

PISA 2006: Science Competencies for Tomorrow's World

What PISA tells us about quality, equity and efficiency in education

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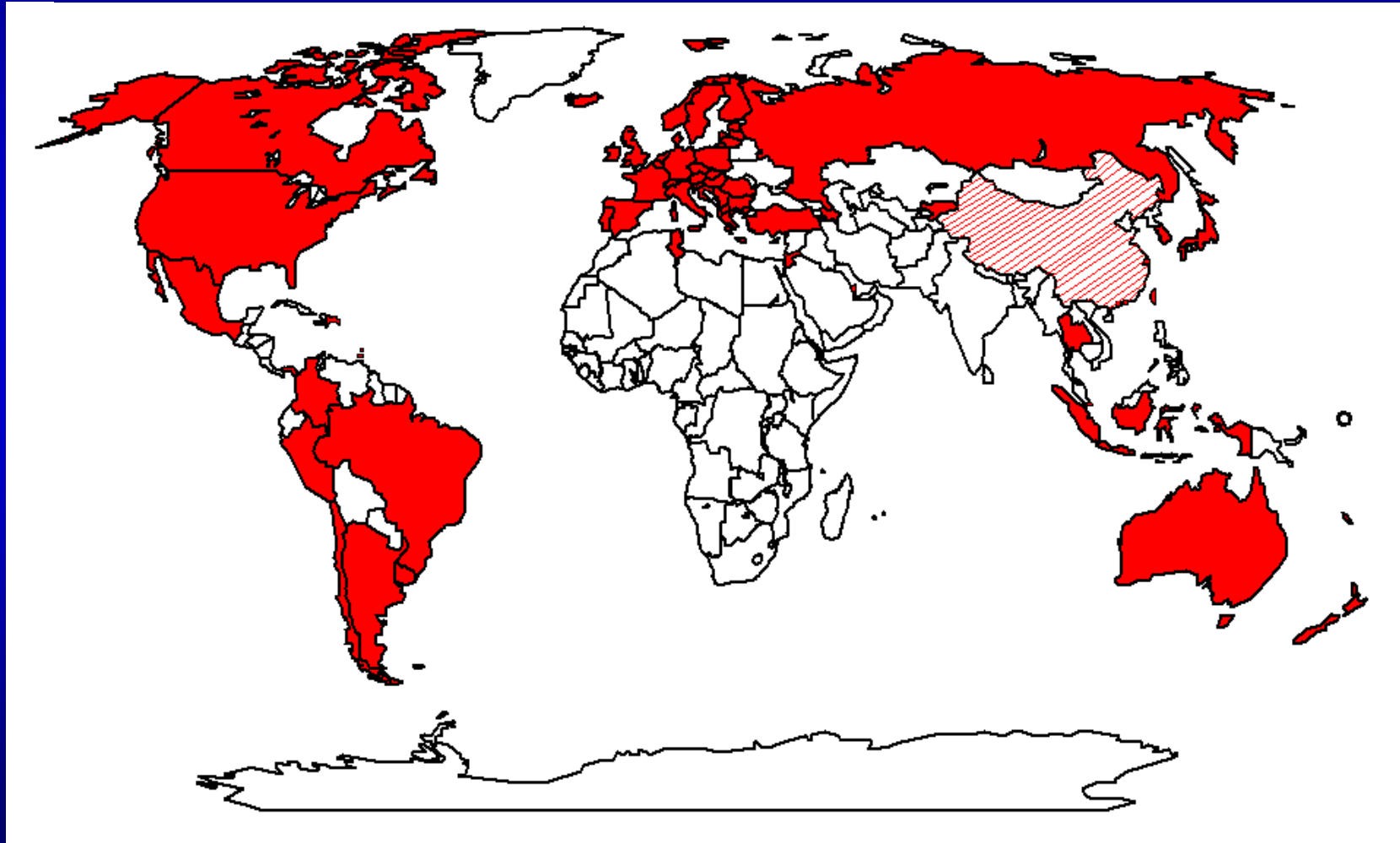
What is PISA?

A three-yearly global assessment that...

- ... examines the performance of 15-year-olds in key subject areas as well as a wider range of educational outcomes, including student attitudes to learning, their beliefs about themselves, and their learning strategies

- ... collects information from students, schools, parents and systems to identify policy issues

PISA countries in 2009



Making international comparisons of achievement requires decisions about...

what to assess,

whom to assess.

Deciding what to assess...

looking back at what they were expected to have learned

looking ahead to what they can do with what they have learned.

For PISA, the OECD countries chose the latter.

PISA assessments

□ Reading literacy

- Using, interpreting and reflecting on written material.

□ Mathematical literacy

- Recognising problems that can be solved mathematically, representing them mathematically, solving them.

□ Scientific literacy

- Identifying scientific questions, recognising what counts as scientific evidence, using evidence to draw conclusions about the natural world.

How PISA works

- A strong international network of expertise among the participating countries...
 - From establishing the assessment frameworks...
 - The PISA assessments include tasks from more than 40 countries
 - ... developing the instruments...
 - Cross-national and cross-cultural validity
 - ... to analysing and interpreting the results
 - National, regional and international analyses and reports
 - In-depths country peer reviews
- ... supported by a consortium of the leading research institutions...
 - ACER, CITO, ETS, NIER, WESTAT
- ... co-ordinated through the OECD in collaboration with other international organisations .

Development of assessments

- Frameworks by international experts
- Assessment materials
 - submitted by countries
 - developed by research consortium
 - screened for cultural bias
 - by countries
 - by expert, international panel
 - items with prima facie cultural bias removed at this stage
 - translated from English & French originals
 - trialled to check items working consistently in all countries
- Final tests
 - items shown in trial to be culturally biased removed
 - best items chosen for final tests
 - balanced to reflect framework
 - range of difficulties
 - range of item types (constructed response, multiple choice)

Science in PISA 2006

- Scientific knowledge and *use* of that knowledge in...
 - ... identifying scientific issues,
 - ... explaining scientific phenomena,
 - ... using scientific evidence

Deciding whom to assess...

grade-based sample

OR

age-based sample

For PISA, the OECD countries chose the latter, selecting 15-year-olds in school as the population.

PISA sampling requirements

□ Population: all 15-year-olds in school

- Minimum of 150 schools randomly selected per country (85% must participate)
- 35 students randomly selected per school (80% must participate), giving samples of between 3,500 and 50,000 per country
- Total of 400,000 students
- Countries doing regional comparisons have larger than average samples - Italy (22000), Canada (22000), Spain (20000)

Key features of PISA 2006

□ Information collected

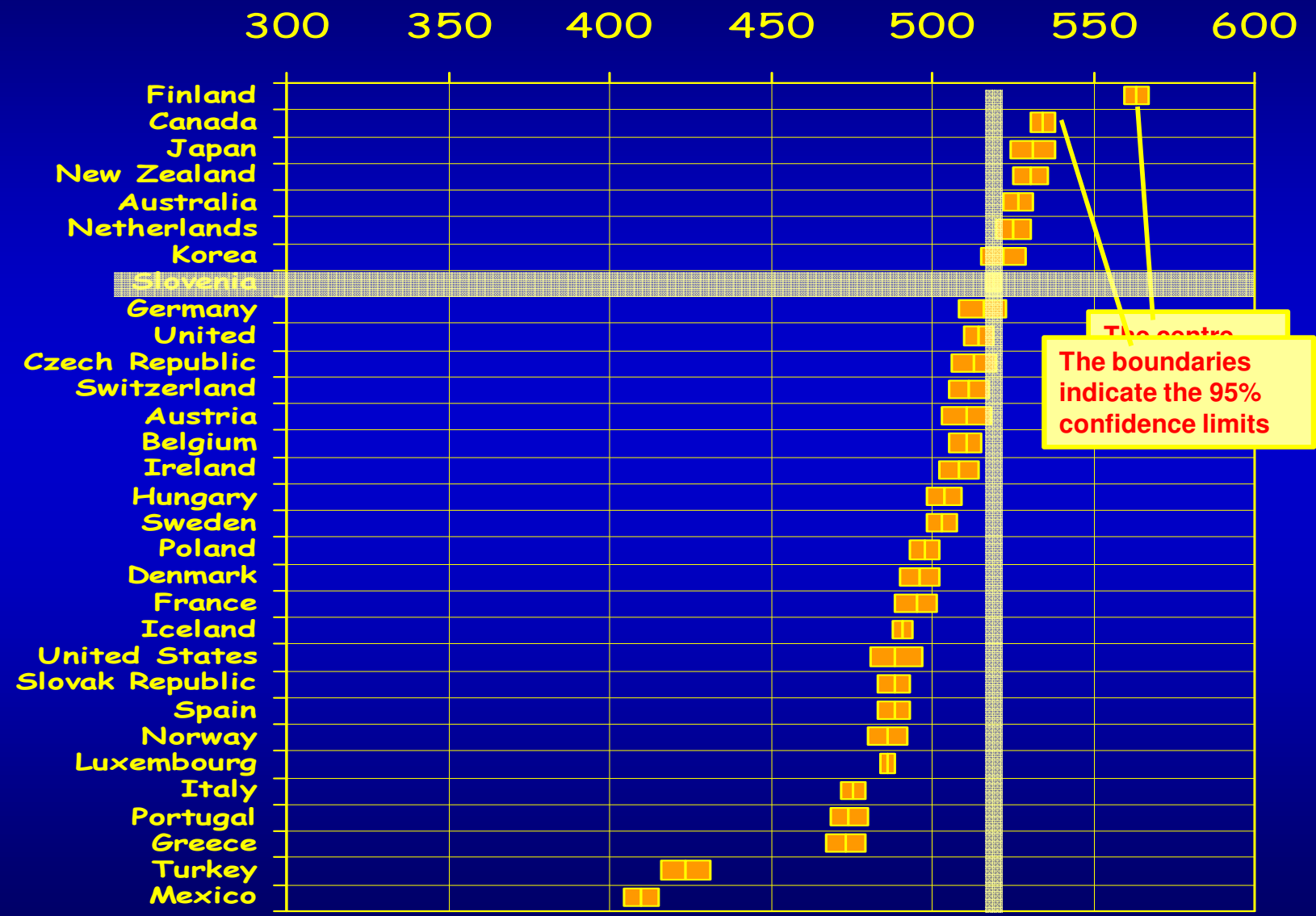
- each student
 - 2 hours on paper-and-pencil tasks (subset of all questions)
 - $\frac{1}{2}$ hour for questionnaire on background, learning habits, learning environment, engagement and motivation
- school principals
 - questionnaire (school demography, learning environment quality)

