It is also noteworthy that the performance difference is mainly due to the significantly higher performance of females in PISA 2006.
- In Indonesia, mathematics performance was 29 score points higher in PISA 2006 than in PISA 2003, which was, as in the case of reading, largely driven by the higher performance of males in PISA 2006.
- In Brazil, mathematics performance was 13 score points higher in PISA 2006 than in PISA 2003, which was mainly driven by performance improvements at the lower end of the distribution.

Mathematics performance in PISA 2006 was significantly lower in France (15 score points), essentially because of an increase in students at the lower end of the performance distribution which means that the difference between the highest and lowest performing students grew.

[1] The scale of a given domain is set by PISA whenever it is represented with a large number of questions in the survey. Trend analyses can only be carried after that.

In Hungary, mathematics performance between 2003 and 2006 remained just as stable as in reading. The difference of 1 score points (PISA 2003 – 490 score points, PISA 2006 – 491 score points) is statistically irrelevant just like the minimal differences between the score points in the six percentiles, or the performance differences in males' and females' scores. Such stability of performance is not as exceptional in mathematics as in reading: among OECD countries, in Denmark, Finland, Ireland, Poland, Slovakia, Spain and Switzerland mathematics performance remained unchanged.

### Gender differences

As opposed to reading, where performance differences between males and females grew continuously in favour of females between 2000 and 2006, in mathematics the performance advantage of males remained unchanged between PISA 2003 and PISA 2006, at 11 score points. The largest gender differences (22 score points) are observed in Austria and New Zealand. Countries with mathematics scores significantly higher for males include Germany, the United Kingdom, Italy, Luxembourg, Portugal, Australia, the Slovak Republic, Canada, Switzerland, the Netherlands and Finland, and the partner countries Chile, Columbia and Brazil. The only country where females significantly outperformed males in mathematics is Qatar.

While males in Hungary perform significantly higher in mathematics than females, as in most countries, the difference of 10 score points can be regarded as average across the OECD countries (males 496, females 486 score points).

# What is in the background of the results?

## Segregation and the impact of home background – the reproduction of social differences in Hungary

Besides comparing the performance of countries and giving a survey of students' skills, PISA assessments consider several factors and circumstances that may be closely related to science, mathematics and reading literacy or even influence them. Such factors include the socio-economic backgrounds of students and schools; the ways in which teaching is organized and delivered in classes; the human and financial resources available to schools; school autonomy; and system-level factors such as curricular differences and organizational policies and practices.

A complete analysis of the performance-influencing factors monitored in PISA and a detailed discussion of the causes are beyond the scope of this publication. The soon-to-be-published PISA 2006 National Report will discuss in detail those school-level and education-system-level factors that can influence the performance of schools or even the education system as a whole. In the present volume, we only report on how social-economic and cultural background, one of the most powerful factors influencing student performance, affect science performance by comparing in this respect the Hungarian educational system with that of other PISA countries.

