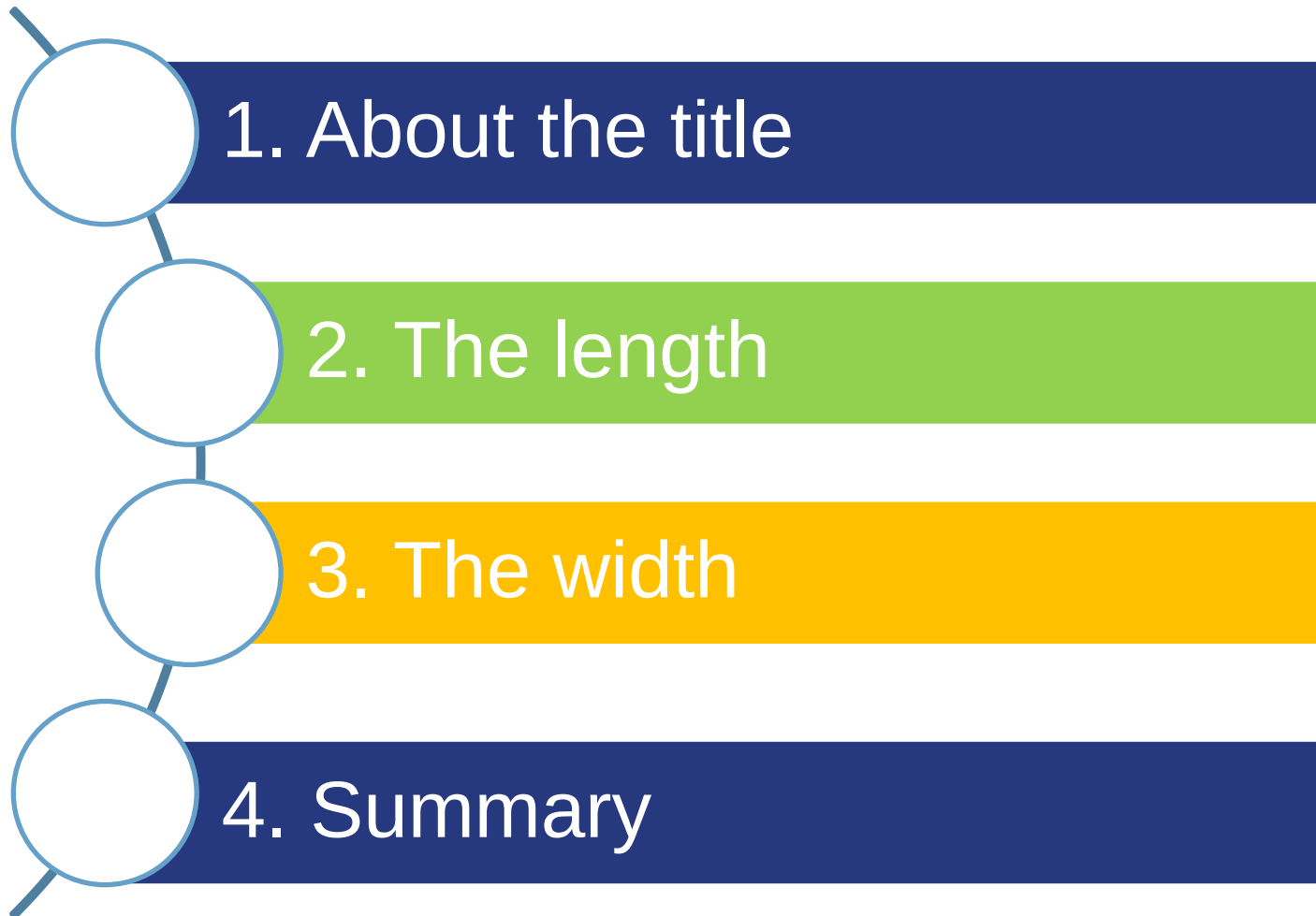


Going to length and width with PISA

Selected examples of accompanying PISA research projects in Germany and their potentials for educational policy and practice

