Programme for International Student Assessment (PISA)
Methodologies and results

Miyako Ikeda
September 14, 2015
Topics covered today

1. What is OECD/PISA
2. Survey methodologies
3. Some analytical approaches and results
4. Impact on policies
5. Recommendations and future strategies
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• Organisation for Economic Co-operation and Development
• Established in 1961
• Missions:
  – To promote policies that will improve the economic and social well-being of people around the world.
  – To provide a forum in which governments can work together to share experiences and seek solutions to common problems.
  – To conduct analyses and provide recommendations, which are independent and evidence-based.
OECD (2)

- Headquarters: Paris, France
- Staff: approximately 2500
- 34 member countries
  Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.
PISA design

- Launched in 1997 by OECD
- Target population: 15-year-old students
- Assessments conducted every three years since 2000
- Reading, Mathematics, Science (and Problem Solving)
- Major/minor domains
- Booklet rotation

<table>
<thead>
<tr>
<th>Year</th>
<th>Read</th>
<th>Math</th>
<th>Science</th>
<th>Prb Slv</th>
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<tr>
<td>2000</td>
<td>Read</td>
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<td>Science</td>
<td>Prb Slv</td>
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<tr>
<td>2003</td>
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<td>Math</td>
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<tr>
<td>2006</td>
<td>Read</td>
<td>Math</td>
<td>Science</td>
<td>Prb Slv</td>
</tr>
<tr>
<td>2009</td>
<td>Read</td>
<td>Math</td>
<td>Science</td>
<td>Prb Slv</td>
</tr>
<tr>
<td>2012</td>
<td>Read</td>
<td>Math</td>
<td>Science</td>
<td>Prb Slv</td>
</tr>
<tr>
<td>2015</td>
<td>Read</td>
<td>Math</td>
<td>Science</td>
<td>Collab. Prb. Slv</td>
</tr>
</tbody>
</table>
PISA assessment

- Assessing what students can do with what they have learned

- Diagram showing the cycle:
  - Problem in context
  - Mathematical results
  - Results in context
  - Mathematical problem

- Arrows indicating the process:
  - Evaluate
  - Formulate
  - Interpret
  - Employ
PISA participants

- Around 510,000 students from 65 countries and economies participated in PISA 2012 ([Link](#))
- Over 70 countries and economies are participating in PISA 2015
- Background questionnaires:
  - Students
  - School principals
  - Parents (option)
  - Teachers (option)
PISA publications

• Publications
  – Initial reports (Link)
  – Thematic reports (Link)
  – Policy briefs (Link)
  – Technical reports (Link)
  – Data Analysis Manuals (Link)

SAS and SPSS versions are available.
PISA database


![PISA database screenshot](image)

- **Results**
  - **Key findings**: PISA key findings include rankings of student performance by country/economy and information on student background, their approaches to learning and the organisation of their schools.
  - **Databases for each year the students took the test**: 2012, 2009, 2006, 2003, 2000

- **Overviews**
  - **Briefs: Pisa in Focus**: A series of concise 4-page monthly education policy-oriented briefs designed to describe a PISA topic.
  - **Video series: Strong Performers and Successful Reformers in Education**: Produced jointly by the OECD and the Pearson Foundation, this series of videos highlights initiatives taken by education authorities around the world to help school students do better.
PISA 2012 database

- PISA 2012 database (Link)
  - Questionnaires
  - Codebooks
  - SAS control files
  - SPSS control files
  - Data sets in TXT format
    - Student questionnaire data file
    - School questionnaire data file
    - Parent questionnaire data file
    - Cognitive item response data file
    - Scored cognitive item response
- Compendia

Results in reading, mathematics and science (i.e. plausible values) are included here
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PISA sampling design

- Draw a student sample in two stages
  - **Stage 1**: a sample of schools is selected from a complete list of schools with 15-year-old students. Probability Proportional to Size (PPS) sampling.
  - **Stage 2**: 35 students are randomly selected within the selected schools.

→ Need to apply “weights” in analyses
  - **Sample weights**: for unbiased population estimates
  - **80 replicate weights**: for correct standard errors
    - Balanced Repeated Replication (BRR) method; the Fay method with a factor of 0.5.
Item Response Theory (IRT): the Rasch model

- Item difficulty and student ability are linked by a logistic function.
- With this function, it is possible to compute the probability that a student succeeds on an item.

Plausible Values (PVs)

- Mathematically computing distributions around the reported values (=a posterior distributions).
- Assigning to each observation a set of random values drawn from the posterior distributions.

→ Need to use 5 PVs in analyses

- Run analysis five times with each of the 5PVs
- Combine the five estimates to obtain the final estimate and standard error.
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Three-level regression model: variance decomposition

- Between systems
- Between schools
- Between students

OECD countries:
- Between systems: 10%
- Between schools: 36%
- Between students: 54%

All participating countries and economies:
- Between systems: 23%
- Between schools: 31%
- Between students: 46%
Three-level regression model: variance decomposition

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OECD countries

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Mean scores

Average performance of 15-year-olds in mathematics

High mathematics performance
... Shanghai-China performs above this line (613)

Low mathematics performance
... there are 12 countries below Mexico

PISA 2012 Fig I.2.13

Mean scores

Average performance of 15-year-olds in mathematics

High mathematics performance
... Shanghai-China performs above this line (613)

