Petra Stanat
Stefan Schipolowski
Nicole Mahler
Sebastian Weirich
Sofie Henschel
(Eds.)

IQB Trends in Student Achievement 2018

The Second National Assessment of Mathematics and Science Proficiencies at the End of Ninth Grade

Summary

WAXMANN

This summary and the references it contains relate to the report on the *IQB Trends in Student Achievement 2018*:

Stanat, P., Schipolowski, S., Mahler, N., Weirich, S., & Henschel, S. (Eds.). (2019). *IQB-Bildungstrend 2018. Mathematische und naturwissenschaftliche Kompetenzen am Ende der Sekundarstufe I im zweiten Ländervergleich.* Münster: Waxmann.

Free download on the IQB website:
https://www.iqb.hu-berlin.de/bt/BT2018/Bericht

Contents

IQB Trends in Student Achievement 2018

1. Introduction to the assessment

Six years on from the IQB National Assessment Study 2012, the IQB Trends in Student Achievement 2018 study examines, for the second time, the extent to which academic performance in mathematics and the natural sciences (i.e., biology, chemistry, and physics) towards the end of middle school (known as the *Sekundarstufe I* in Germany) meets the proficiency expectations established in the educational standards introduced by the Standing Conference of the Ministers of Education and Cultural Affairs of the States in the Federal Republic of Germany (KMK). For the first time, the assessment thus provided a means of not only describing the mathematical and scientific proficiencies acquired by grade-9 students in 2018, but also of using trend analyses to examine the extent to which performance patterns have changed since 2012. The IQB Trends in Student Achievement 2018 study marks the end of the second cycle of national education monitoring based on KMK educational standards.

The IQB Trends in Student Achievement 2018 study thus focuses on the extent to which the proficiency targets established by the KMK were met in each of the federal states (*Länder*) in Germany in 2018 (distributions of students across proficiency levels), and on the extent to which the results in the various states changed between 2012 and 2018 (trends). Tying these comparative perspectives together enables us to draw conclusions on aspects such as how many students there are in each state who reach the normative standard (*Regelstandard*) or fall short of the minimum standard in a specific proficiency domain, respectively, and whether these percentages have increased or were reduced during the six-year assessment period. State-based rankings, however, are insignificant, and are thus not addressed in the IQB Trends in Student Achievement.

Another focus of the IQB's analysis concerns the extent to which differences in the proficiencies achieved by students relate to their gender (gender-related disparities), characteristics of their social background (social disparities), and their immigration background (immigration-related disparities). Although an education system cannot totally balance out uneven entry requirements, it is a generally accepted goal of education policy to minimize the disparities associated with students' background characteristics. As such, the extent to which this was able to be achieved was reviewed, both for 2018 and as a comparison between 2012 and 2018. In some states, however, not enough information was available on the background characteristics of family members for a high proportion of students, meaning they had to be excluded from the analyses on social and immigration-related disparities or their results are to be interpreted with caution (see below for participation rates). The findings of these analyses thus provide an incomplete picture of the situation in Germany.

The IQB's assessments also always take into account specific issues that affect the results of teaching and learning processes, as well as key conditions of these processes. The IQB Trends in Student Achievement 2018 study analyzed motivational student characteristics in mathematics and the sciences, characteristics of the quality of instruction in mathematics, and aspects of teacher training in mathematics and the sciences.

After some initial background information, the most important results of the assessment are shown below using tables and graphs, and are summarized with keywords.

Subjects and proficiency domains assessed

- In the subject of mathematics, all five areas of proficiency (core themes) described in the educational standards were assessed: *Numbers, measurements, space and shape, functional relations,* and *data and chance*. A global scale of mathematics proficiency was also created, summarizing all of the core themes. The results outlined here relate to the global scale of mathematical proficiency only. The results for the individual core themes are available in the additional material on the IQB website.
- In each of the science subjects (i.e., biology, chemistry, and physics), proficiencies were assessed in the areas *subject knowledge* and *scientific inquiry*.