*Center for International Student Assessment (ZIB)
Technical University Munich*

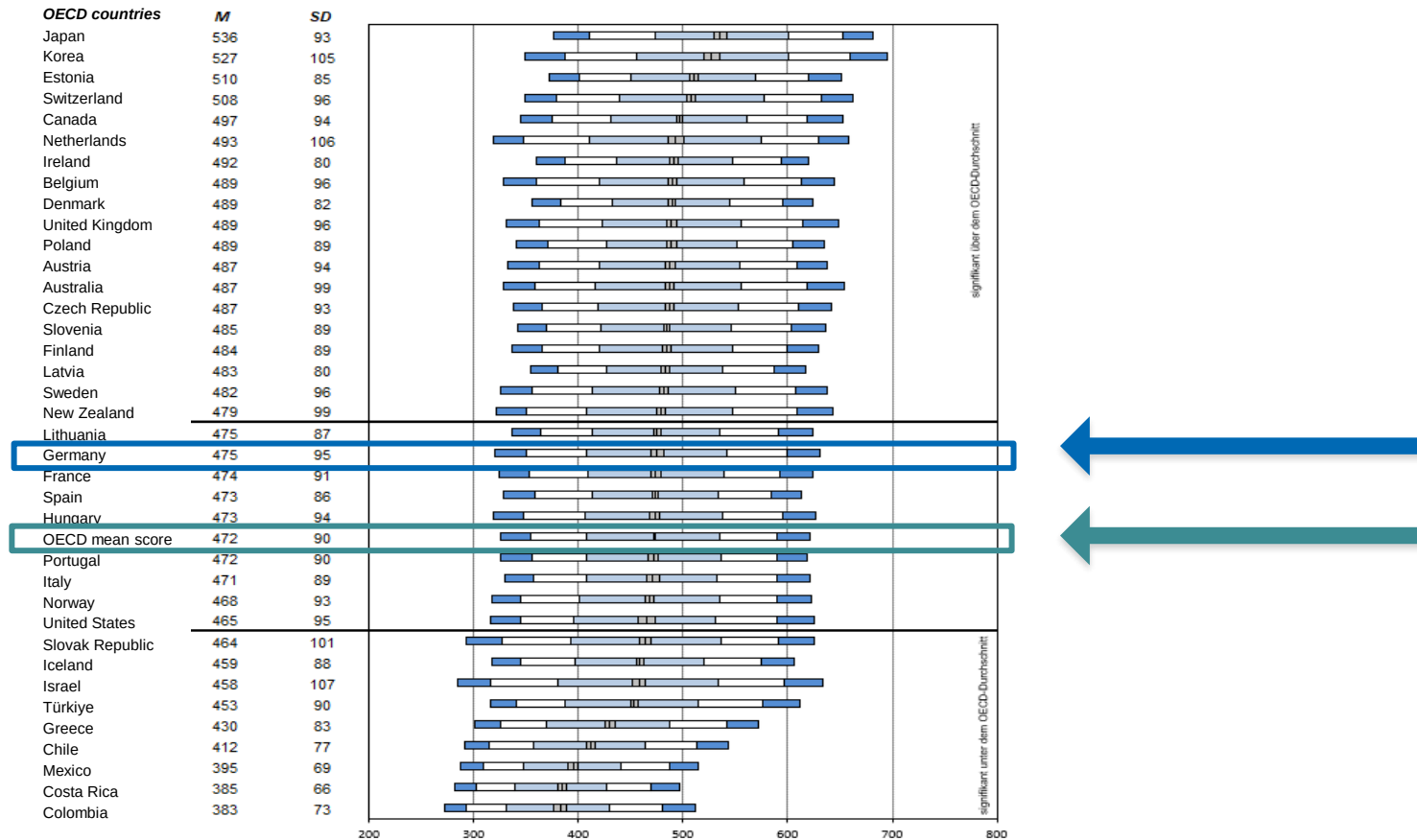
Dr. Jennifer Diedrich
(National Project Manager | Deputy Lead PISA National Center)



