Beyond the lessons learned from international comparative research in education

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Aims of international comparative research

Postlethwaite (1988)* discriminated four major aims of comparative education:

- "Identifying what is happening elsewhere that might help improve our own system of education"
- "Describing similarities and differences in educational phenomena between systems of education and interpreting why these exist"
- "Estimating the relative effects of variables (…determinants) on outcomes (both within and between systems of education)"
- "Identifying general principles concerning educational effects" (relationship between variables within an educational system and an outcome)"

**Postlethwaite, T.N., The Encyclopeadia of Comparative Education and National Systems of Education, Preface, Oxford, Pergamon, 1988.*

Development of international comparative studies in education

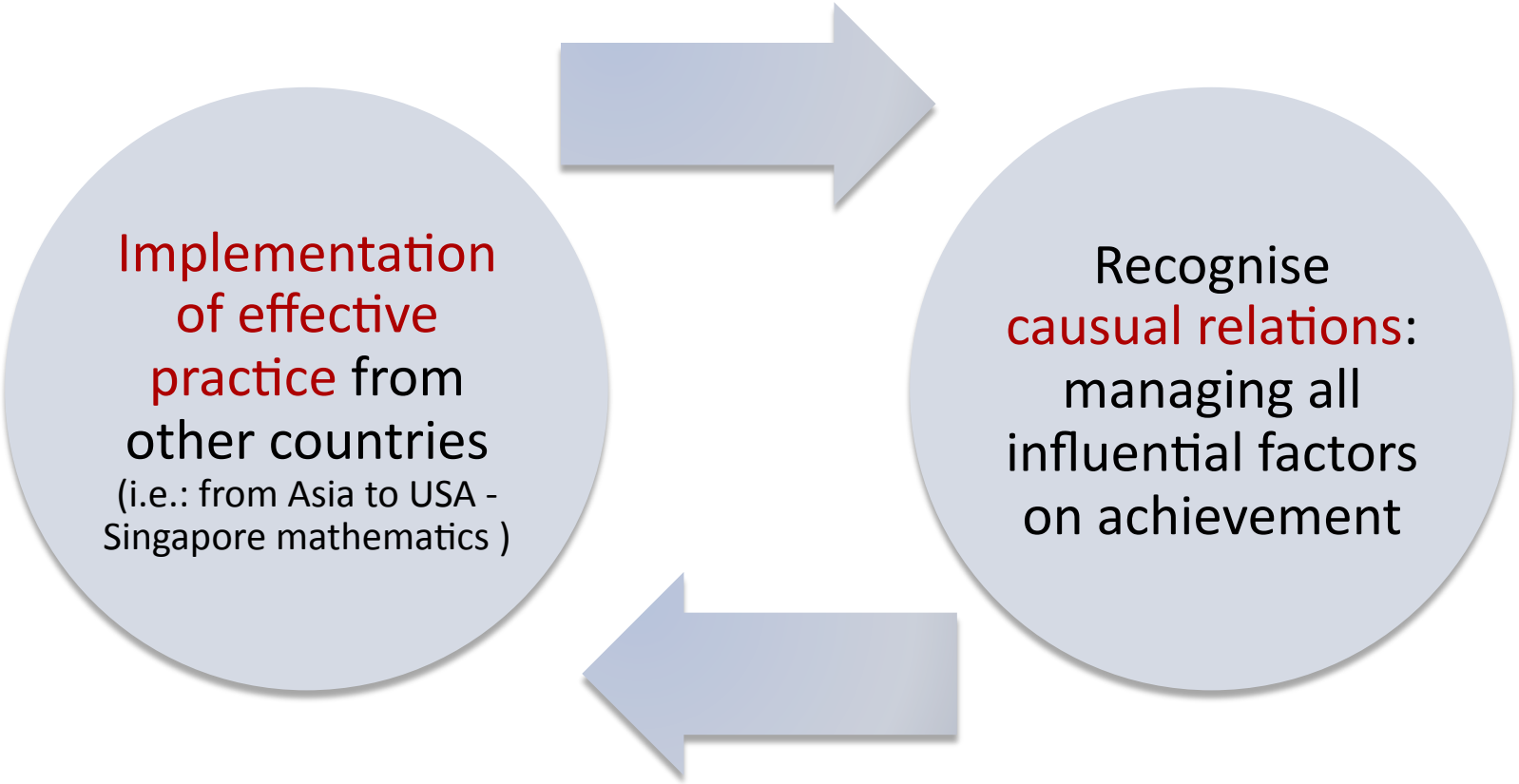
50 years ago: first int. comparisons of outcomes of school systems

- The need to compare educational systems recognized;
- Beginning of development of measurement of educational outcomes
- Equal student tests and questionnaires for all participants

20 years ago: issues of comparisons

- Measurement of knowledge + factors (test theories, indices)
- Age and years of schooling
- Measuring knowledge covered by curriculum or competences
- Analyzing trends

Today: Use of results



Limitations to the use of findings

- Pure scientific experiments are not applicable in education.
  - It is not possible to control all influential variables.
  - It is not possible to set the control group.
  - Significant causal relations are therefore rarely found.
  - Primary results: in the form of national means by background variables or indices on national level

- Comparisons are not precise enough to serve as proposals for educational changes in a country.
- Additional analyses are needed to reveal deeper links.