Proficiency level models

- Proficiency level models are used to assist in interpreting students' results in the tests. The models describe the competencies of students achieving a certain test result (i.e., which kind of task requirements they are typically able to meet given their test results).
- They can also be used to determine the extent to which the students' proficiencies in the respective subject and domain comply with the targets established in the educational standards and proficiency level models (minimum standard, normative standard, normative standard plus, optimal standard; cf. Tab. 1.1).
- For the subject of mathematics, KMK educational standards exist both for the *Hauptschulabschluss* (the most basic regular school-leaving certificate, HSA) and the *Mittlerer Schulabschluss* (intermediate school-leaving certificate, MSA). Based on this, an integrated proficiency level model was developed, mapping the proficiencies of all ninth-graders in courses that end at least in an HSA or MSA.
- In the science subjects, meanwhile, educational standards were only defined for the MSA. Hence, proficiency level models are also only available with regard to the MSA.

Table 1.1: Proficiency level models and standards in mathematics and the sciences

Mathematics		
Proficiency levels	MSA standards	HSA standards
V	Optimal standard	
IV	Normative standard plus	Optimal standard
III	Normative standard	Normative standard plus
II	Minimum standard	Normative standard
I.b		Minimum standard
I.a		

Biology, chemistry, and physics	
Proficiency levels	MSA standards
V	Optimal standard
IV	Normative standard plus
III	Normative standard
II	Minimum standard
I	