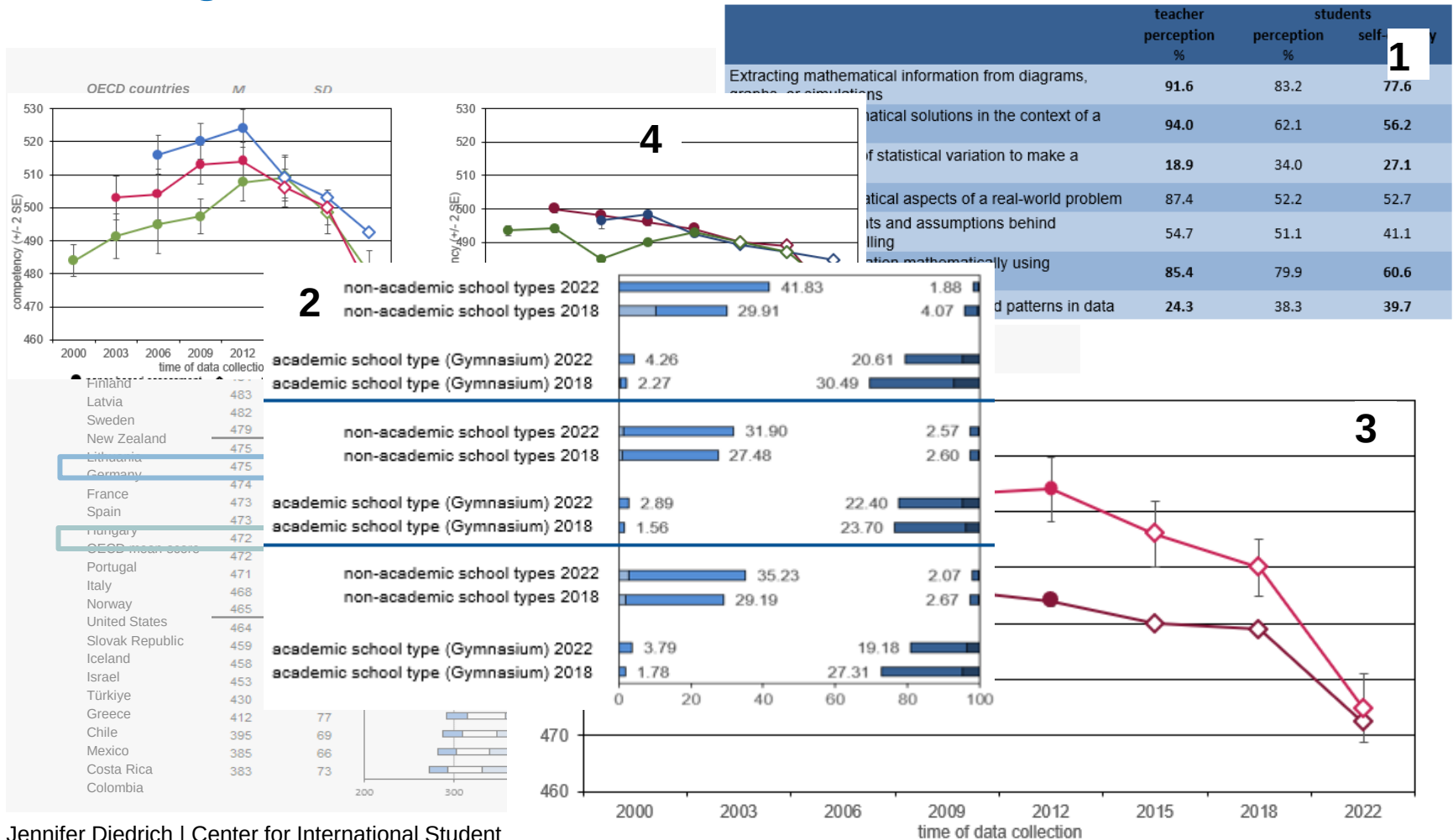
About the title

The league...