Overview of Results from PISA 2006

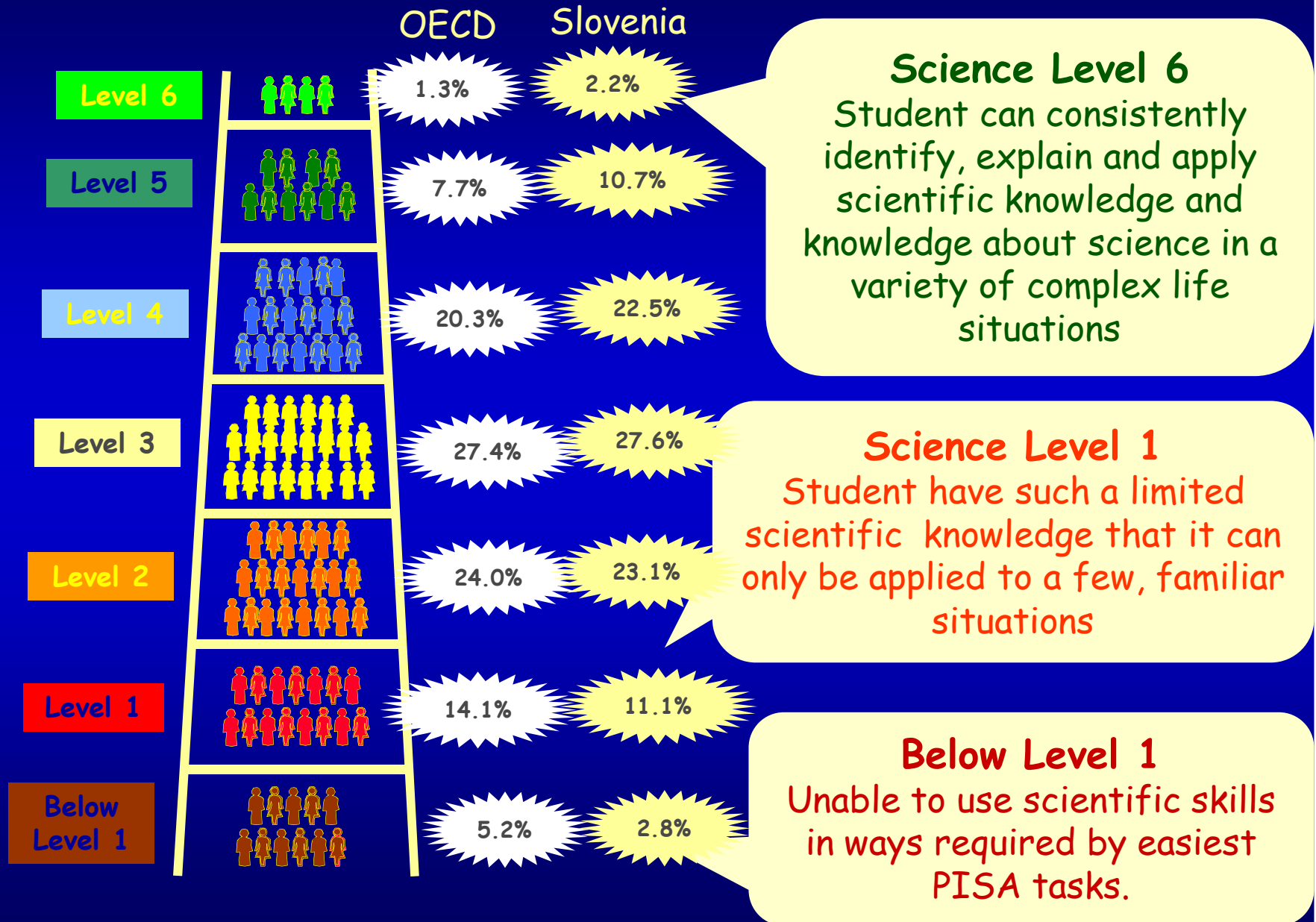
PISA provides key benchmarks for the quality of education systems

1. Overall performance of education systems
2. Equity in the distribution of learning opportunities
 - Measured by the impact students' and schools' socio-economic background has on performance...
... not merely by the distribution of learning outcomes
3. Consistency of performance standards across schools
4. Gender differences