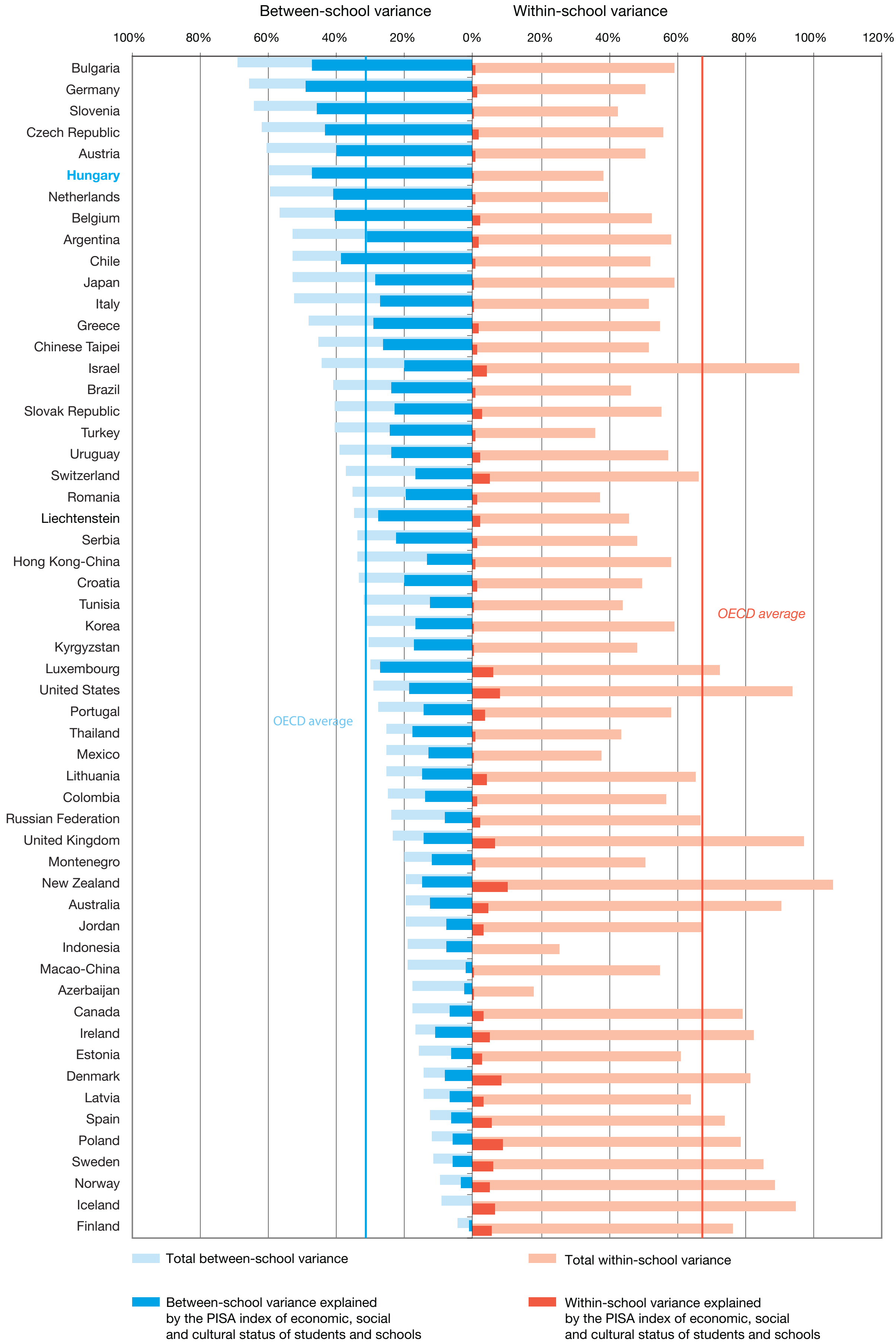
### Variance between schools

The performance of students participating in the survey can be interpreted on at least three levels. On the one hand, we can look at the overall performance of a country's students: partly this is what has been done in the previous chapters which compare countries on the basis of their students' mean performance. On the other hand, we can consider how schools, the basic units of education, performed: how do their students perform overall and how different their students' skills are? Finally, we can have a look at the spectrum of student proficiency within schools, and the competencies students in a given school have.

Among OECD countries, only 9% of the variation in student performance is attributable to the different education systems they come from.[1] This means that the cause of performance differences are to be found, in 91%, within the education system as well as in between- and within-school differences in student performance.

The education systems of countries that participated in PISA 2006 try with different strategies to meet those two seemingly contradicting social needs which – because of the variations in student abilities and interests – point toward the differentiation of the education system on the one hand, and which, in order to ensure equity and mobility would move toward a homogeneous education system on the other hand. While some countries offer schools with different curricular contents and set of requirements in secondary education for parents and students, others define a uniform and comprehensive set of requirements for all schools and students. Among others, this is one reason why countries and education systems differ significantly in respect of  variations in student performance are rather attributable to between-school differences while student groups within the school are mainly homogeneous or the performance of schools is similar but there are big differences in student results within-school.

[1] In all the countries that took part in the PISA 2006 assessment the percentage is higher, 26%.




*Source: OECD PISA 2006 database, Table 4.1a.*

Figure 12. | Variance in student performance between schools and within schools on the science scale[1]

[1] Expressed as a percentage of the average variance in student performance in OECD countries.

Figure 12 shows what percentage of student performance variations in education systems is attributable to between-school and within-school differences. In Hungary – as it can be expected from an educational system with many school types – the majority of differences in student results (60% of the OECD average) comes from between-school[2] differences. This percentage is high especially if we take into account that otherwise student dispersion in Hungary is relatively low. If we make a comparison to the overall variance in the given country for all countries, between-school differences make up by far the highest proportion (70%) in Hungary – Germany having the next highest percentage with 60%.

Because differences between schools are large, school choices will have a larger influence on student performance in Hungary than in most countries participating in PISA 2006. In the countries found in the lower section of Figure 12 – in the Scandinavian and Baltic states or Poland, for example, where differences between schools are small – parents can rely on high and consistent performance standards across schools and can choose any for their children. In Hungary, this is not so. It is not necessarily attributable to differences in the effectiveness of schools. In Hungary various school types with different goals and outcomes are chosen by students at various competency levels. It is partly the reason why various school types were created so as to make selection according to competency levels possible. The question is at what age this selection should take place.