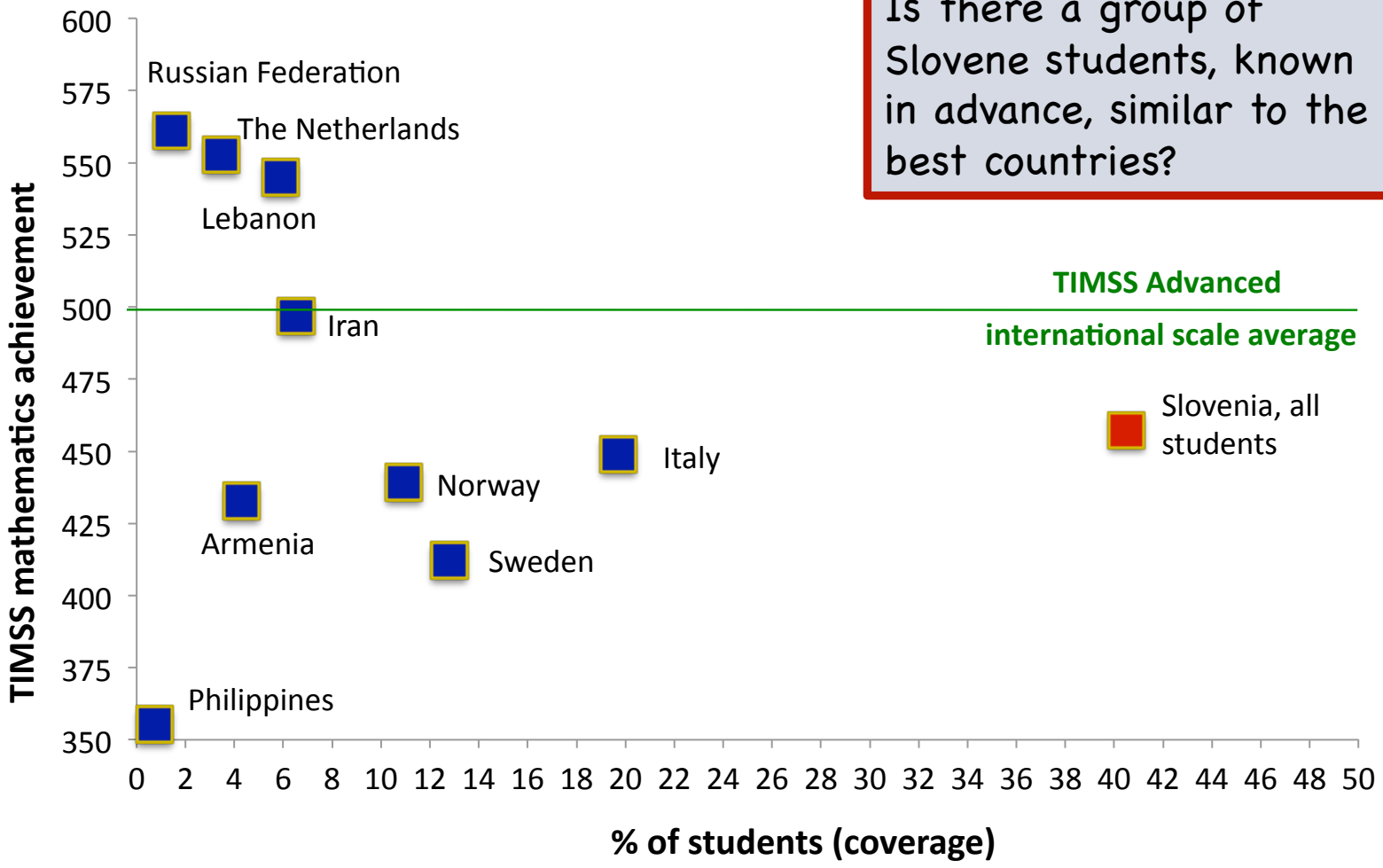
Changing in use of statistical methods

- Take into consideration very large data sets and large numbers of variables at the same time (exploratory against confirmatory analysis)
- Find new kinds of hierarchical links between achievement and educational variables on school and student levels
- Finding stronger links between different variables over smaller groups inside large sets of participating units + qualitative methods (clustering)

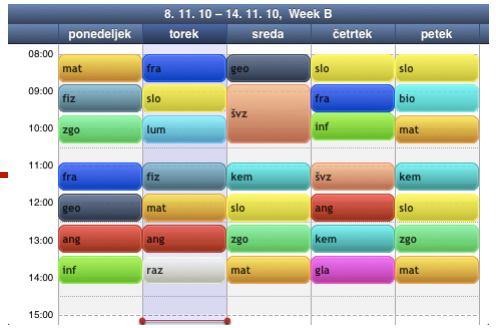
EXAMPLE: Timss Advanced in Slovenia

Slovenia & TIMSS Advanced mathematics achievement

National question:
Is there a group of Slovene students, known in advance, similar to the best countries?