Mean science scores

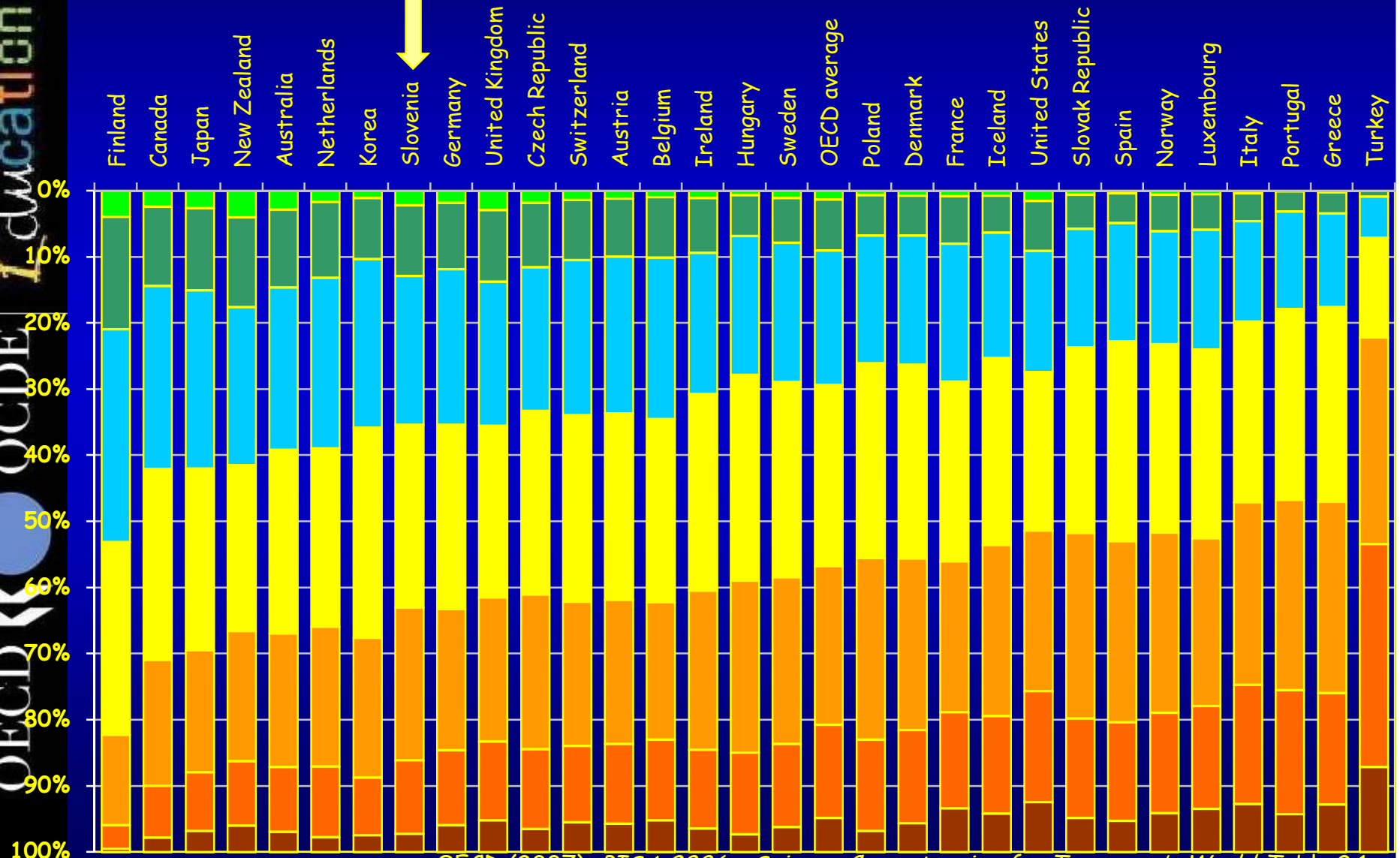


PISA Proficiency Levels



Percentage of students at each proficiency level

OECD Education

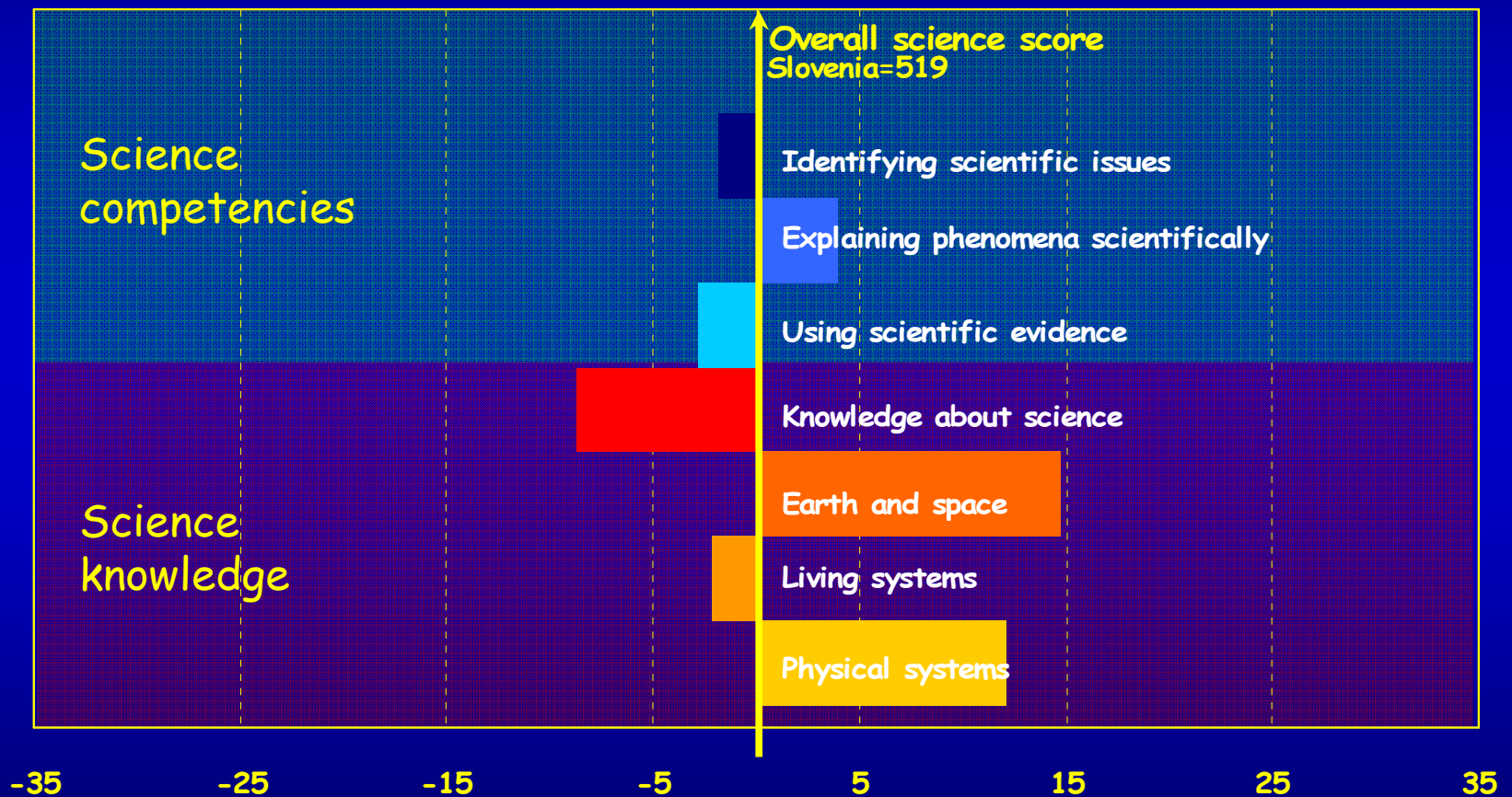


OECD (2007), PISA 2006 - Science Competencies for Tomorrow's World, Table 2.1a

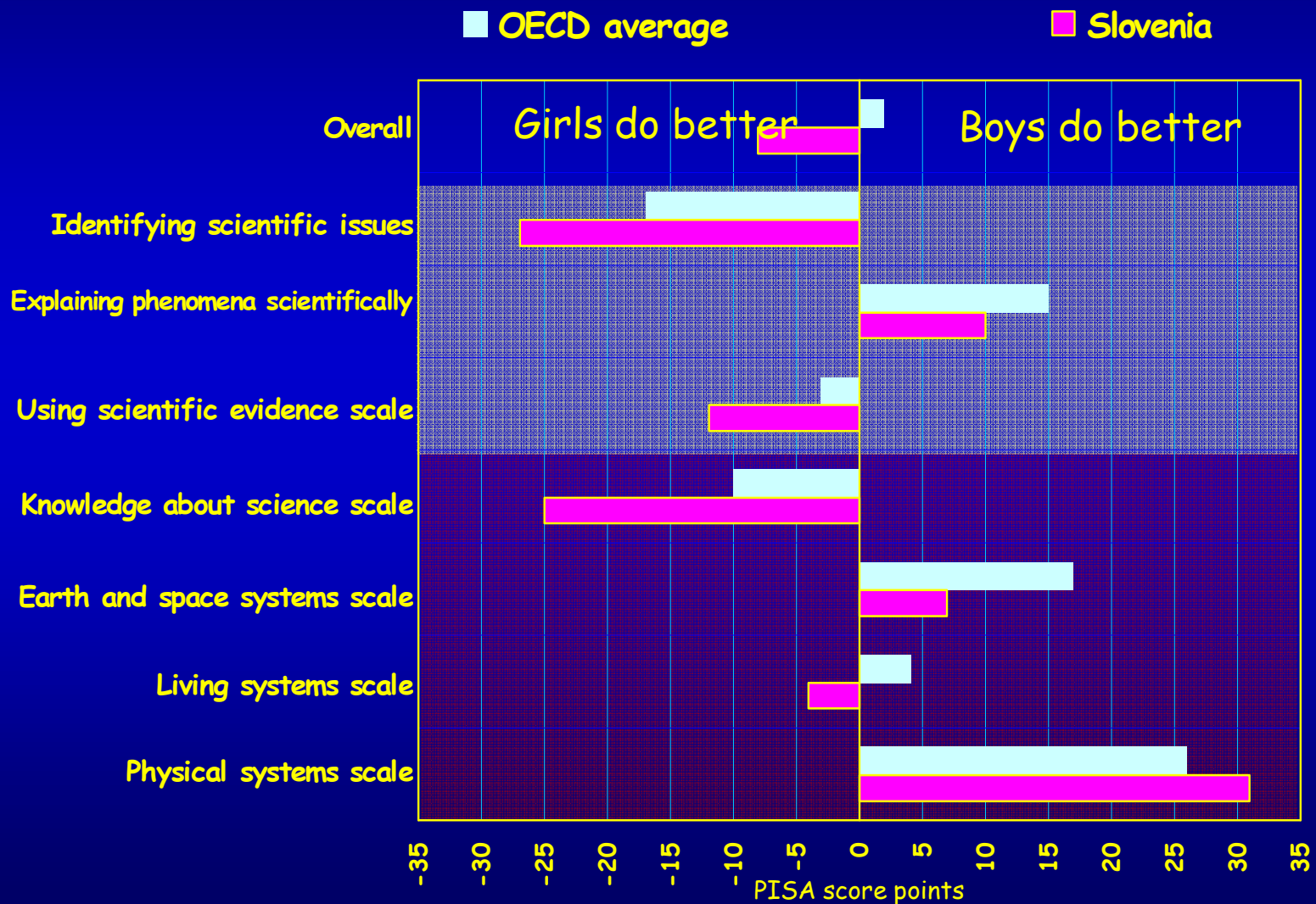
Science in PISA 2006

- The three competencies that PISA measured in science in 2006:
 1. Identifying scientific issues
 2. Explaining scientific phenomena
 3. Using scientific evidence

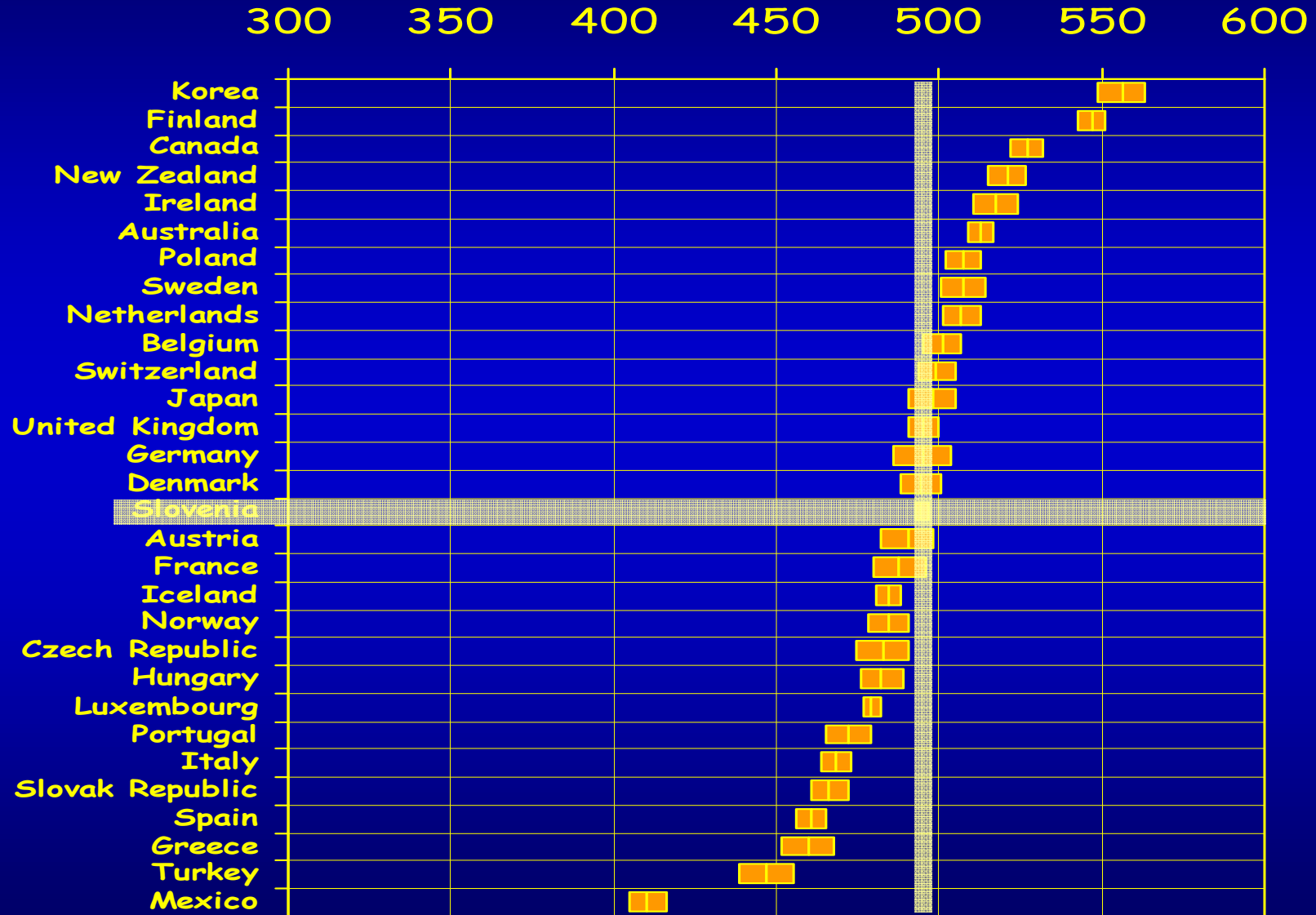
Strengths and weaknesses of countries in science relative to their overall performance