Low mathematics performance
... there are 12 countries below Mexico

PISA 2012 Fig I.2.13
Strong socio-economic impact on student performance

Socially equitable distribution of learning opportunities
Strong socio-economic impact on student performance

Socially equitable distribution of learning opportunities
Correlation: Spending per student from the age of 6 to 15 and mathematics performance in PISA 2012

R² = 0.01

PISA 2012. Figure IV.1.8
Three-level regression model: variance decomposition

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Two-level regression model: variance between and within schools

Student mathematics performance

- Performance differences between schools
- Performance variation of students within schools

School type, school policies, school learning environment, etc

Student gender, SES, migrant background, attitudes, and dispositions, etc

Countries: Finland, Iceland, Sweden, Norway, Denmark, Estonia, Ireland, Spain, Canada, Poland, United States, Mexico, Malaysia, New Zealand, Greece, United Kingdom, Australia, Portugal, Indonesia, Chile, Thailand, Switzerland, Croatia, Macao-China, Viet Nam, Korea, Hong Kong-China, Singapore, China, Japan, Czech Republic, Luxembourg, Italy, Luxembourg, Italy, Japan, Bulgaria, Israel, Shanghai-China, Slovakia, Germany, Slovenia, Slovak Republic, Turkey, Hungary, Belgium, Netherlands, Chinese Taipei.
Gender difference in performance

Boys perform better

Girls perform better

PISA 2012
Tables I.2.3a, I.4.3a, I.5.3a
Girls are more **anxious** towards mathematics than boys (OECD average)

- I often worry that it will be difficult for me in mathematics classes
- I get very tense when I have to do mathematics homework
- I get very nervous doing mathematics problems
- I feel helpless when doing a mathematics problem
- I worry that I will get poor marks in mathematics

Girls are more anxious towards mathematics than boys

OECD average

PISA 2012
Gender report
Figure 3.10
Students’ mathematics anxiety

Percentage of students who reported that they “agree” or “strongly agree”

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<thead>
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<tbody>
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<td>OECD average</td>
<td>59</td>
<td>33</td>
<td>31</td>
<td>30</td>
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<tr>
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<tr>
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<tr>
<td>Viet Nam</td>
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<td>33</td>
<td>44</td>
<td>39</td>
<td>72</td>
</tr>
<tr>
<td>Japan</td>
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<td>56</td>
<td>39</td>
<td>35</td>
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Factors contribute to performance

- Education Policy Outlook International Conference 2015

PISA
TALIS
PIAAC
EAG
Policy Reviews
Country Reviews

Set high standards for all
Invest in teachers and teaching
Use data to follow student progress
Recognise role of leadership
Ensure sound policy making
Support disadvantaged students
Accountability

LINK
Impact on policies

OECD countries are using different policy options to improve their education systems...

- **Canada**: National commitment to ECEC
- **US**: Funding grants
- **Mexico**: Constitutional Reform
- **Chile**: Subsidies for disadvantaged schools
- **UK**: Student funding
- **UK**: School improvement
- **Finland/Nordic**: Curriculum reform
- **France/Nordics**: Teacher training reform
- **Italy**: School evaluation reform
- **Portugal**: VET reforms
- **Germany**: Investing in the future
- **Reforms in school leadership and teachers**
- **Austria**: New middle school reform
- **Japan**: Setting national priorities for education
- **Australia, N. Zealand**: Support to students from specific populations
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Recommendations for other analyses

• Longitudinal study (i.e. Danish study [LINK])
• Analyses of computer logfile data
• Regional analyses
• Other themes:
  – Low performers (proficiency levels)
  – Item-level analysis
  – etc
Future directions of PISA

PISA 2015
- Computer-based assessment
- Collaborative problem solving
- Student subjective well-being

PISA 2018
- Global competence
PISA for Development

- PISA for Development (PISA-D) intends to make participation in PISA more accessible & relevant for developing countries.

- Main project outputs:
  1. Contextual questionnaires & data-collection instruments adapted to a wider range of economic and social contexts
  2. The descriptive power of cognitive assessments in reading, maths & science enhanced to meet a wider range of student abilities
  3. An approach developed for including out-of-school 15 year-olds in the assessments.
  4. Country capacity in assessment, analysis & use of results for monitoring & improvement strengthened among participating countries.
  5. Engagement established with pilot countries, development partners & with other developing countries to identify peer-to-peer learning opportunities regarding participation in PISA & its potential contribution to the UN-led discussions on the post-2015 framework
PISA-D: Partners in the project

Development Partners

- France (AFD)
- Germany (BMZ/GIZ)
- Ireland (Irish Aid)
- Japan (JICA)
- Korea
- Norway (Norad)
- United Kingdom (DFID)
- Inter-American Development Bank
- Global Partnership for Education (GPE), through the World Bank
- World Bank

Technical Partners

- UNESCO
- UNESCO Institute of Statistics (UIS)
- Education For All Global Monitoring Report (EFA GMR) team
- UNICEF
- And the following assessment programmes: ASER; EGRA; EGMA; SACMEQ; PASEC; Pre-PIRLS and PIRLS; TIMSS; LLECE; STEP; LAMP; UWEZO; and WEI-SPS
- Education International
PISA-D: Participating countries

Guatemala
Senegal
Ecuador
Paraguay
Cambodia
Zambia
Find out more about PISA at [www.pisa.oecd.org](http://www.pisa.oecd.org)

- All national and international publications
- The complete micro-level database

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Thank you!