General academic secondary schools - gymnasia

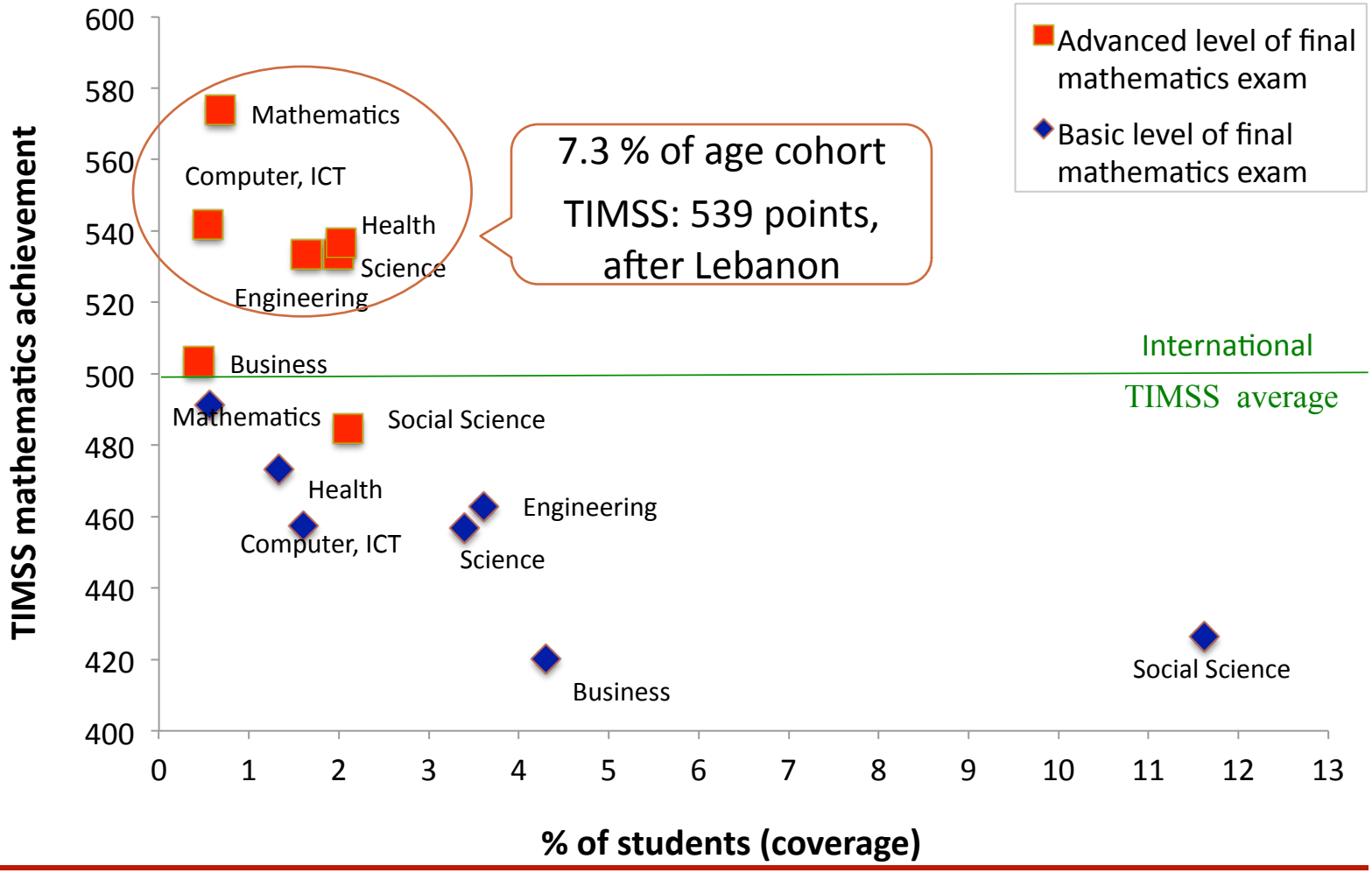


- General program for all students, the same mathematics for all students, most advanced level in Slovenia, 40% of age cohort
- Final examination (*matura*) from mathematics required for any university study, can be done at basic or advanced level.
- In advanced level students can reach higher number of points = more chances for being accepted in the intended study.