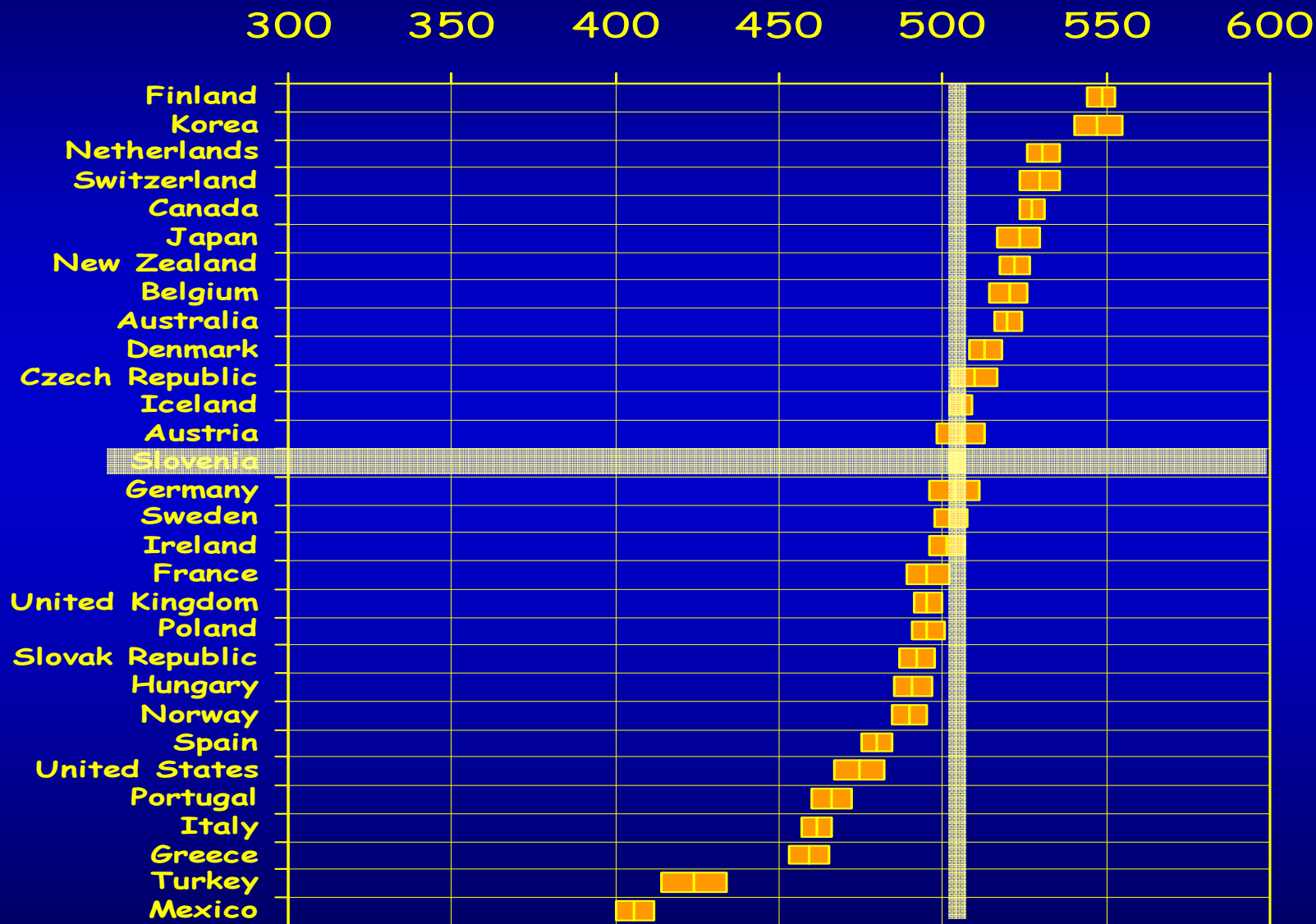
Gender differences in science



Mean reading scores

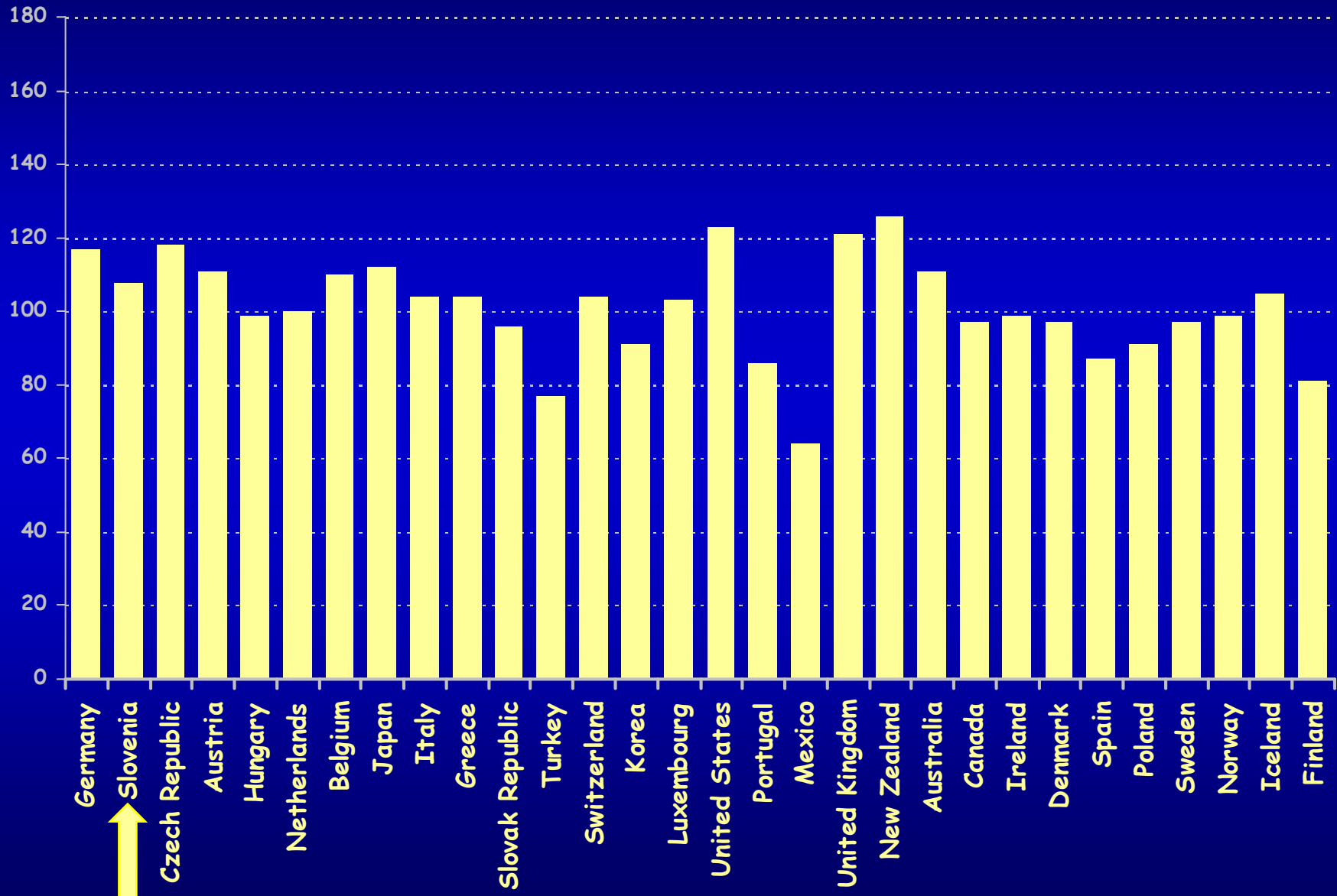


Mean mathematics scores

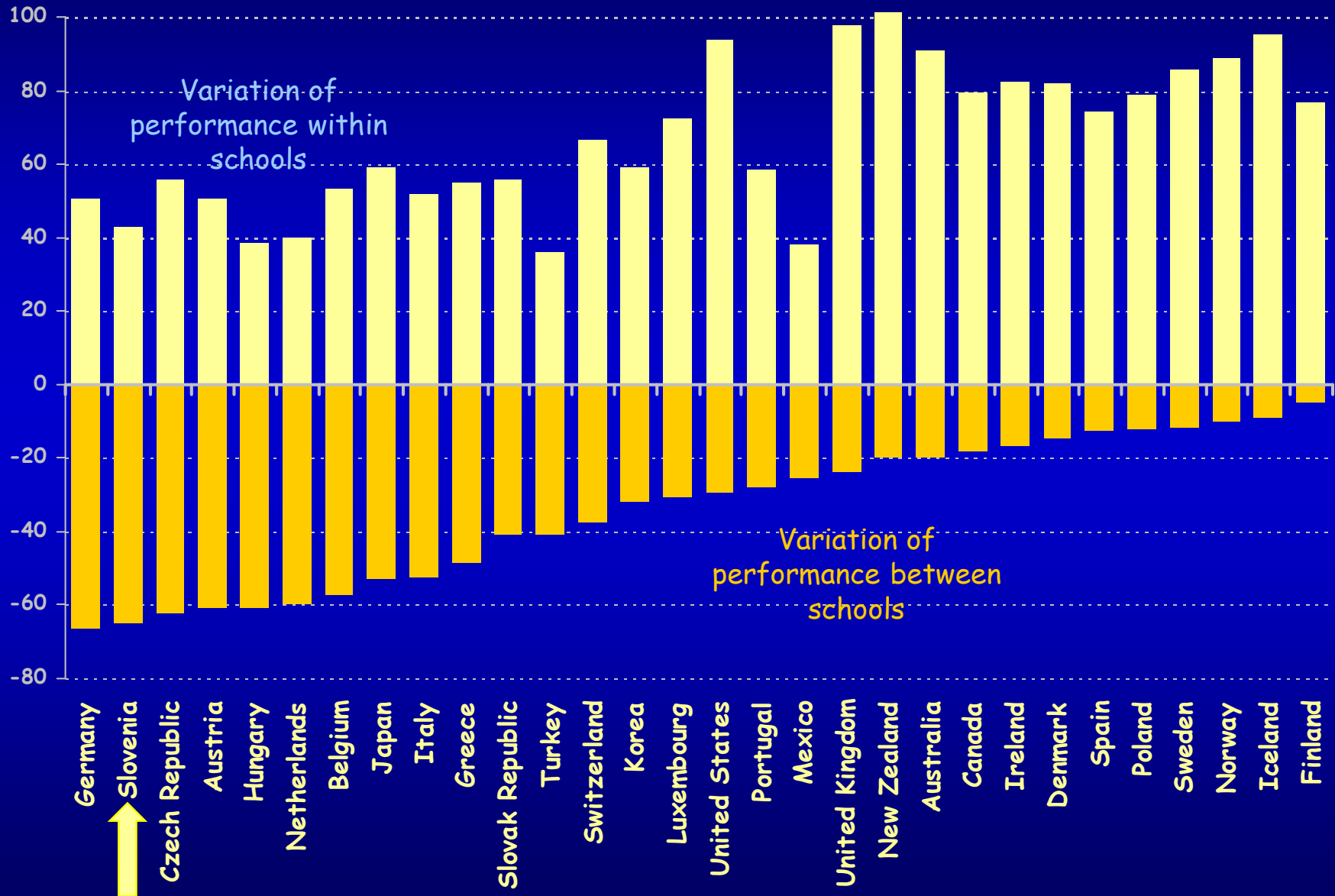


Performance variation across schools

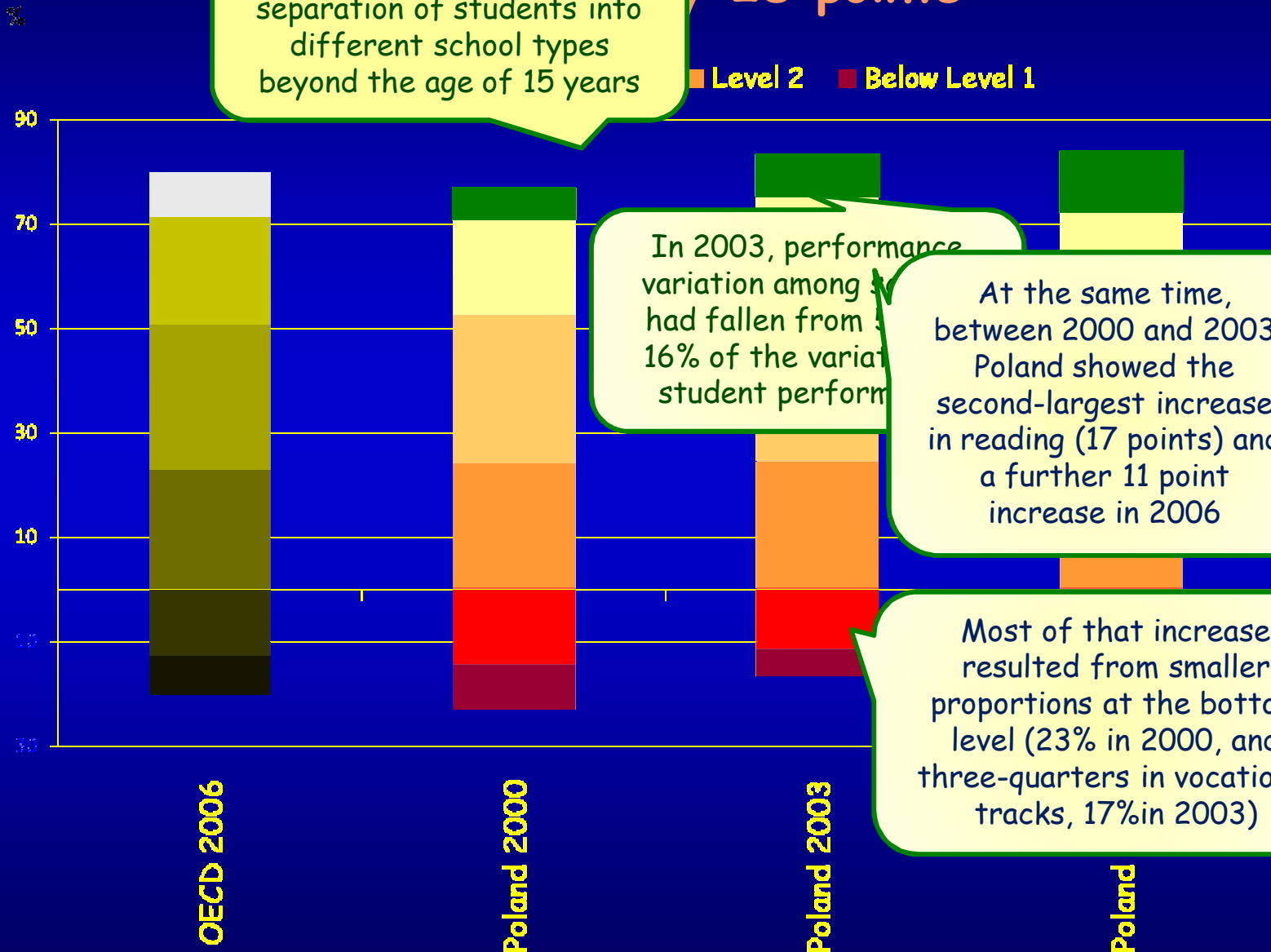
Variation in student performance



Variation in student performance