Mean mathematical competence in PISA 2022



The league... and its context



Context: domainspecific background questionnaires

(Self-efficacy) in mathematical competencies in the context of 21st-century challenges

	teacher perception %	students perception %	students self-efficacy %
Extracting mathematical information from diagrams, graphs, or simulations	91.6	83.2	77.6
Interpreting mathematical solutions in the context of a real-life challenge	94.0	62.1	56.2
Using the concept of statistical variation to make a decision	18.9	34.0	27.1
Identifying mathematical aspects of a real-world problem	87.4	52.2	52.7
Identifying constraints and assumptions behind mathematical modelling	54.7	51.1	41.1
Representing a situation mathematically using variables, symbols, or diagrams	85.4	79.9	60.6
Evaluating the significance of observed patterns in data	24.3	38.3	39.7

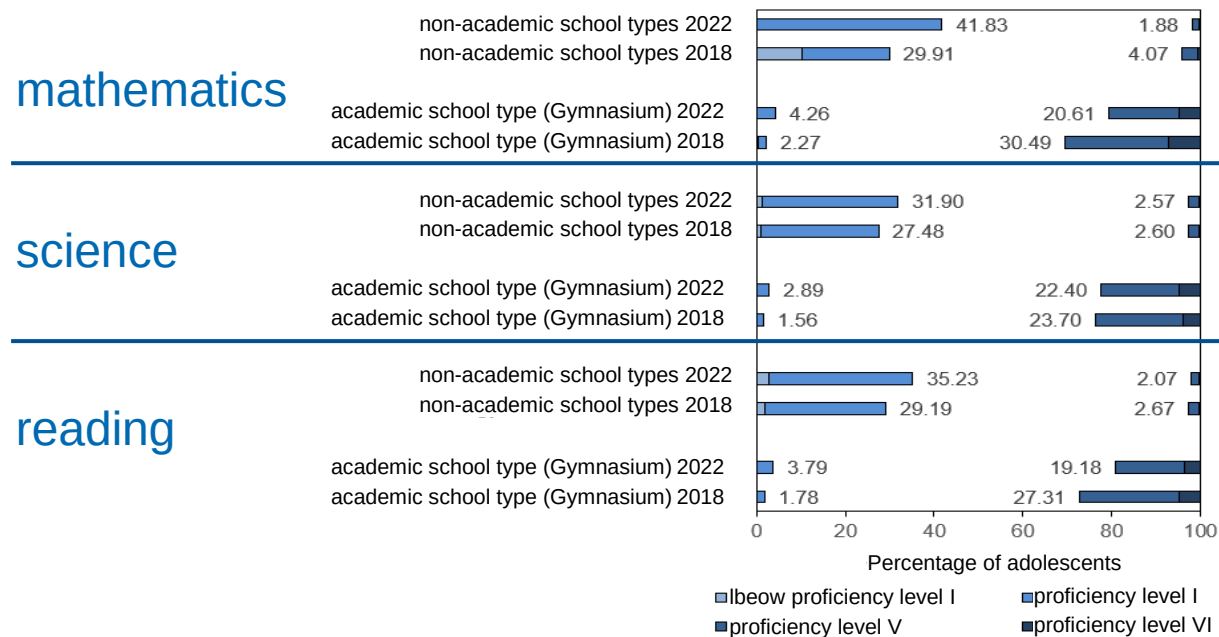
Comparison of teachers' and students' perceptions and students' self-efficacy in mathematical competencies in the context of 21st-century challenges.

¹Percentage of agreement, combining the two categories with the highest levels of agreement