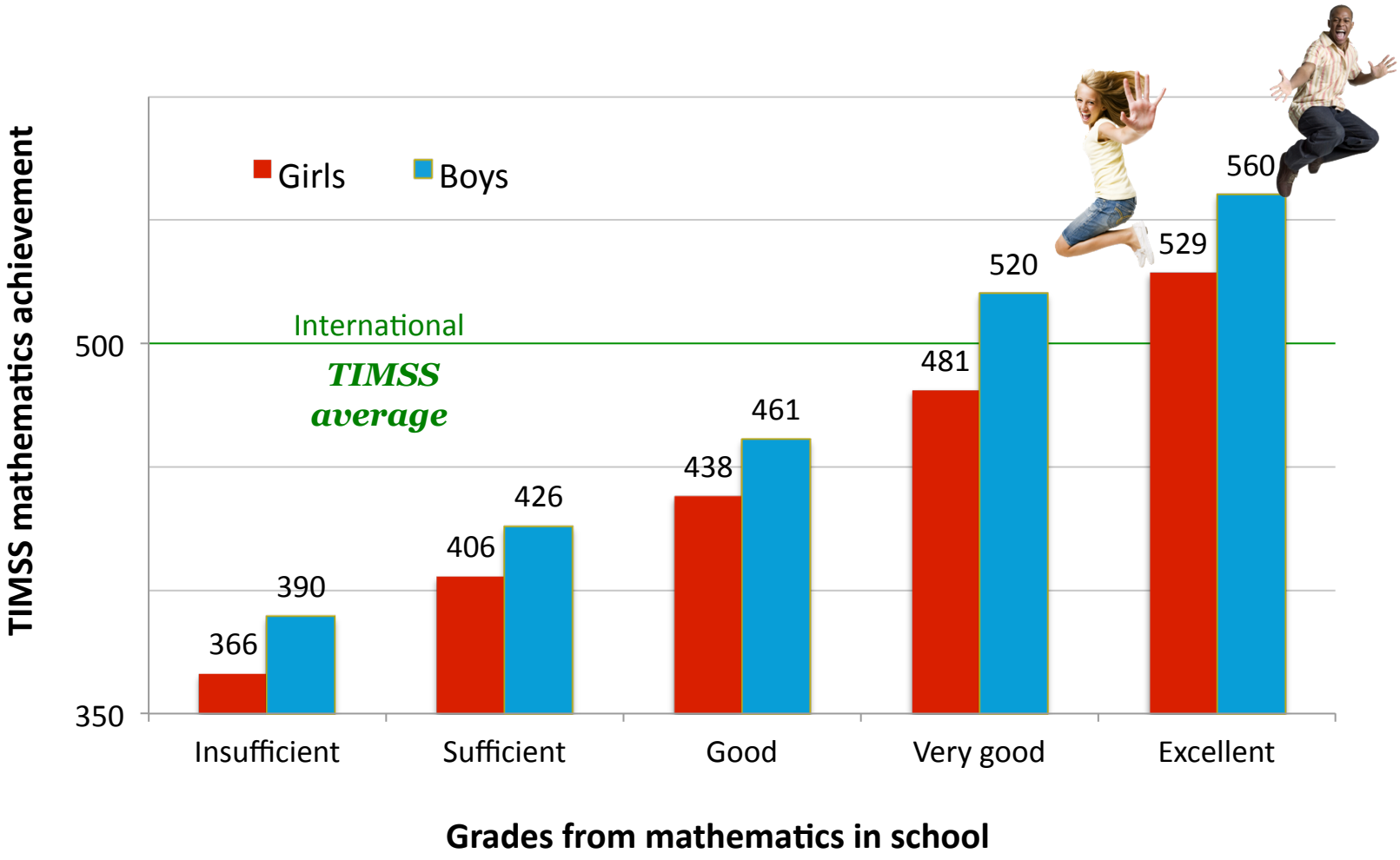
QUESTIONS:

- Characteristics of best students?
- How can teachers/system recognize them in advance?