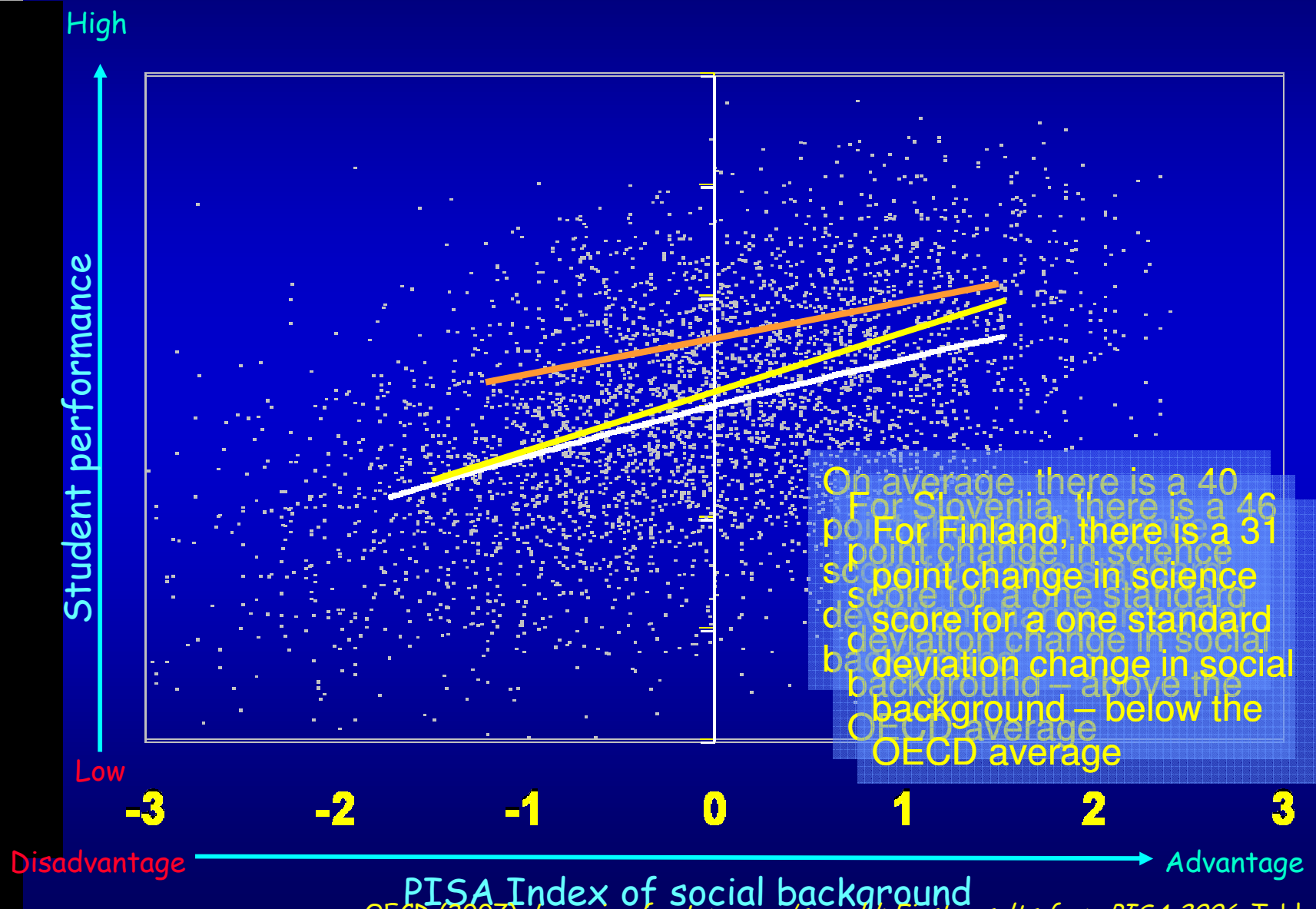


From 2000 to 2006, Poland raised its PISA reading score by 28 points

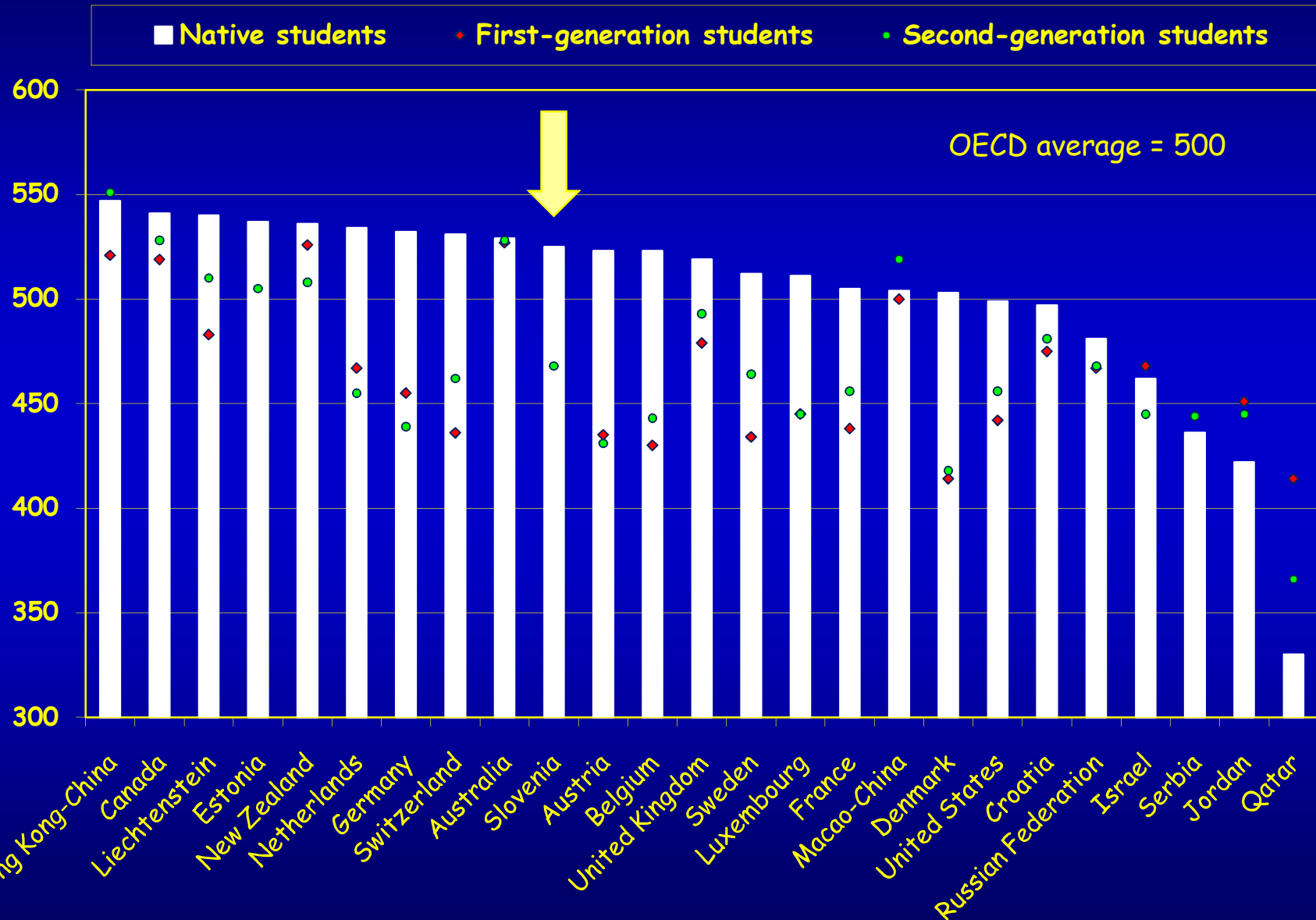


Equity

Performance and socio-economic background



Performance and migration

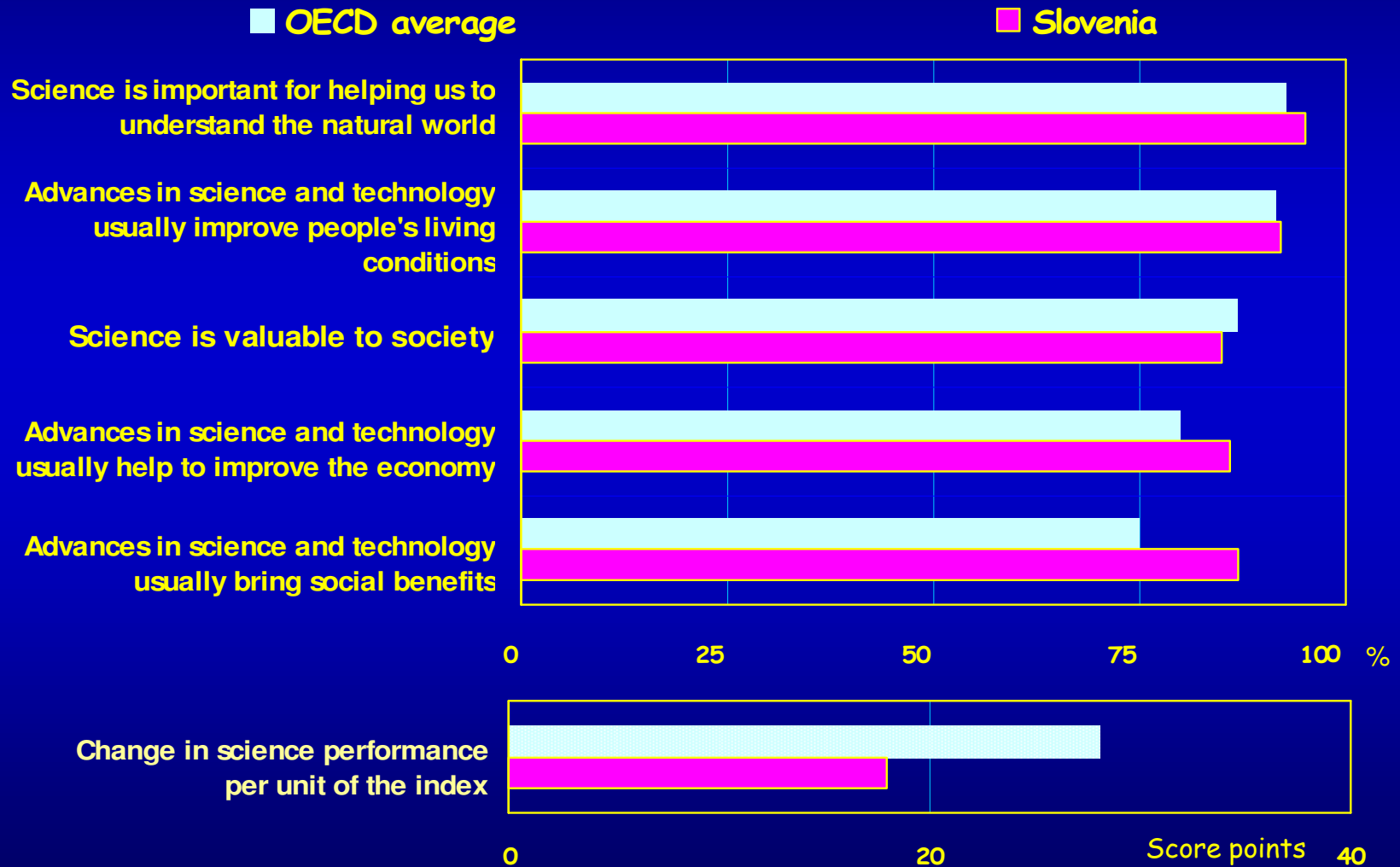


PISA 2006: Science Competencies for Tomorrow's World, Figure 4.2a.