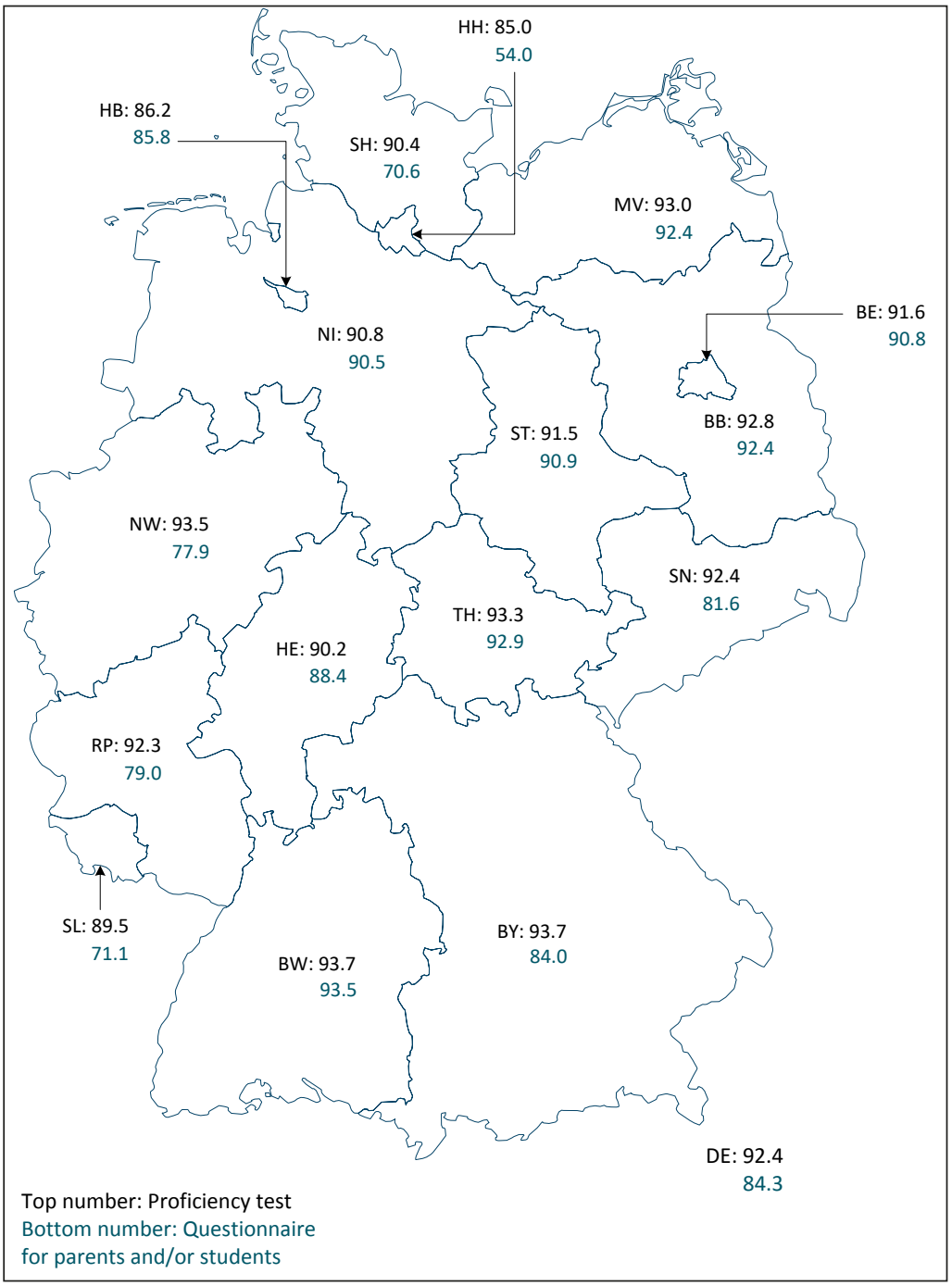
Target population and sample

- The target population of the IQB Trends in Student Achievement 2018 encompasses all ninth-grade students at general-education schools in Germany. This includes special-needs schools.
- The only students not included in the target population are those with special educational needs in the "intellectual development" domain, as well as those who have been taught in German for less than a year.
- The sample of the IQB Trends in Student Achievement 2018 was selected randomly, and encompasses 44,941 ninth-grade students at 1462 schools. Due to the feasibility of collecting data under the test conditions at special-needs schools, only students receiving support in the domains of "learning", "language" and "emotional and social development" were included in these schools.

Participation rates

- Participation in the proficiency tests for the IQB Trends in Student Achievement 2018 was compulsory both for schools and students at public schools. The participation rates for the tests are around 92 percent overall, and at least 85 percent in the individual states (cf. Fig. 1.1).
- The participation rates for the student questionnaires, on the other hand, are often lower, and differ considerably between states, as participation was voluntary in some states and required parental consent. One of the purposes of the student questionnaires was to record background characteristics required to determine social and immigration-related disparities (e.g. parent profession and education, and the children's and parents' country of birth). These characteristics were also recorded through parent questionnaires. Even after all the information from the student and parent questionnaires was pooled, participation rates in six states were less than 80 percent.
- As was the case in 2012, the validity of the results for the social and immigration-related disparities is thus also significantly limited in the IQB Trends in Student Achievement 2018 for some states due to a lack of information, meaning these results cannot be reported in full, or should be interpreted with caution. This specifically relates to the following states:
  - Hamburg: No results for 2018 or for the trends
  - Berlin, Bremen, Saarland: No results for the trends
  - Nordrhein-Westfalen, Rheinland-Pfalz, Saarland, Schleswig-Holstein: Results for 2018 to be interpreted with caution
  - Baden-Württemberg, Bayern, Mecklenburg-Vorpommern, Nordrhein-Westfalen, Rheinland-Pfalz, Schleswig-Holstein: Results for the trends to be interpreted with caution

Figure 1.1: Participation rates for the proficiency test and for the parent and student questionnaire, respectively