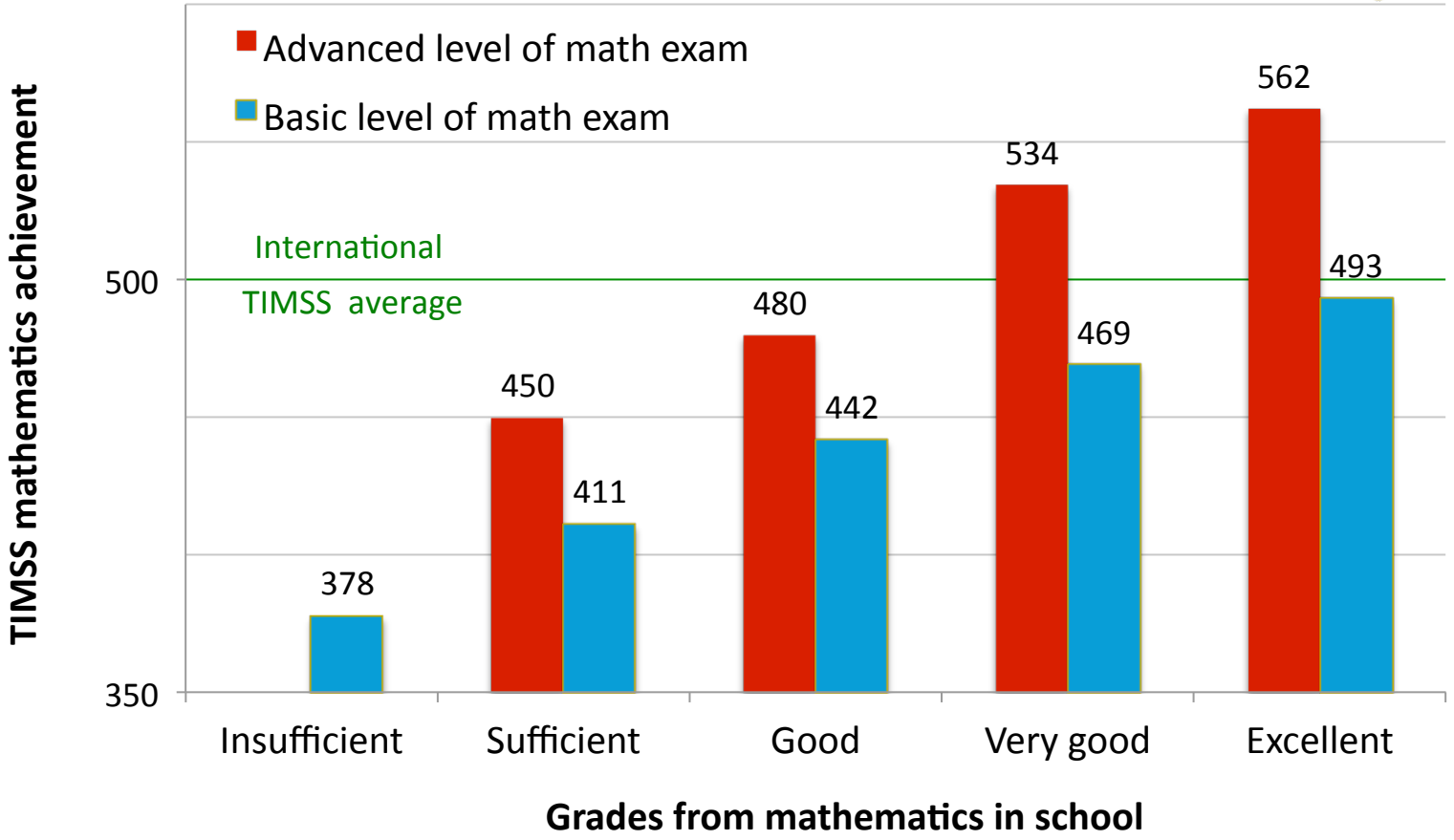
Mathematics achievement by the area of future study



TIMSS achievement, gender and grades



TIMSS achievement, levels of math exam & grades



Finding groups of similar TIMSS students

Find groups of mathematics students by the method of clustering:

1. Choose student/teaching variables to look for similarities between students.
2. Find groups of similar students.
3. Determine their characteristics.
4. Link mathematics achievement to characteristics of groups.
5. Present ideas "how to recognize students" to provide for them appropriate opportunities to learn.

New approach: TIMSS as symbolic data

- **Keep nominal structure of data** (i.e. answers always, few)

- **Presentation** of student data by vectors:

  X = (0, 1, 0, 0, 1, 0, 0, 0, 1, …)

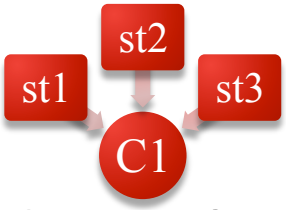
  var 1 var 2 var 3

  A, B, C, D A, B, C, A, B, …

- **Dissimilarity** between two students vectors:
  - Distance between students is an Euclid difference between students' vectors

Clustering approach

- **Repeat** until the best solution is reached:
  - Distribute students into given number of groups so that dissimilarity inside each group is minimal.
  - It is heuristic approach*.



- **Extract characteristics**:
  - A variable is said to be **characteristic for the cluster**, if large proportion of the cluster units **have the same value**.
- **Descriptions of clusters**

  Summarize characteristics to describe students in each cluster.

*The software used: CLAMIX & CLUSE : Korenjak Černe, S., Batagelj V.