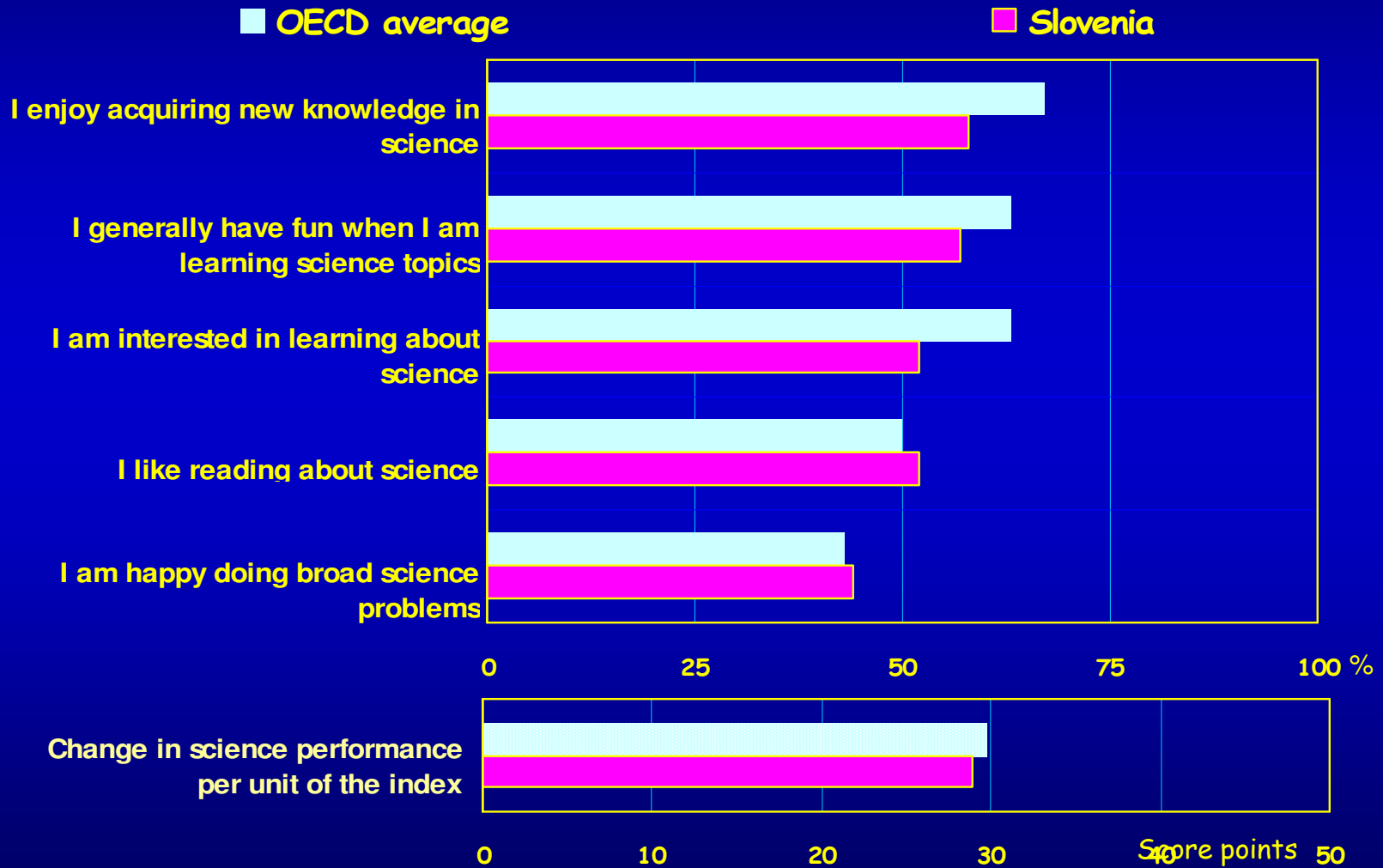
Students attitudes to science and
their awareness of the life
opportunities science may open

Students generally value science...

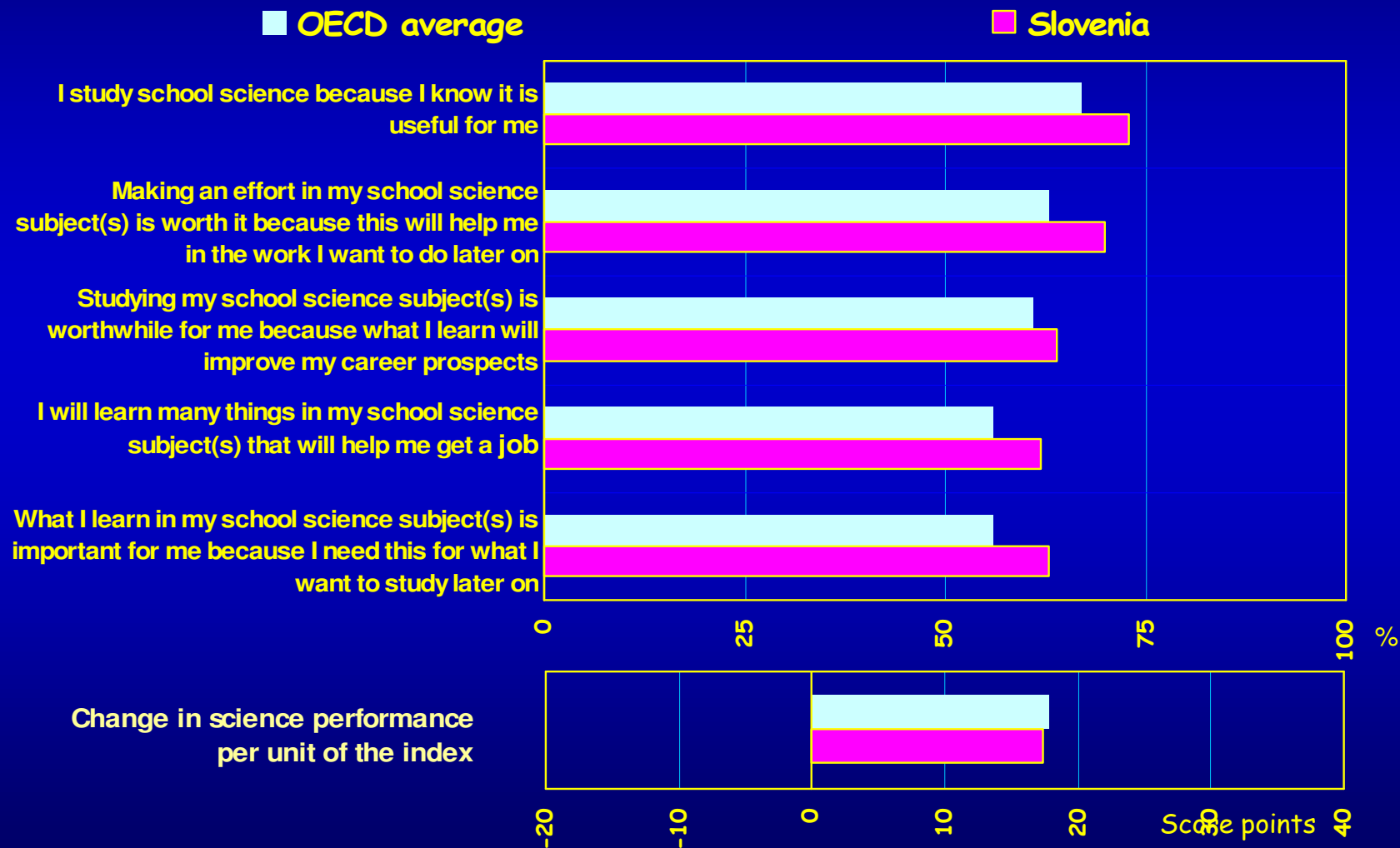
but report stronger belief in the technological potential of science than in its capacity to make social improvements