Information regarding the interpretation of results

- In *mathematics*, the results for the achievement of educational standards generally relate to all ninth-graders, regardless of whether they are studying for the HSA or MSA (integrated proficiency level model; see above). When interpreting the results, it is important to note that the information relating to the percentage of ninth-graders who achieve or exceed the normative standard for the MSA, or who fail to meet the minimum standard for the MSA, always also includes students not studying for the MSA.
- The results for the achievement of educational standards *in the science subjects*, on the other hand, only include students studying for the MSA (proficiency level models are only available for the MSA; see above).
- Furthermore, it must generally be noted that the student proficiencies were assessed at the end of grade 9, i.e. one year before they obtain the MSA.
- The analyses of mean proficiency, meanwhile, include the results of all ninth-graders in *all assessed subjects*.
- The reporting metric used for mean proficiency is defined in such a way that, in Germany in 2012, it exhibits an overall mean value of $M = 500$ points and a standard deviation of $SD = 100$ points.
- The increase in proficiency expected during a school year can also be used to classify differences in proficiency. Estimates of the expected increase in proficiency between grades 9 and 10 indicate that this equals about 50 points on the reporting metric for mathematics and around 20-35 points in the science subjects.
- Students with special educational needs at regular schools and special-needs schools were included in all analyses if they were able to take part in the study on their own (i.e., without additional assistence). With regards to the analyses of achievement of educational standards, the only students with special needs who were excluded were those who were not taught based on the educational standards (i.e., do not aspire at least an HSA; this concerns about 2 % of all ninth-graders).

2. Characteristics of ninth-graders in 2012 and 2018

Table 2.1: Proportion and distribution of ninth-graders with special educational needs in the German states during the 2017/2018 school year, and changes compared to the 2011/2012 school year

	S with SEN		S with SEN in the LLE support focus areas		S with SEN at regular schools		S with SEN in the LLE support focus areas at regular schools	
State	%	+/-	%	+/-	% of S with SEN	+/-	% of S with SEN	+/-
Baden-Württemberg[2]	5.2	1.0	3.3	0.5	7.1	–	9.5	–
Bayern[1]	4.0	-0.2	2.4	-0.2	–	–	–	–
Berlin	7.1	1.1	4.6	0.3	66.2	28.0	80.8	34.3
Brandenburg	8.6	0.0	5.9	-0.1	41.8	17.2	51.1	22.3
Bremen	8.8	2.0	6.6	3.3	87.8	49.6	92.5	35.2
Hamburg	8.8	2.6	6.8	2.5	62.5	46.8	69.5	61.8
Hessen	6.0	0.7	4.0	0.5	23.3	16.7	31.1	23.6
Mecklenburg-Vorpommern	13.5	1.2	10.6	1.2	22.7	5.4	23.9	4.2
Niedersachsen[2]	6.9	2.4	5.0	1.7	44.5	–	51.2	–
Nordrhein-Westfalen	7.0	1.4	5.2	1.0	40.8	29.3	48.9	36.7
Rheinland-Pfalz	6.2	1.6	4.9	1.3	25.8	19.1	29.4	22.6
Saarland[1]	5.0	0.2	2.9	0.4	–	–	–	–
Sachsen	8.1	0.0	6.1	-0.1	26.3	10.0	24.9	11.1
Sachsen-Anhalt	9.3	-0.2	6.7	-0.5	28.7	18.9	36.1	25.1
Schleswig-Holstein	7.9	1.9	5.7	1.3	72.5	28.2	83.8	32.6
Thüringen	7.1	-1.0	5.2	-1.0	35.1	15.8	40.8	19.2
Deutschland	6.4	1.1	4.5	0.7	32.6	20.1	39.4	25.3

Notes. S = Students; SEN = Special educational needs; LLE = Support focus areas of "Learning", "Language", "Emotional and social development"; +/- Change compared to the 2011/2012 school year.
[1] The given percentage of students with special educational needs only relates to students at special-needs schools. There is no information available for students with special educational needs at regular schools.
[2] There is no information available for students with special educational needs at regular schools for the 2011/2012 school year.
Source: State bureaus of statistics and own calculations.