In Figure 12, variance in student performance is indicated by bars for every country. The length of the bars indicates variance in student performance in a given country as percentages of the average variance between OECD countries. The length of the bars to the left of the central line shows between-school differences, and the length of the bars to the right of the central line shows within-school differences. That is, in Hungary the proportion of between-school differences is 60% of the average variance of OECD countries. Within-school differences account for 38% of the OECD average level.

### The relationships between socio-economic background and science performance

One of the most important goals of education systems is to provide equal opportunities for each member of the younger generation so that students, regardless of their home and social background, get high-standard and effective education. As the quality and effectiveness of education strongly influence the future life chances, income levels and social condition of students, the educational system will be one of the most important means of social mobility by providing equal chances. That is why the PISA 2006 survey devotes significant attention to revealing how the participating countries, education systems can guarantee equal chances for students with different backgrounds, that is how equitable they are.

Even though the results from PISA 2006 show that poor performance in school does not automatically follow from a disadvantaged home background, social, economic and cultural status remain one of the most powerful factors influencing student science knowledge and competencies. Overall, 20 per cent of the student performance variation in science in the OECD area is explained by ESCS[3], the PISA index of economic, social and cultural status. However, there are a few participating countries with high average result where the index explains little. These countries – for example, Finland, Canada, Japan and Hong Kong – can guarantee high-standards and equal opportunities in their education systems, that is they are effective and equitable at the same time.

[2] Different school types within one school in Hungary are treated as separate units in the PISA survey.

[3] Economic, social and cultural status index. The index is created by merging those questions from the student questionnaire that are related to social, economic and cultural status, and include information about parental occupations, parental education, home educational resources, cultural possessions at home as well as immigrant background. The OECD average of the index is 0, its standard deviation is 1.

| Countries | Mean score | Expected score of students with average ESCS | Percentage of variance expoliand by ESCS in student performance | Score point difference associated with one unit on the ESCS | Expected difference in the performance of two sutdents with 1 unit difference in their ESCS and attending schools with equal average ESCS | Expected difference in the performance of two students with equal ESCS and attending schools with 1 unit difference between their average ESCS |
|---|---|---|---|---|---|---|
| OECD | | | | | | |
| Australia | 527 | 519 | 11,3 | 43 | 29 | 56 |
| Austria | 511 | 502 | 15,4 | 46 | 10 | 110 |
| Belgium | 510 | 503 | 19,4 | 48 | 17 | 102 |
| Canada | 534 | 524 | 8,2 | 33 | 23 | 44 |
| Czech Republic | 513 | 512 | 15,6 | 51 | 19 | 120 |
| Denmark | 496 | 485 | 14,1 | 39 | 32 | 41 |
| Finland | 563 | 556 | 8,3 | 31 | 30 | 10 |
| France | 495 | 502 | 21,2 | 54 | - | - |
| Germany | 516 | 505 | 19 | 46 | 14 | 114 |
| Greece | 473 | 479 | 15 | 37 | 16 | 66 |
| **Hungary** | 504 | 508 | 21,4 | 44 | 7 | 85 |
| Iceland | 491 | 470 | 6,7 | 29 | 29 | -5 |
| Ireland | 508 | 510 | 12,7 | 39 | 28 | 48 |
| Italy | 475 | 478 | 10 | 31 | 7 | 87 |
| Japan | 531 | 533 | 7,4 | 39 | 5 | 133 |
| Korea | 522 | 522 | 8,1 | 32 | 9 | 80 |
| Luxembourg | 486 | 483 | 21,7 | 41 | 24 | 69 |
| Mexico | 410 | 435 | 16,8 | 25 | 6 | 37 |
| **Netherlands** | 525 | 515 | 16,7 | 44 | 11 | 123 |
| New Zealand | 530 | 528 | 16,4 | 52 | 41 | 55 |
| Norway | 487 | 474 | 8,3 | 36 | 31 | 29 |
| Poland | 498 | 510 | 14,5 | 39 | 35 | 21 |
| Portugal | 474 | 492 | 16,6 | 28 | 17 | 32 |
| Slovak Republic | 488 | 495 | 19,2 | 45 | 21 | 56 |
| Spain | 488 | 499 | 13,9 | 31 | 24 | 21 |
| Sweden | 503 | 496 | 10,6 | 38 | 32 | 34 |
| Switzerland | 512 | 508 | 15,7 | 44 | 26 | 70 |
| Turkey | 424 | 463 | 16,5 | 31 | 9 | 65 |
| United Kingdom | 515 | 508 | 13,9 | 48 | 32 | 71 |
| United States | 489 | 483 | 17,9 | 49 | 34 | 51 |
| **OECD total** | **491** | **496** | **20,2** | **45** | | |
| **OECD average** | **500** | **500** | **14,4** | **40** | **21** | **64** |
| **Partners** | | | | | | |
| Argentina | 391 | 416 | 19,5 | 38 | 13 | 57 |
| Azerbaijan | 382 | 388 | 4,7 | 11 | 7 | 15 |
| Brazil | 390 | 424 | 17,1 | 30 | 8 | 48 |
| Bulgaria | 434 | 446 | 24,1 | 52 | 13 | 68 |
| Chile | 438 | 465 | 23,3 | 38 | 11 | 54 |
| Chinese Taipei | 532 | 546 | 12,5 | 42 | 14 | 107 |
| Colombia | 388 | 411 | 11,4 | 23 | 11 | 31 |
| Croatia | 493 | 497 | 12,3 | 34 | 14 | 83 |
| Estonia | 531 | 527 | 9,3 | 31 | 22 | 42 |
| Hong Kong-China | 542 | 560 | 6,9 | 26 | 9 | 64 |
| Indonesia | 393 | 425 | 10,2 | 21 | 1 | 42 |
| Israel | 454 | 448 | 10,9 | 43 | 26 | 69 |
| Jordan | 422 | 438 | 11,2 | 27 | 18 | 28 |
| Kyrgyzstan | 322 | 340 | 8,2 | 27 | 6 | 75 |
| Latvia | 490 | 491 | 9,7 | 29 | 21 | 35 |
| Liechtenstein | 522 | 513 | 20,4 | 49 | 17 | 130 |
| Lithuania | 488 | 487 | 15,2 | 38 | 24 | 47 |
| Macao-China | 511 | 523 | 2,2 | 13 | 7 | 15 |
| Montenegro | 412 | 412 | 7,5 | 24 | 11 | 65 |
| Qatar | - | - | - | - | - | - |
| Romania | 418 | 431 | 16,6 | 35 | 12 | 60 |
| Russian Federation | 479 | 483 | 8,1 | 32 | 20 | 39 |
| Serbia | 436 | 440 | 13,2 | 33 | 12 | 75 |
| Slovenia | 519 | 513 | 16,7 | 46 | 7 | 121 |
| Thailand | 421 | 461 | 15,9 | 28 | 8 | 42 |
| Tunisia | 386 | 408 | 9,5 | 19 | 4 | 36 |
| Uruguay | 428 | 446 | 18,3 | 34 | 14 | 45 |