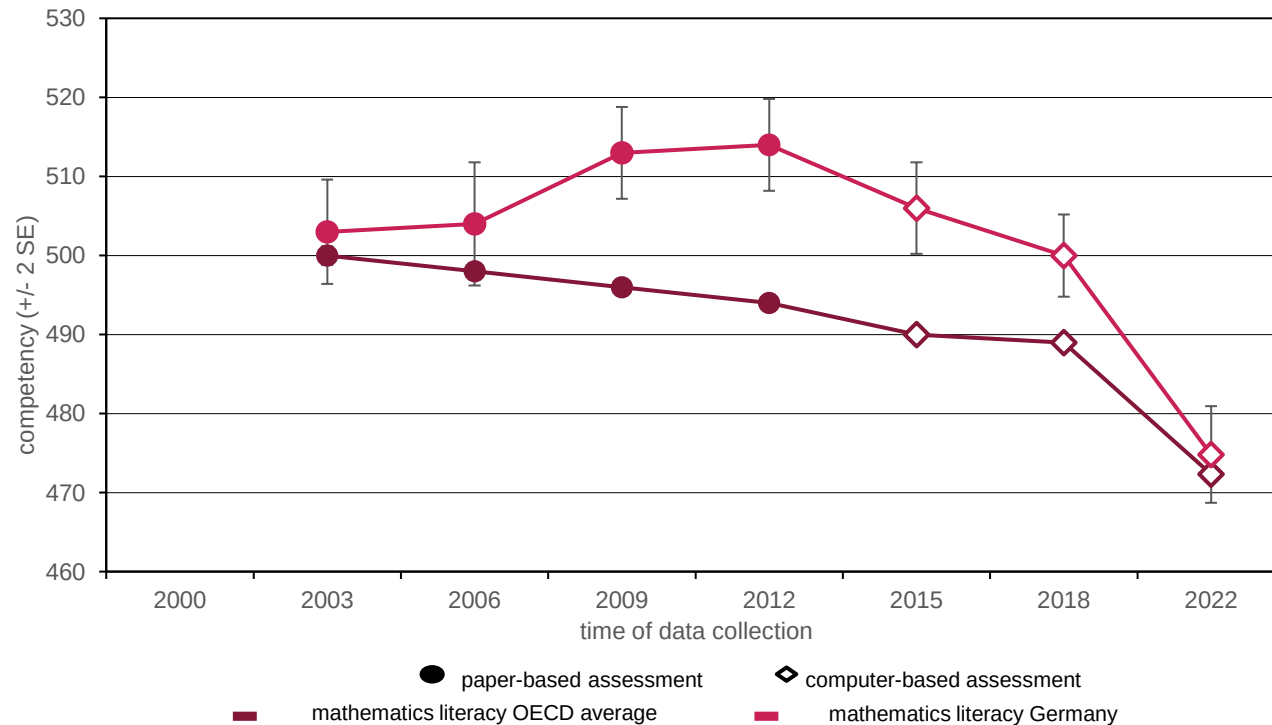
Context: variables of national interest

Development of the shares of low-performing and high-performing students separated by school types