Table 2.2: Percentage of ninth-graders by immigration status in the German states in 2018 and changes compared to 2012

	No immigration background	With immigration background								N/A	
		Total		One foreign-born parent		Second generation		First generation			
State	%	%	+/-	%	+/-	%	+/-	%	+/-	%	+/-
Baden-Württemberg[1]	56.8	43.2	**14.0**	15.7	**3.4**	20.7	**7.7**	6.8	**2.9**	2.5	**-13.1**
Bayern[1]	71.1	28.9	4.1	11.7	1.3	11.9	1.7	5.4	1.1	12.7	**-10.6**
Brandenburg	87.9	12.1	**3.9**	5.1	-0.3	2.4	**1.3**	4.6	**2.9**	2.6	**-6.1**
Hessen	55.3	44.7	**8.3**	14.8	2.0	20.3	2.1	9.6	**4.2**	5.1	**-4.9**
Mecklenburg-Vorpommern[1]	90.6	9.4	1.5	3.1	-0.6	1.8	0.5	4.5	1.6	2.8	**-19.9**
Niedersachsen	66.5	33.5	**10.5**	11.6	**2.7**	14.1	3.4	7.8	**4.4**	2.7	**-3.9**
Nordrhein-Westfalen[1, 2]	61.3	38.7	**5.0**	14.2	**2.4**	18.7	1.1	5.8	1.4	19.6	-2.4
Rheinland-Pfalz[1, 2]	66.2	33.8	**8.7**	12.0	1.7	15.6	**4.1**	6.2	**2.8**	16.9	**-5.5**
Sachsen	88.4	11.6	1.6	5.3	-0.3	2.6	**1.2**	3.6	0.7	13.8	-3.5
Sachsen-Anhalt	87.3	12.7	**5.7**	4.8	0.9	2.8	**1.5**	5.1	**3.3**	3.0	**-7.1**
Schleswig-Holstein[1, 2]	77.7	22.3	**5.1**	9.8	1.8	7.8	1.0	4.7	**2.3**	24.9	-1.6
Thüringen	89.9	10.1	2.3	3.8	-1.0	2.4	1.0	3.9	**2.3**	2.6	**-5.1**
Berlin	52.9	47.1	–	19.3	–	18.4	–	9.4	–	5.1	**-41.6**
Bremen	50.1	49.9	–	15.4	–	24.6	–	9.8	–	4.3	**-48.8**
Saarland[2]	67.0	33.0	–	11.3	–	13.9	–	7.8	–	23.5	**-26.4**
Deutschland	66.4	33.6	**6.8**	12.4	**1.9**	14.8	**2.5**	6.4	**2.4**	11.5	**-8.1**