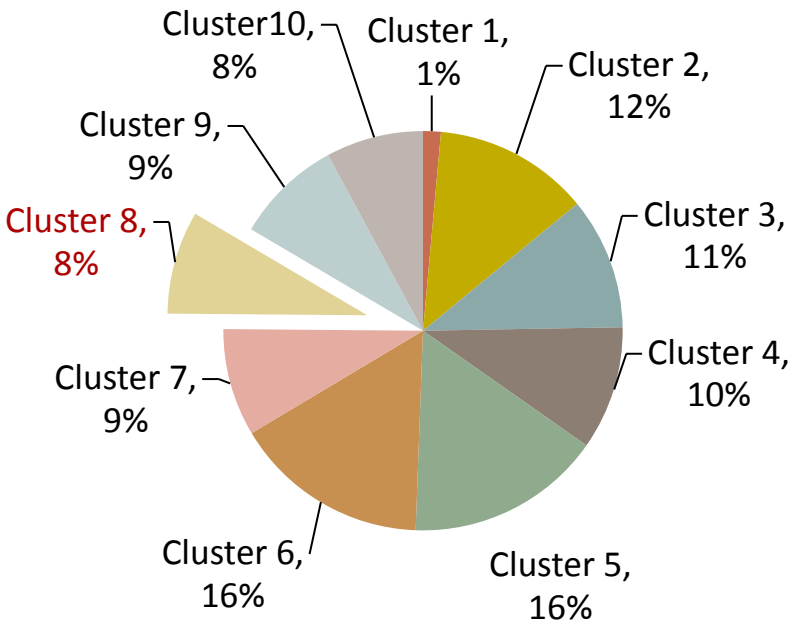
Clustering of TIMSS for two sets of variables

Find clusters of similar students by:

- **A. student background and attitudes**
  - attitudes of students towards mathematics and teacher,
  - home environment, socio-economic status
  - education of parents, perception of future education
- **B. student learning environment**
  - reports about class and teacher activities at lessons,
  - teacher's report about realization of teaching in class,
  - the student's view of the teacher characteristics
  - the school climate
- Best solutions: 10 clusters for each sets of variables A and B.

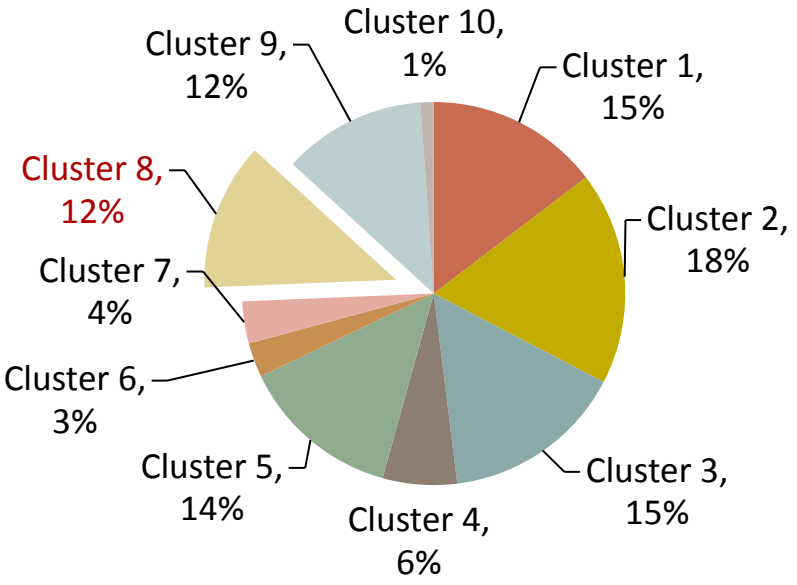
Distribution of students to clusters

Background of students



Cluster 1: missings

Learning environment



Cluster 7: missings

Findings

- The largest differences among clusters made:
  - teachers characteristics
  - grades
  - reasons for choosing the math program
  - parental support

- Teacher characteristics: students asked what makes good teacher (4 categories-importance)
- Parental support: students asked how much parents support learning, thinking they are smart, give them emotional support

Mathematics for girls & physics for boys?

Cluster 3: Motivated girls for math with strong parental support

- almost all **girls**, with **excellent** grades for math and physics in G8
- 2/3 **take the advanced level** of the mathematics exam and **not physics**
- strong support from **parents**
- enjoy math problems, **positive attitudes** toward mathematics
- 60 % **always like mathematics** and worked hard on TIMSS test.

Cluster 7: Successful physics students

- **boys** who are **good at physics** but **not** at **mathematics.**
- 91 % **take physics** as an optional subject in the final examination
- 76 % do not take the advanced level of the mathematics exam.
- 58 % had **excellent grades from physics** and 50% from math in G8
- 78 % of students has his **own computer**.