Context: time

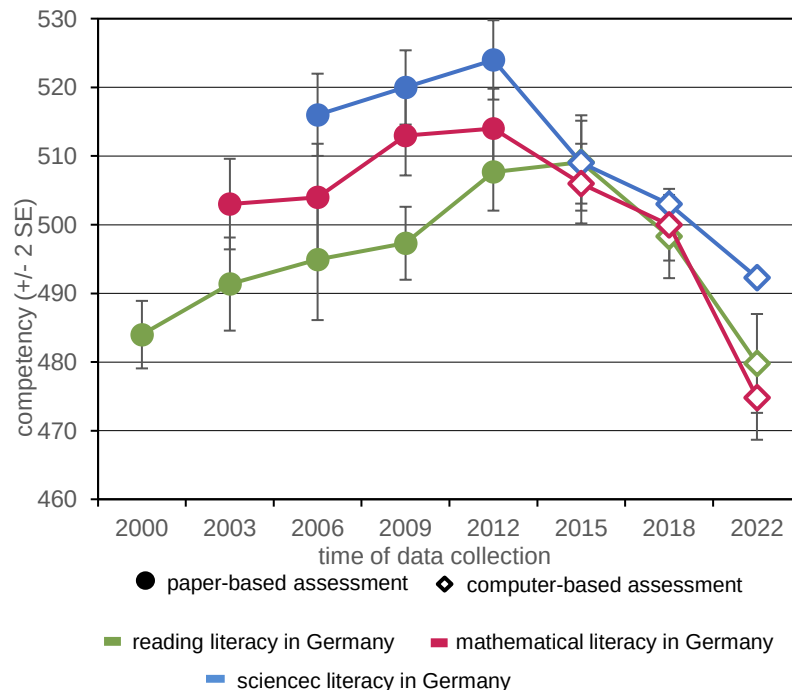
Development of mathematical literacy



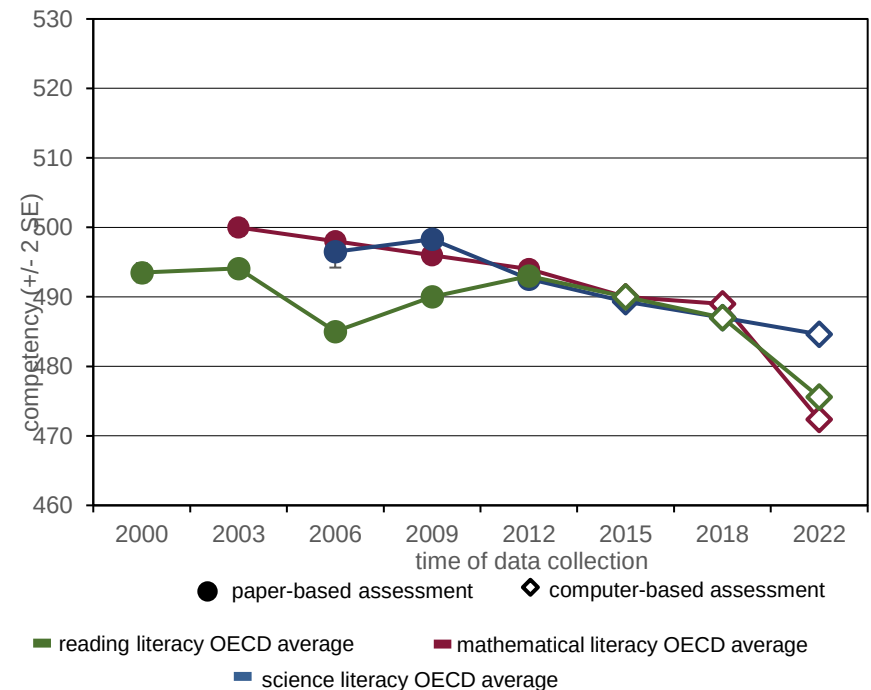
Context: time + reference group

overview of developments across all assessments

Trend Germany



Trend OECD average



With context the picture gets sharper

We have seen

- Background questionnaires: Attitudinal variables differentially predict outcomes like competence
- Variables of national interest: Results may vary for different comparison groups
- Timeframe: It needs the context of time to understand the development
- But the international PISA dataset can answer only so much
- Policy might have questions that exceed those of international interest

Accompanying research in PISA in Germany

Other national additions

Length: oversample for subnational reporting

Width: national TcQ



Width: students general cogn. ability

2000 2003 2006 2009 2012 2015 2018 2022 2025

National Add-on studies

Width (longi.): Coactiv

Length: I. at risk groups
Width (longi.): VI. PISA +
Width: VI. & V. Piloting CBA

Width: II. Mode-effect

Length: III. classroom observations
Width: VII. correlates of CT
Width: VIII. Pilot LDW

Length: teacher student linkage
Width: trend in innovative domains
Width: FLA-Writing

The length

Oversample

I. Characterising at risk-groups

Policy question

- What are the benefits of different types of test adaptation when testing fifteen-year-olds at special education needs schools?

Study design

- Oversample at SEN schools in PISA 2012
- All 9th grades (modal grade) in 49 SEN-schools

Oversample

I. Characterising at risk-groups

Study design

- Tested in 3 experimental groups:
 - 1) regular 120 Min PISA booklet
 - 2) regular 120 Min PISA booklet with easier items
 - 3) 60 Min UH booklet

Results^(a)

- Itemdifficulty is equivalent for regular- and UH-booklets
- SEN-students show higher competence when assessed with the UH-booklet

(a) Gebhardt, M., Sälzer, C., Mang, J., Müller, K., & Prenzel, M. (2015). Performance of Students with special educational need in Germany: Findings from Programme for International Student Assessment 2012. Journal of Cognitive Education and Psychology, 14(3), 343-356. <https://doi.org/10.1891/1945-8959.14.3.343>

Oversample with additional constructs

II. Within subject mode-effect in PISA 2018

Policy question

- Are the testinstruments equivalent in item discrimination and construct coverage, when administered in a different mode?