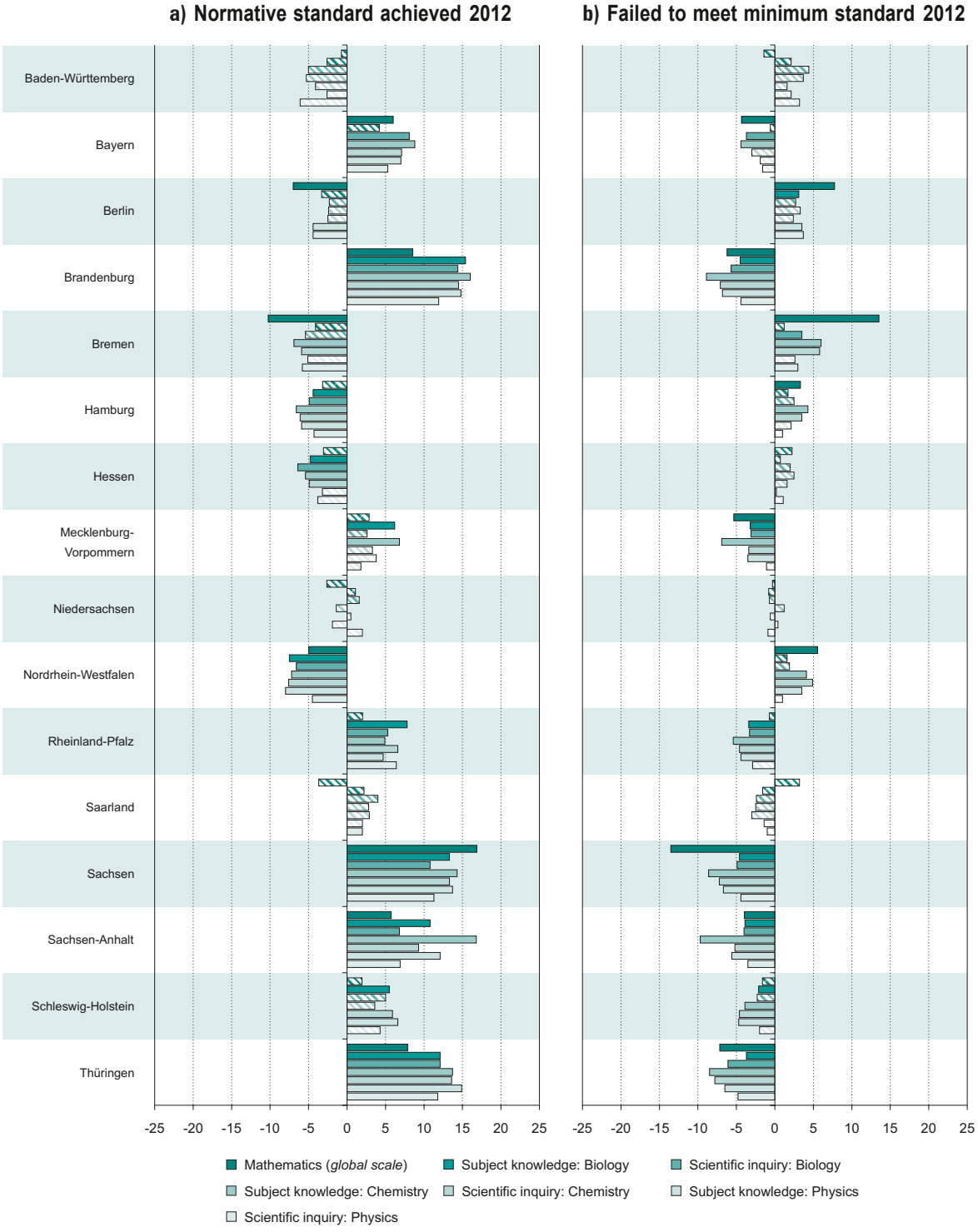
Notes. The table shows rounded values, meaning the percentage totals may slightly deviate from 100.
% = Percentages based only on information for unequivocally classifiable students; +/- = Change compared to the IQB National Assessment Study 2012; Second generation: Both parents foreign-born, but student themselves born in Germany; First generation: Both parents and the student foreign-born.
[1] The findings for 2012 and for trend analyses should be interpreted with caution due to a large percentage of missing data (20-30%) (cf. Chapter 3.1).
[2] The findings for 2018 and for trend analyses should be interpreted with caution due to a large percentage of missing data (20-30%) (cf. Chapter 3.1).
For Berlin, Bremen, and Saarland, results for immigration-related disparities can only be reported for 2018, as the necessary information for 2012 is only available for less than 70% of students (cf. Chapter 3.1).
No results for immigration-related disparities can be reported for Hamburg, as the necessary information is only available for less than 70% of students (cf. Chapter 3.1).
Values in bold are statistically significant ($p < .05$).

- There are changes in the composition of the student population between the 2011/2012 school year and the 2017/2018 school year. The extent of these changes, however, varies greatly between states.
- As a result of inclusive measures, a much larger percentage of ninth-graders with special educational needs now attends regular schools (+20.1 %; cf. Tab. 2.1).
- The percentage of students from immigrant families has also continued to rise overall in Germany (+6.8 %; cf. Tab. 2.2), whereas no significant changes have been recorded for the socioeconomic status of the ninth-graders' families.
- School structural reforms have resulted in considerable shifts in the percentages of ninth-graders at the various school types in a number of states.
- The extent to which changes in the mix of students correlate with the proficiencies achieved by the students cannot be clearly assessed using the data from the IQB Trends in Student Achievement 2018, though the pattern of results does not show any direct link.