*Source:* OECD PISA 2006 database, Table 4.4a and 4.4b

Table 7. | The effects of socio-economic background on student performance in science

The ESCS and science performance can be looked at from more aspects:

- What is the average standard in education? That is, what competencies does a student with average ESCS have? (Table 7, column 2)
- What is the index's coefficient of determination? That is, in what extent does the ESCS explain the competency differences? (Table 7, column 3)
- How much effect does the ESCS index have? That is, how large a competency difference can be expected from students with different ESCS? (Table 7, column 4)

As can be seen in the table, the effect of ESCS is above the average in Hungary as a single unit change will cause a performance increase of 44 score points, significantly higher than the OECD average of 40 score points. In the Czech Republic, France, New Zealand and Bulgaria this value is even more than 50 score points. At the same time, the coefficient of determination of the index is the biggest in France, Luxembourg and Hungary. 21.4% of the variance can be explained by the differences of the index value. This means that students in Hungary, France and Luxembourg have the least chance to perform better than what can be expected on the basis of their social, cultural and economic status.

### Schools' social, economic and cultural background and school performance

An important means of characterizing an educational system is to analyze how social, economic and cultural background relates to student performance, but when defining education policy it is even more important to see the distribution of social, economic and cultural capital across schools and how this background affects the performance of the schools.