Study design

- Oversample of 111 schools (2368 students) in PISA 2018 for PBA
- 2nd test day: Within-subject rotation of CBA vs. PBA

Results

- CBA and PBA measure the same construct...
- ...but CBA shows a slightly higher item difficulty and varying item discrimination^(a)

(a) Goldhammer, F., Harrison, S., Bürger, S., Kroehne, U., Lüdtke, O., Robitzsch, A., Köller, O., Heine, J.-H., & Mang, J. (2018). Vertiefende Analysen zur Umstellung des Modus von Papier auf Computer. In Reiss, Kristina [Hrsg.]; Weis, Mirjam [Hrsg.]; Klieme, Eckhard [Hrsg.]; Köller, Olaf [Hrsg.]: PISA 2018. Grundbildung im internationalen Vergleich, 163-186. Münster ; New York: Waxmann 2019.

Oversample with additional constructs

III. Classroom observations in math and science

Policy question

- How are multidimensional educational goals implemented in classrooms?

Study design

- Classroom observations in a subsample of the modal grade sample of PISA 2022 and analyses of the tasks given in the observed classes
- Testing teachers' subject didactic knowledge

Results

- Classroom tasks only rarely included components of motivation^(a)
- [Special issue coming soon]

Guidance on motivation-
supporting classroom
materials

(a) Heinle, A., Schiepe-Tiska, A., Reinhold, F. et al. Supporting student motivation in class: the motivational potential of tasks. *Z Erziehungswiss* **25**, 453–470 (2022).
<https://doi.org/10.1007/s11618-022-01090-3>

The width

Additional constructs in a subsample

IV. Item difficulty in CBA vs. PBA

Policy question

- Are the testinstruments equivalent in difficulty, when administered in a different mode?

Study design

- In PISA 2012 a subsample > 800 students
- 2nd test day: Reading in CBA; Reading in PBA

Results

- CBA and PBA measure the same construct...
- ...but CBA shows a slightly higher item difficulty^(a)

(a) Kroehne, U., Hahnel, C., & Goldhammer, F. (2019). Invariance of the response processes between gender and modes in an assessment of reading. *Frontiers in Applied Mathematics and Statistics*, 5. <https://doi.org/10.3389/fams.2019.00002>

Additional constructs in a subsample

V. Underlying constructs in digital reading

Policy question

- Which competences are assessed with reading in CBA (vs. PBA)

Study design

- In PISA 2009 a subsample of $N > 800$ students
- 2nd test day: Reading in CBA; ICT competence; Working memory tests; [...]

Results

- Besides reading competence, ICT competency plays a vital role in digital reading
- The effect of ICT competency is mediated by students navigation capacity^(a)

(a) Hahnel, C., Goldhammer, F., Naumann, J., & Kröhne, U. (2016). Effects of linear reading, basic computer skills, evaluating online information, and navigation on reading digital text. *Computers in Human Behavior*, 55(Part A), 486–500. <https://doi.org/10.1016/j.chb.2015.09.042>

Longitudinal study and additional constructs

VI. PISA Plus

Policy question

- How do PISA-competencies develop over time?
- How do PISA-competencies compare with curricular-based tests?
- Are students competency gains differentially affected by their characteristics (e.g. social background, grade repetition)?

Study design

- Longitudinal study: out of 222 schools in PISA 2012 148 schools (4871 students) were assessed again in 2013
- Besides Core-PISA students were assessed with the curricular-based national assessment on a 2nd test day

Longitudinal study and additional constructs

VI. PISA Plus

Results

- From 9th to 10th grade students competency increased in the curricular-based national assessment, but only to a minor degree on the PISA-scale^(a, b, c)
- Graderepetition did not yield higher competency, interest, motivation or self-efficacy in mathematics^(d)
- After accounting for the competency 2012, social background (SES, Migration) had only minor effects on students competency in 2013^(e)