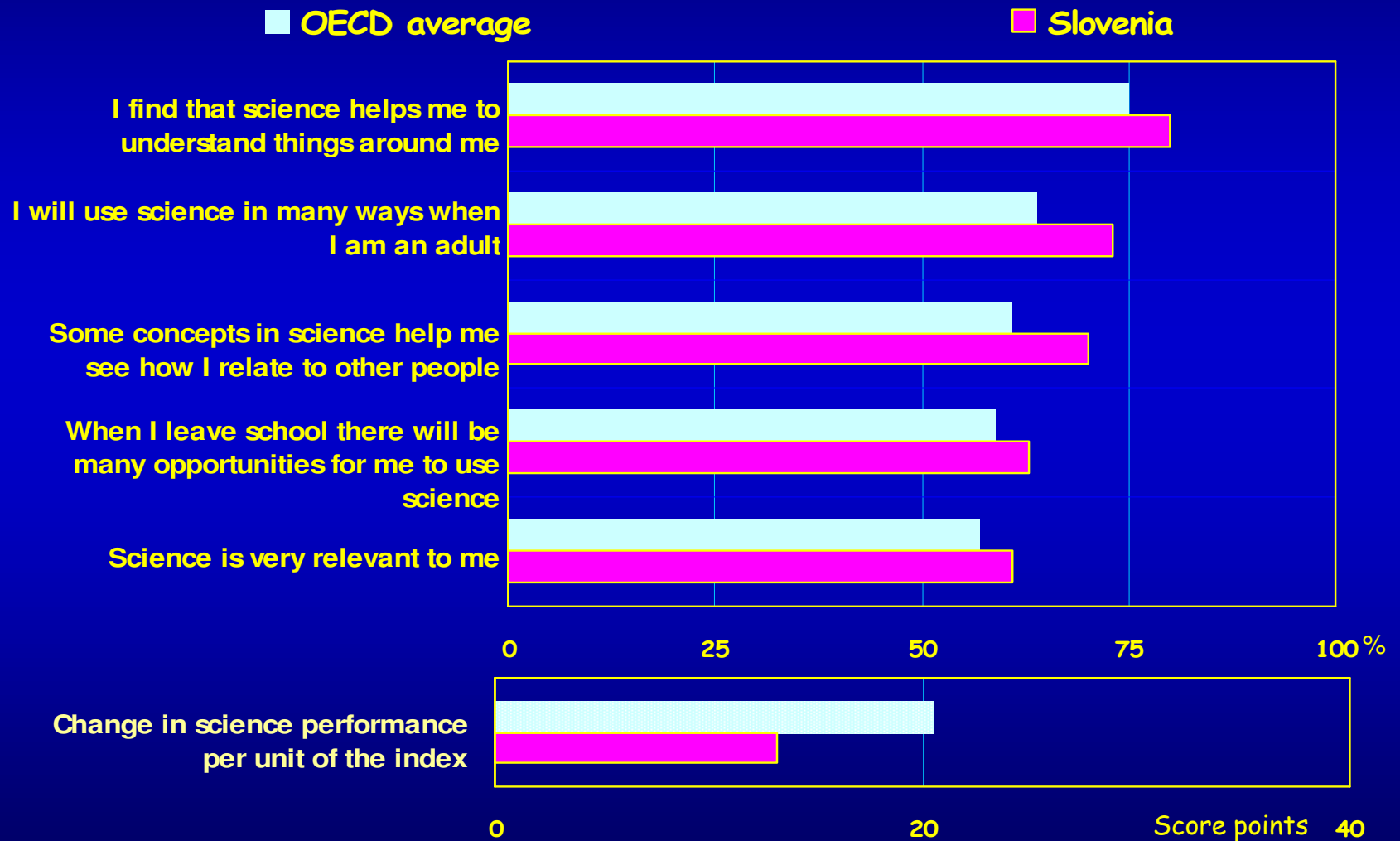
Enjoyment of science



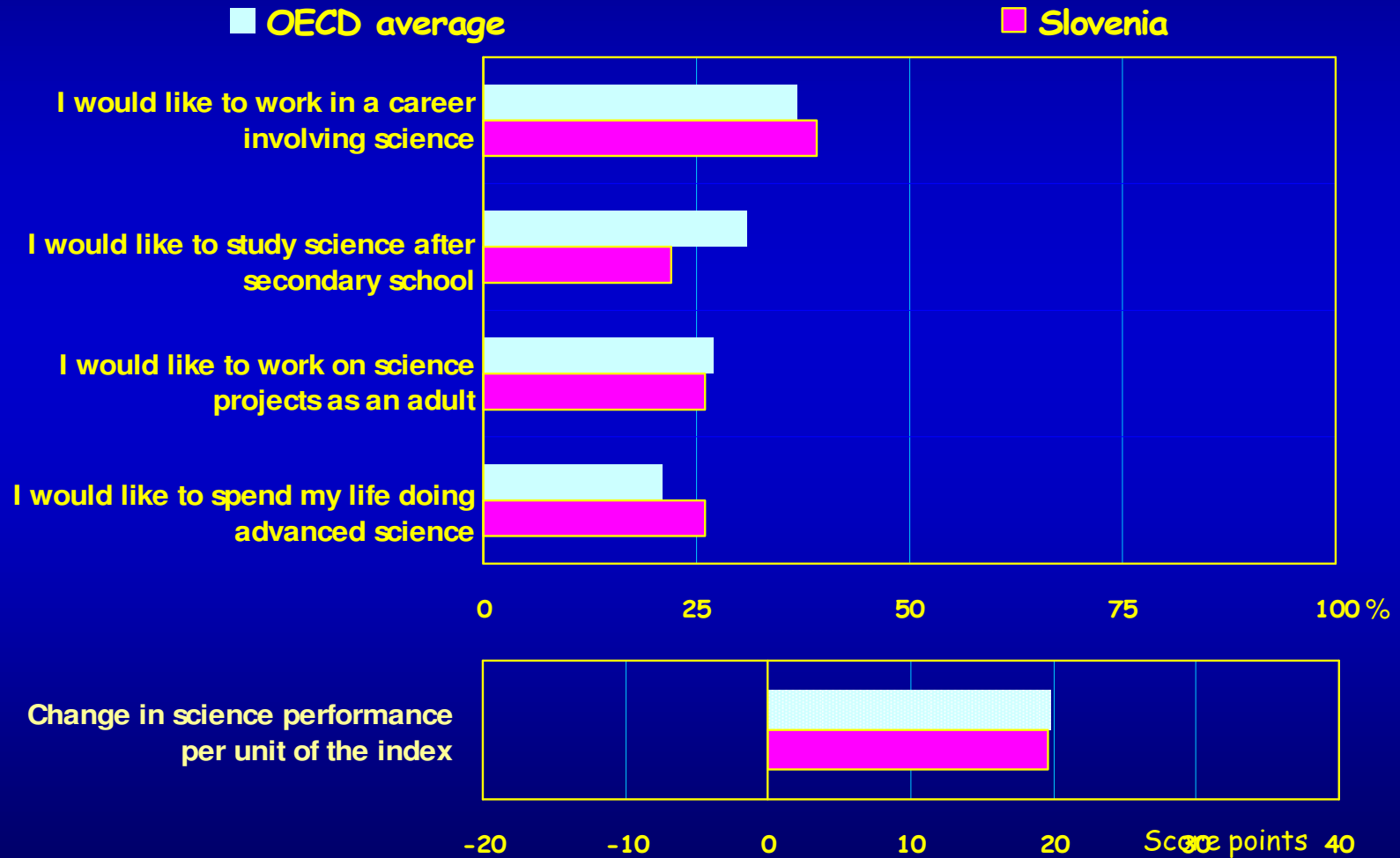
Instrumental motivation to learn science



...but somewhat less so when it concerns themselves...

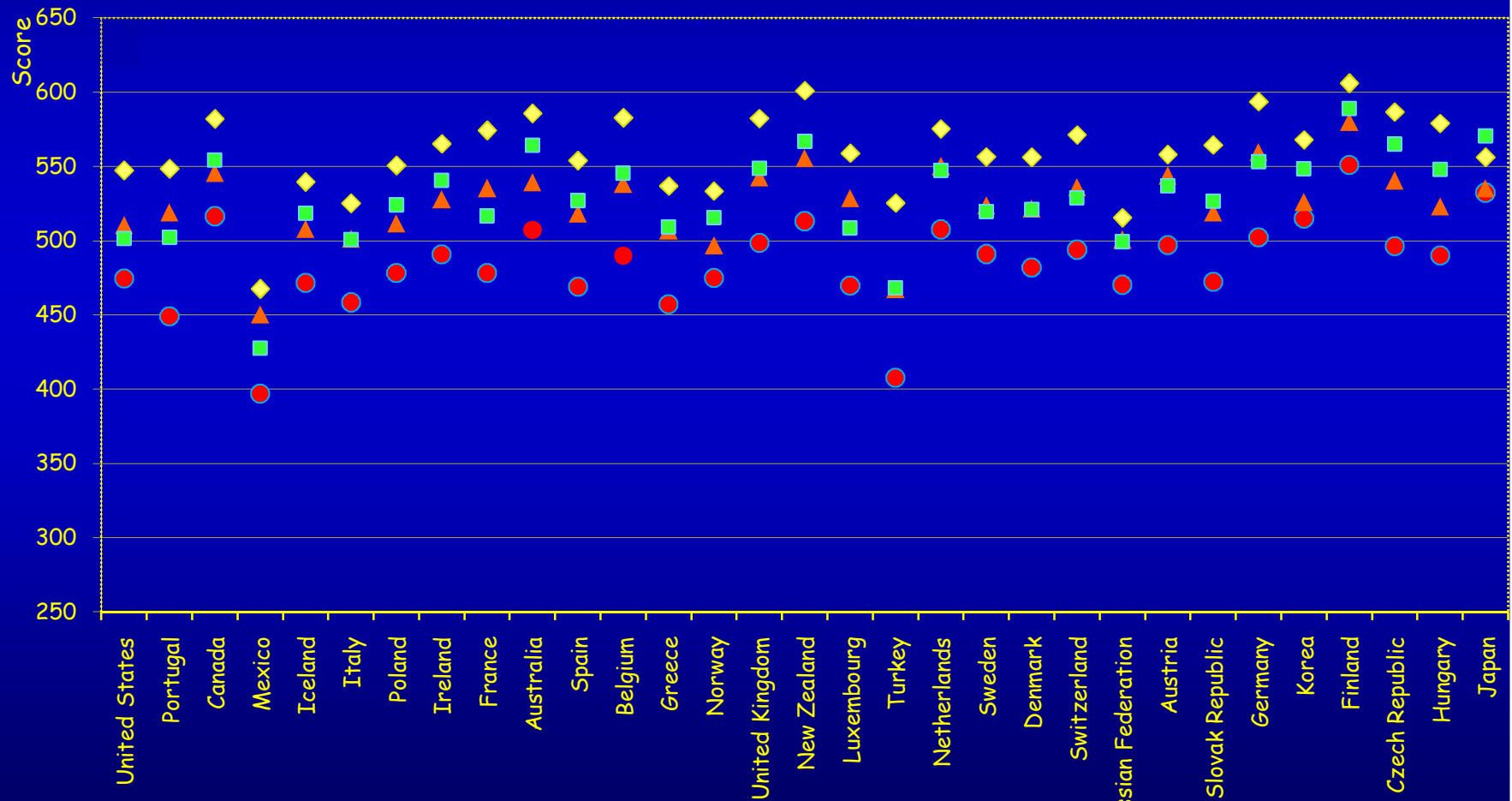


...and only a minority report interest in a scientific career



Students expecting a science-related career and their performance in science

- Students not expecting a science career without a parent in a science-related occupation
- ▲ Students not expecting a science career with at least one parent in a science-related occupation
- Students expecting a science career without a parent in a science-related occupation
- ◆ Students expecting a science career with at least one parent in a science-related occupation