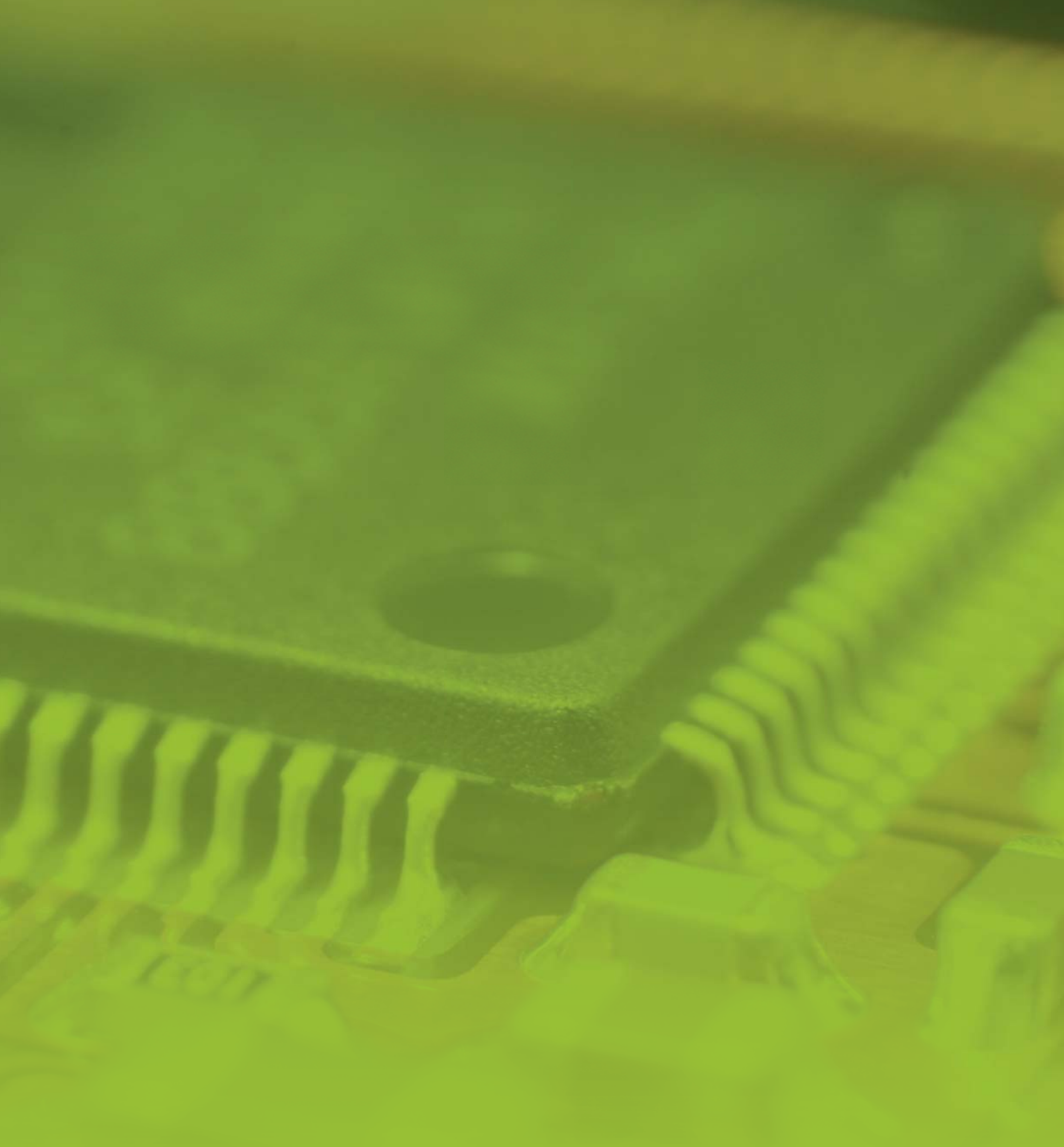
In Hungary, students' ESCS is slightly below the OECD average while the dispersion of the index is identical to the average dispersion in the OECD countries. We can also look at how much the schooling system segregates, that is we can analyze the differences between schools in the social status of their students and the homogeneity of students' social composition within schools. Students' ESCS index in Hungary is closely related to which school they attend: 46% of the index variance is attributable to social, economic and cultural differences between schools. This is the highest in the OECD (the average is 24%) and even among all the participating countries only Bulgaria (51%) and Chile (53%) surpass it. This shows that the schooling system in Hungary is segregated by social, economic and cultural background, there are large differences between schools in the home background of their students, but at the same time within-school student groups are relatively homogeneous. This is probably explained by the fact that even at the end of elementary education there is already a strong relationship between students' social, cultural and economic background and their performance, leading to the formation of socially, culturally and economically homogeneous groups during the achievement-based selection process. Another reason for this relationship can be that families with different social, economic and cultural backgrounds have different expectations on schools: while families with more disadvantaged socio-economic backgrounds more often expect schools to prepare their children for work as quickly as possible, families with a good socio-economic background rather find opportunities for academic pursuits more important, which leads to a segregation of the social composition of schools.