Expectations from a good teacher

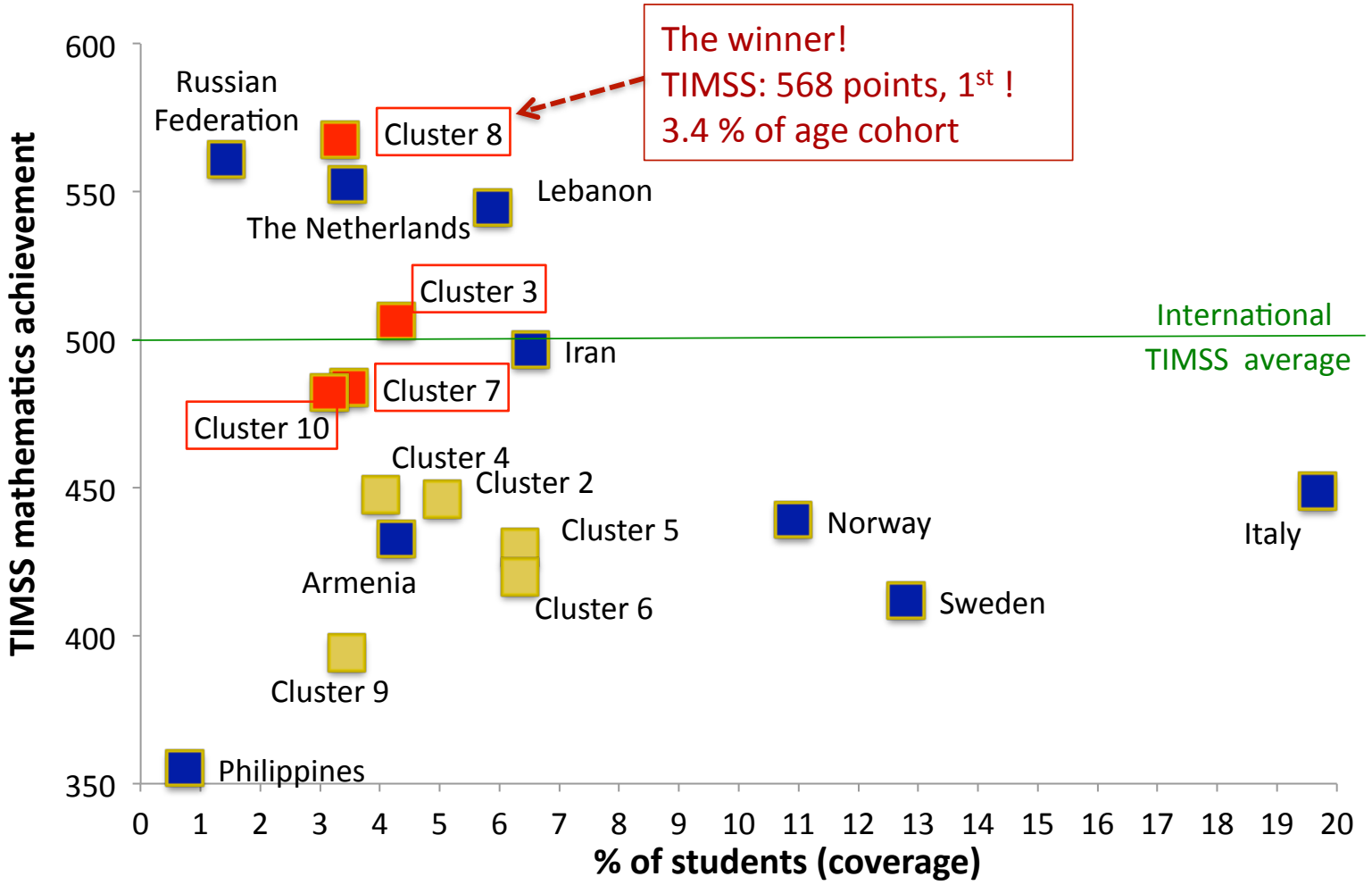
Cluster 10: Students with high expectations of a good teacher with strong support from parents and high self-confidence.

- **High expectations** of a good mathematics teacher:
  more than 80 %: **good teacher** gives additional explanations, adapts the speed of explanation to students' needs, is fair, has authority and provides clear grading criteria.
- **Having a good teacher** was a very important **reason** for choosing the level of the mathematics exam, but
- only **33 % take the advanced** level of the final math exam.
- 80 % students said that **parents like** them **very much**
- 60 % of students' **parents encourage** their work for school.
- 70 % of students strongly agree that their parents think they are smart.

Cluster 8: Most successful students in mathematics and physics

- Over 90 % had **excellent grades** for mathematics and physics in G8
- Take **the advanced** level of the final mathematics exam in grade 12
- They recognise (94 %) **good teacher as someone who**
  - **explain content well (94%)**
  - adapt speed of explanation to students' need (67%).
- They choose the advanced level of the mathematics exam because
  - they are **doing well** in mathematics and
  - **have positive** attitudes toward mathematics.
- 73 % also **take advanced physics** program.
- Almost 70 % of students have their **own computer**.
- 70 % report that their parents think they are **smart**.
- Two thirds **are boys.**