- (a) Heine, J.-H., Nagy, G., Meinck, S., Zühlke, O., & Mang, J. Empirische Grundlage, Stichprobenausfall und Adjustierung im PISA-Längsschnitt 2012–2013. *Zeitschrift für Erziehungswissenschaften*, 20, 287–306 (2017). <https://doi.org/10.1007/s11618-017-0756-0>
- (b) Schiepe-Tiska, A., Rönnebeck, S., Heitmann, P., Schöps, K., Prenzel, M., & Nagy, G. (2017). Die Veränderung der naturwissenschaftlichen Kompetenz von der 9. zur 10. Klasse bei PISA und den Bildungsstandards unter Berücksichtigung geschlechts- und schulartspezifischer Unterschiede sowie der Zusammensetzung der Schülerschaft. *Zeitschrift für Erziehungswissenschaften*, 20, 151–176 (2017). <https://doi.org/10.1007/s11618-017-0754-2>
- (c) Hahnel, C., Goldhammer, F., Kröhne, U., Schiepe-Tiska, A., Lüdtke, O., & Nagy, G. Der Einfluss kognitiver Basisfertigkeiten auf die Änderung der in PISA gemessenen Lesekompetenz. *Zeitschrift für Erziehungswissenschaften*, 20, 205–228 (2017). <https://doi.org/10.1007/s11618-017-0748-0>
- (d) Ehmke, T., Sälzer, C., Pietsch, M., Drechsel, B., & Müller, K. Kompetenzentwicklung im Schuljahr nach PISA 2012: Effekte von Klassenwiederholungen. *Zeitschrift für Erziehungswissenschaft*, 20, 99–124 (2017). <https://doi.org/10.1007/s11618-017-0752-4>
- (e) Kiemer, K., Haag, N., Müller, K. & Ehmke, T. Einfluss sozialer und zugewanderungsbezogener Disparitäten, sowie der Klassenkomposition auf die Veränderung der mathematischen Kompetenz von der neunten zur zehnten Klassenstufe. *Zeitschrift für Erziehungswissenschaften*, 125–149 (2017). <https://doi.org/10.1007/s11618-017-0753-3>

Additional constructs

VII. Correlates of Creative Thinking

Policy question

- Does creative thinking (CT) as assessed in PISA really measure a facet of creativity?

Study design

- Added constructs: Divergent thinking, general cognitive ability, domain-specific creative activities and achievements

Results

- From the FT: PISA CT correlates medium to highly with divergent thinking as well as creative activities and achievements and to a lesser extent general cognitive ability^(a)
- MS: [under construction]

(a) Policy brief: Zentrum für internationale Bildungsvergleichsstudien. (2021). *Stellungnahme des ZIB zur innovativen Domäne in PISA 2022: Kreatives Denken*. Zentrum für internationale Bildungsvergleichsstudien

Additional constructs in a subsample

VIII. Pilot study of *Learning in a Digital World*

Policy question

- Which constructs does the innovative domain in PISA 2025 assess?
- How can indicators of self-regulated learning be derived?

Study design

- In PISA 2022 a subsample around 800 students
- 2nd test day, 6 months later: Units from the innovative domain 2025

Results

[under construction]

Summary + Outlook

Summary

- Germany has a tradition of making the most out of PISA by drawing additional (sub)samples and adding constructs
- Additional studies were initiated by both politics and science
- Some of them required additional funding (e.g. PISA Plus, mode effect in PISA 2018)
- All studies yielded worthwhile results

We are interested in getting to know more about PISA in your country? What are your additions? ...

Outlook **PISA 2025 in Germany**



Length: teacher-
student-linkage

Width: FLA-Writing

Width: trends in
innovative domains

Outlook **PISA 2025 in Germany**

2022 > 2025

Length: teacher-
student-linkage

Width: FLA-Writing

Width: trends in
innovative domains

Policy question

How much variance in students english competence can be attributed to the teacher?

Study design

Oversample of the teacher to allow for linking

Outlook **PISA 2025 in Germany**

Guidance on ideal use of
AI in english writing

2022 → 2025

Length: teacher-
student-linkage

Width: FLA-Writing

Width: trends in
innovative domains

Policy question

- How good can students write in english?
- How does their writing differ with/without the aid of AI-tools?

Study design

- Within-subject rotation of writing tasks with or without AI-tools
- Additional constructs: PISA math, science, reading

Outlook PISA 2025 in Germany

Guidance on the
differential importance of
21st cent competences

2022 → 2025

Length: teacher-
student-linkage

Width: FLA-Writing

Width: trends in
innovative domains

Policy question

- Horizontal: How can innovative domains be compared with each other?
- Vertical: How have the competences in innovative domains developed in Germany in 22 vs 3 years ago?

Study design

- Between-subject rotation of PISA 2003 problem-solving, PISA 2022 creative thinking, general cognitive competence

...Are you also going to width and length?

Thank You!

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