Beside science performance variations attributable to between-school and within-school differences, Figure 12 shows the extent to which these can be explained by schools' and students' different ESCS indices. In Hungary, only an insignificantly small percentage of within-school differences can be explained by the differences in students' backgrounds while, from the 60% of between-school differences, 47% can be accounted for by the variation of the ESCS index between schools and students. If schools' and students' social, cultural and economic backgrounds are taken into account, the differences in school performance independent of these factors are relatively small.

If we compare how students' within-school ESCS and schools' average ESCS affect student performance, it is not surprising that we can see the ESCS index primarily exercising its influence through schools' average ESCS. Between two students with different social backgrounds, but attending schools with identical backgrounds, we can expect much less performance difference than between two students who have identical social backgrounds but go to schools that have different backgrounds (Table 7, columns 5 and 6). This is so in all countries, but Hungary belongs to that group where the effect of schools' average ESCS is above the OECD average while the within-school effect is among the smallest. Besides, it must be taken into account that the dispersion of schools' ESCS is relatively high in Hungary, that is, the distribution of social, economic and cultural capital within the schooling system is uneven, which has serious consequences for the learning opportunities of individual students.

In summary, we can claim that the schooling system in Hungary is unsuccessful in decreasing social inequalities, it cannot provide equal opportunities for students from more disadvantaged home backgrounds. Schools in secondary education are segregated by social, cultural and economic background, and the average science, mathematics and reading performance of a school's students is closely related to this, which means that the school system does not meet the requirements for equity.

Using the data of the 55 participating countries, the analysis of the relation between the PISA results and school characteristics supports the claim that early selection – into school types with different curricula and outcome requirements – reinforces the relation between social, economic and cultural status and student performance but there is nothing to substantiate the assumption that early selection increases the effectiveness of the education system. As the first possible age of selection (at 11 at the beginning of the 5th grade) in Hungary is among the earliest in the PISA countries, we should consider postponing the selection age in view of this statement and the results discussed above.



# Today’s education and tomorrow’s society

We live in an age of competing economies. There are competitions between bigger regions, countries making up a whole continent as well as dynamically developing smaller regions like the one where the newer member states of the European Union, including Hungary, are found. They compete for working capital, markets and, of course, human resources, quality labour and the innovation potential present in the world.

## What is competitive knowledge?

For the past decades, there have been a lot of debates about how the competitive knowledge that students have to acquire in public education should look like. Now we are close to a consensus. It is widely accepted that public education prepares students properly for the challenges of our age (lifelong learning, continuous evolution in IT and technology etc.) if it focuses on the acquisition of general competencies rather than knowledge. Such a fundamental competency is reading literacy, which is the basis of all learning processes, as well as the capacity to reason and communicate both in speech and writing; the ability to use their knowledge, which is responsible for the convertibility of real-life problems and theoretical knowledge; scientific enquiry and the ability to perform scientific research etc.

The consensus on how to define competitive knowledge have made it possible and necessary to measure this knowledge on an international level. So the PISA survey was born, which provides participating countries with indicators about the quality of their public education through measuring competitive knowledge.

## The place of Hungarian public education in the world and Eastern Europe

Table 8 shows how the countries participating in PISA 2006 performed in the three subject areas. Performance is not indicated in mean score points but rather as differences (higher, lower or statistically identical) from the OECD average. The degree of deviations is not shown within these categories.

There are 12 countries that performed higher than the OECD average in all the three subject areas, while there are 23 countries with performance not below the OECD average in any areas. These 23 countries (and maybe we can add the Czech Republic) has gained an advantage over the other economies in terms of competitiveness. The other side of the coin is represented by those 30 participants which performed lower than the OECD average. In the short term, the majority of these economies can expect to attract industries that require less qualified labour and probably to face higher unemployment.

Overall, Hungary stands closer to the lower-performing group of countries as we could not achieve above-average results in any of the subject areas. Moreover, in mathematics and reading we performed lower, though not dramatically lower, than the OECD average. Only our science performance is promising but, as will be discussed later, we cannot expect progress here either without gradually overwriting traditions.

Within Eastern Europe, we are in the middle. Slovenia, the Czech Republic and Estonia are ahead of us in education, just as in economic development. They are on track to catch up with the more developed regions of the EU. With its educational reform of 1999, Poland has moved an important step closer to establishing high-quality standards in public education. The reading literacy of their 15-year-olds have improved 29 score points in six years, and the country, which performed below the OECD average in 2000, has already surpassed it.