TIMSS achievement: Countries and clusters of Slovene students

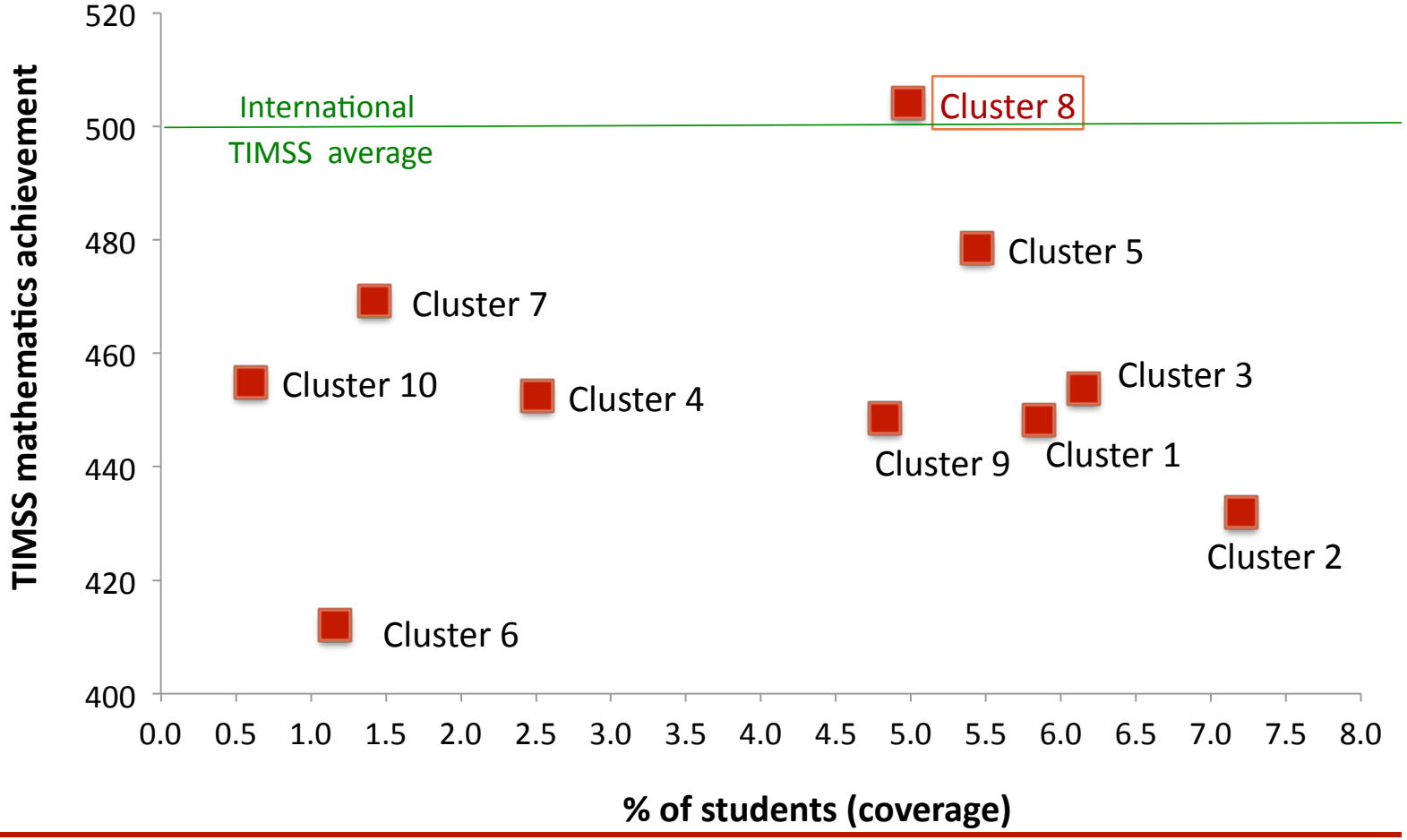


Future of group of best students ?

Is cluster 8 important for our school system?

Yes, students of science & technology!

TIMSS achievement by clusters of learning environment



Learning environment: the best group I/2

All students have **very good prepared teachers:**

- explain the content well, have authority, are fair and have clear grading criteria.
- appreciate student **work for mathematics outside school**.
- **always give homework**, always as set of exercises,
- **never** ask students to find examples of the **use of mathematics** or **data collection and analyses**.
- **participated in training** programs about math content and use of ICT.
- More than 2/3 of students **never use computer** or calculator for modeling, solving equations or algebraic expressions.

Learning environment: the best group I/2

- More than 2/3 students
  - **every lesson** listen to **teacher explanations**
  - **never** have to **read textbook** in school or for homework.
- More than 1/2 of students agree that the teacher
  - is preparing them well for final exam,
  - makes students **like to work** on math problems,
  - makes students **feel successful.**
- Teachers with **very high expectations** for student achievement.

Conclusions: Is our method usable?

We found

- students in Slovenia who **scored highest** in TIMSS A!
- **characteristics of teachers,** linked to high scores of students
  - Well prepared, **demanding** but fair, with clear grading system
  - **Good explanation** of content, learning without textbooks
  - **Value students' work** for mathematics done outside the school
  - **No need** for intensive use of **ICT,** but **homework every lesson**
  - **Make them like to work** on math and feel successful

Did the method help to understand structure of general gymnasia students and teaching better?

THANK YOU!

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