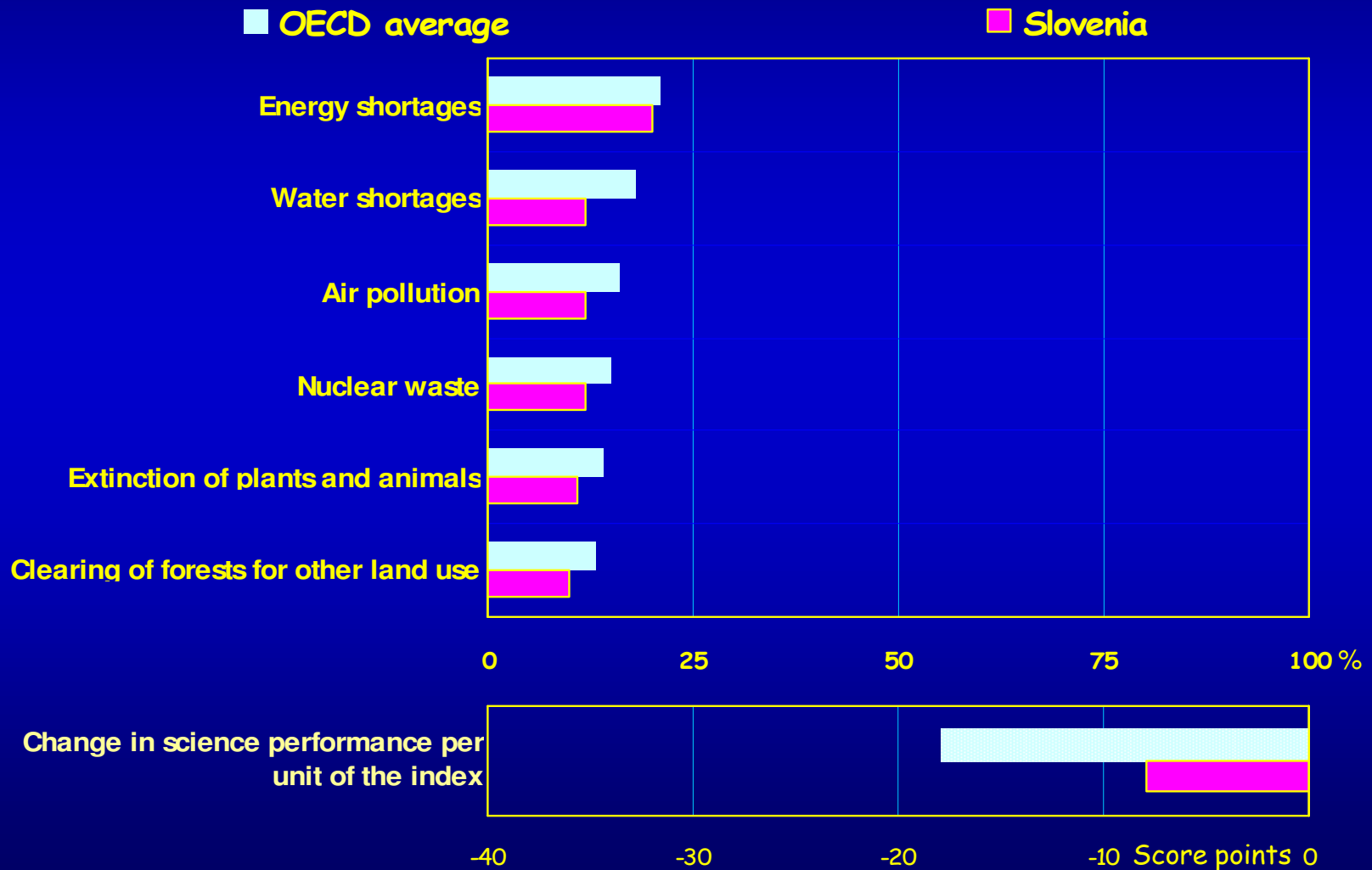
Note: Science performance scores are only shown for groups where there are at least 3% of students.
 Source: OECD PISA database, Table 3.14.

Science and the environment

- 58% of 15-year-olds report familiarity and knowledge of the increase of greenhouse gases in the atmosphere, 73% with consequences of clearing forests for other land use, 60% with issues around pollution and acid rain (large variation across countries)...
 - Awareness of environmental issues is closely linked with students' science performance...
... and with their social background
- Only a minority are optimistic that the issues will be successfully addressed...
 - ... and the better they perform in science, the less optimistic they are .

Some degree of pessimism among students about the future of the natural environment

problems associated with the areas below will improve over the next 20 years



PISA 2006 - some system and school factors associated with performance

(across 55 countries and above and beyond students' socio-economic background and other school factors)

- Some autonomy and accountability factors show a positive association with performance.
 - Systems providing schools more autonomy in budgeting.
 - The proportion of students in schools with autonomy in budgeting.
 - 57% of students across the OECD are in such schools.
 - Schools posting achievement data publicly.
 - But no specification as to how this is done, *e.g.* linking to previous year's performance or performance of schools with similar intake.

PISA 2006 - some system and school factors associated with performance

(across 55 countries and above and beyond students' socio-economic background and other school factors)

□ However, PISA offers a note of caution on selection or grouping of students :

- Grouping students by ability within schools.
 - Schools where students are sorted by ability for all subjects are associated with lower performance.
- Schools selecting students by academic record/achievement
 - These schools perform better,
 - BUT there is no benefit to the system as a whole (a higher proportion of schools selecting students by academic record/achievement is not associated with higher performance).

PISA 2006 - some system and school factors associated with performance

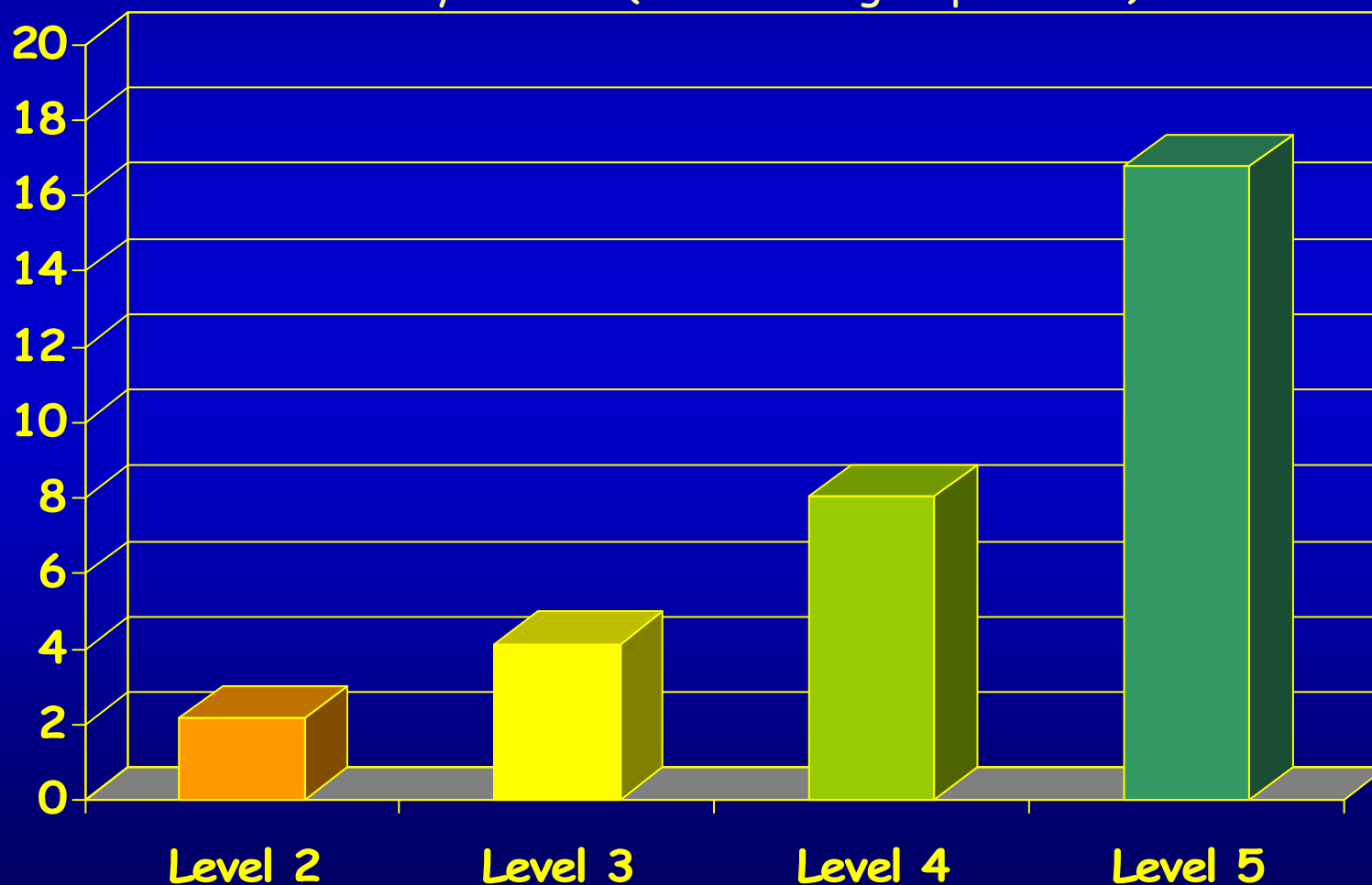
(across 55 countries and above and beyond students' socio-economic background and other school factors)

□ However, PISA offers a note of caution on selection or grouping of students :

- Systems where students are sorted into distinct educational tracks/institutions at an early age.
 - There is no benefit to the system as a whole (an early age of selection is not associated with higher performance).
 - BUT there is a negative impact on equity.

Is performance in PISA associated with later success?

Increased likelihood of postsecondary participation at age 19 associated with reading proficiency at age 15 (Canada) after accounting for school engagement, gender, mother tongue, place of residence, parental, education and family income (reference group Level 1)



Further information

- www.pisa.oecd.org
 - All national and international publications
 - The complete database
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- john.cresswell@oecd.org