Behind the four countries mentioned, right in front of the chase, do we find Hungary in the company of Latvia, Lithuania, Slovakia and Croatia. In these five countries one of the most important questions for the next five years will be the following: in which direction will they go from the middle? Will they join Poland, which belonged to this group in 2000? Or will they fail to make changes or to preserve the competitiveness of their education and students, dropping behind the rest of Europe both economically and socially? From

| Country | Reading | Science | Mathematics |
|---|---|---|---|
| Finland | ▲ | ▲ | ▲ |
| Hong Kong-China | ▲ | ▲ | ▲ |
| Canada | ▲ | ▲ | ▲ |
| Estonia | ▲ | ▲ | ▲ |
| New Zealand | ▲ | ▲ | ▲ |
| Australia | ▲ | ▲ | ▲ |
| The Netherlands | ▲ | ▲ | ▲ |
| Liechtenstein | ▲ | ▲ | ▲ |
| Korea | ▲ | ▲ | ▲ |
| Slovenia | ▲ | ▲ | ▲ |
| Switzerland | ▲ | ▲ | ▲ |
| Macao-China | ▲ | ▲ | ▲ |
| Belgium | ▲ | ▲ | ▲ |
| Japan | ● | ▲ | ▲ |
| Taiwan | ● | ▲ | ▲ |
| Austria | ● | ▲ | ▲ |
| Ireland | ▲ | ▲ | ● |
| Czech Republic | ▼ | ▲ | ▲ |
| United Kingdom | ● | ▲ | ● |
| Sweden | ▲ | ● | ● |
| Poland | ▲ | ● | ● |
| Denmark | ● | ● | ▲ |
| France | ● | ● | ● |
| Iceland | ▼ | ▼ | ▲ |
| **Hungary** | ▼ | ● | ▼ |
| United States | ▼ | ● | ▼ |
| Croatia | ▼ | ▼ | ▼ |
| Latvia | ▼ | ▼ | ▼ |
| Spain | ▼ | ▼ | ▼ |
| Lithuania | ▼ | ▼ | ▼ |
| Slovakia | ▼ | ▼ | ▼ |
| Norway | ▼ | ▼ | ▼ |
| Luxembourg | ▼ | ▼ | ▼ |
| Russia | ▼ | ▼ | ▼ |
| Italy | ▼ | ▼ | ▼ |
| Portugal | ▼ | ▼ | ▼ |
| Greece | ▼ | ▼ | ▼ |
| Israel | ▼ | ▼ | ▼ |
| Chile | ▼ | ▼ | ▼ |
| Serbia | ▼ | ▼ | ▼ |
| Bulgaria | ▼ | ▼ | ▼ |
| Uruguay | ▼ | ▼ | ▼ |
| Turkey | ▼ | ▼ | ▼ |
| Jordan | ▼ | ▼ | ▼ |
| Thailand | ▼ | ▼ | ▼ |
| Romania | ▼ | ▼ | ▼ |
| Montenegro | ▼ | ▼ | ▼ |
| Mexico | ▼ | ▼ | ▼ |
| Indonesia | ▼ | ▼ | ▼ |
| Argentina | ▼ | ▼ | ▼ |
| Brazil | ▼ | ▼ | ▼ |
| Columbia | ▼ | ▼ | ▼ |
| Tunisia | ▼ | ▼ | ▼ |
| Azerbaijan | ▼ | ▼ | ▼ |
| Qatar | ▼ | ▼ | ▼ |
| Kyrgyzstan | ▼ | ▼ | ▼ |

▲ Statistically significantly above the OECD average

● Not statistically significantly different from the OECD average

▼ Statistically significantly below the OECD average

Table 8. | Results by country in the three subject areas compared to the OECD average

the countries surveyed, currently Romania, Bulgaria, Serbia and Montenegro are at this level. From this respect, it is far from encouraging that the performance of Hungary has not changed at all in the first three PISA cycles. The curricular reforms that started at the beginning of the 1990s and have been continuously implemented since seem to have a theoretical importance only as they could not change the practice and effectiveness of education so far.

Everybody knows, for example, that a traditional science class will not provide a possibility for acquiring the process of scientific enquiry and measurement properly. All curricula have dealt with this problem and defined those knowledge and competency requirements students need to acquire on a certain level in schools. Among the knowledge and skills measured by PISA they proved to be lower performers in those related to scientific enquiry and measurement, while they were relatively strong in those which primarily required theoretical knowledge.

But what can be done when curriculum alone fail to induce changes in education?

## Is there a guaranteed formula?

Several successful reform attempts are mentioned in this report, which contain elements worthy of attention, but neither can be adopted without reservations in a country the education system of which has unique problems. The PISA assessment together with, as we hope, the National Assessment of Basic Competencies can provide valuable information for determining an exact diagnosis of the "health" of national education in Hungary. If experts could agree on the diagnosis and the goals of the national education that would be a good starting point for developing a customized therapy.

## What diagnosis can we make of the results of the PISA 2006 survey?

Hungarian national education has conceptual and structural problems. In the following, we will only summarize those manifested themselves in the preliminary analysis.

Science related conceptual issues have already been discussed above. We have also mentioned that our students' below-average performance in reading means that many students have limited opportunities for learning and acquiring knowledge which will also limit their life opportunities. The signs are apparent in all measured content areas, and this was a recurring experience during the coding of the test booklets, that students do not have the ability to formulate their arguments, explanations or opinion understandably and logically. As a result, they have serious difficulties not only in the school but also in other life situations, for example in their relationships with people. Our experience shows that the core problem of mathematics education is that students do not learn to think (which is also true for all the other subjects, though the importance and the degree of this factor vary) rather they learn routines. This is how it came about that they cannot solve problems involving known mathematical contents (because they find themselves in an unknown context) with such efficiency as their foreign peers who may otherwise have less theoretical knowledge of mathematics. The problem of routine-based education would obviously manifest itself in physics and chemistry tests as well, but such routine tasks are not included in PISA.

The biggest problem of Hungarian education system is most likely the heterogeneous performance of schools. This had already been revealed in PISA 2000 and 2003. While the parents of a Finnish, Estonian or Korean student can choose any school for their child as the majority of schools offer education with high and consistent performance standards, in Hungary choosing between schools became a key issue. For the past 15 years, parents have carried the burden of responsibility for this choice and as a result – and also because of the introduction of 8-year and 6-year grammar schools – school choices are made even earlier, causing further damages in the equity of our education system.

In an ideal school, the performance distribution of students more or less reflects the performance differences in society. In Hungarian schools this is not so. In a typical Hungarian school there are no big differences in the socio-economic status of parents and consequently in the capabilities of students, which means that school choice is the first step in the "emergence of a caste system" in society where all levels of society reproduce themselves with little chance for mobility. Beside the fact that it escalates segregation and helps the emergence of low-standard and elite schools, a further problem with this process is that the percentage of good-performing students is not as good as in most countries where conditions are similar.

Education in Hungary also has serious financial difficulties. Among the OECD member countries, there are only four where spending per student is lower. Given the fact that today one of the most important priorities, both economically and socially, is good-quality education, the current level of spending is not tenable. Investment in intellectual capital must not be subordinated to short-term interests.

## Solutions and therapies

As it is based on a preliminary analysis of the PISA survey, it is not the goal of this report to recommend comprehensive solutions for solving the most urgent problems of Hungarian national education, but we have three remarks to make.

The fact that results practically did not change in either of the three tested content areas obviously means that curricular regulation in itself is not enough to induce changes in the practice of education. In this respect, Korea's example was especially illuminating for us. Korea instantly integrated important elements of the curricular reform into school exams and  admission requirements and this way made all participants in education, both teachers and students, interested in the development of the given competencies and skills.

Everybody agrees that segregation must be reduced, yet some of the changes introduced in the past few years have increased it instead of reducing it. Such is the problem of early school choice. Poland, which has an education system similar to ours, has postponed this choice with one year to the end of the 9$^{th}$ grade. They claim that this was an important contribution to the development seen in the past seven years.

Finally, we need to talk about spending once more. Among the countries of the world, several examples show the fact that investment in education will have returns first in knowledge and then in the economy. Even when taking into account the purchasing power of their currency, Canada, Austrian, Switzerland, the Netherlands, Belgium, Japan and Finland spend two or three times more on education than Hungary. Estonia can be an encouraging example for us as it shows that a country, with an economic status identical to that of Hungary, can achieve good results if it sees education as a national agenda of strategic importance and accordingly allocates adequate financial resources for it.

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## List of illustrations

Figures



Táblázatok

The unexpectedly poor results in PISA 2000 caused a stir both in the media and among professionals and policy makers in Hungary. The analysis showed that Hungarian 15-year-old students drop behind the students of Europe, Asia and developed overseas countries in reading as well as in applying knowledge. After the shock, however, and unlike in Germany, there were no such plans developed, no such comprehensive programs defining specific measures introduced that would have promised a substantial change. As a consequence, an analysis of the just completed PISA 2006 survey shows that the performance of Hungarian students has not changed at all in the past six years.

There is a close relationship between the quality of education and economic success. The countries that realized this (among others, Finland, Korea and Estonia) made education a strategic sector and, besides initiating reform processes, they devoted significant financial resources to initial and higher education. In Hungary, this shift has not occurred yet. Currently, in the OECD only Mexico, Turkey, Poland and Slovakia spend less on the education of their students between 6 and 15 years of age than Hungary.


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