3. Achievement of educational standards across the states of Germany

3.1 Review: Achievement of educational standards in 2012

Figure 3.1: Percentage of 9th-grade students in the German states who achieved or exceeded the **normative standard**, or who failed to meet the **minimum standard**, for the MSA in **2012**, as a deviation from the respective percentage for Germany as a whole (in percentage points)



Notes. In mathematics, the results relate to all ninth-graders taught based on the educational standards, regardless of the school certificate studied for. In the science subjects, only students studying for the MSA are included.
Hatched bars indicate statistically non-significant differences.

- Figure 3.1a (left) provides a review of the results from the IQB National Assessment Study 2012 regarding the achievement of **normative standards** for the MSA.
- If a bar points to the right, it means the percentage of ninth-graders who have achieved the respective normative standard is higher than for Germany as a whole. Bars pointing to the left indicate a lower percentage than that of Germany as a whole.
- Similarly, Figure 3.1b (right) shows the extent to which the percentage of ninth-graders failing to meet the **minimum standard** for the MSA in the IQB National Assessment Study 2012 was higher (bar pointing to the right) or lower (bar pointing to the left) in the respective state than in Germany as a whole.
- Hatched bars indicate non-significant differences, and should not be interpreted.
- In 2012, particularly favorable results were achieved in almost all of the assessed subjects in several states in Eastern Germany, as well as in Bayern and Rheinland-Pfalz.
- Similarly unfavorable results were only recorded in very few states.

3.2 Trends: Changes in the achievement of educational standards

Figure 3.2: **Changes** in the percentages of ninth-graders achieving or exceeding the **normative standard**, or who fail to meet the **minimum standard**, for the MSA, between 2012 and 2018 (in percentage points)

Notes. In mathematics, the results relate to all ninth-graders taught based on the educational standards, regardless of the school certificate studied for. In the science subjects, only students studying for the MSA are included.
Hatched bars indicate statistically non-significant differences.

- Figure 3.2 shows the trend results. Bars pointing to the right indicate that the percentage of students achieving at least the **normative standard** (cf. Fig. 3.2a, left)/failing to meet the **minimum standard** (cf. Fig. 3.2b, right) is higher in the respective state in 2018 than in 2012. Left-pointing bars indicate that the relevant percentage is lower in 2018 than in 2012.
- In mathematics (*global scale*), the results for Germany as a whole and in most states remained stable during the assessment period.
- In five states, however, the results for mathematics were unfavorable. This was particularly the case for Brandenburg and Mecklenburg-Vorpommern, as well as, to a lesser extent, Rheinland-Pfalz, Sachsen-Anhalt, and Schleswig-Holstein.
- No state shows significant positive changes in mathematics.
- For the sciences, the results show that the percentages of ninth-graders achieving at least the normative standard/failing to meet the minimum standard did not change significantly for Germany as a whole.
- Unfavorable changes were, however, once again found within several states.
- In Brandenburg and Sachsen-Anhalt, a substantially lower percentage of students achieve the normative standards, and a substantially higher percentage fails to meet the minimum standards, in virtually all scientific subjects and proficiency domains in 2018. A similar pattern can also be observed in Thüringen in terms of the achievement of normative standards.
- Some other states also sporadically show unfavorable developments in the science subjects.

3.3 Achievement of educational standards in 2018

Figure 3.3: Percentages of ninth-grade students in the German states who achieve or exceed the **normative standard**, or who fail to meet the **minimum standard**, for the MSA in **2018**, as a deviation from the respective percentage for Germany as a whole (in percentage points)

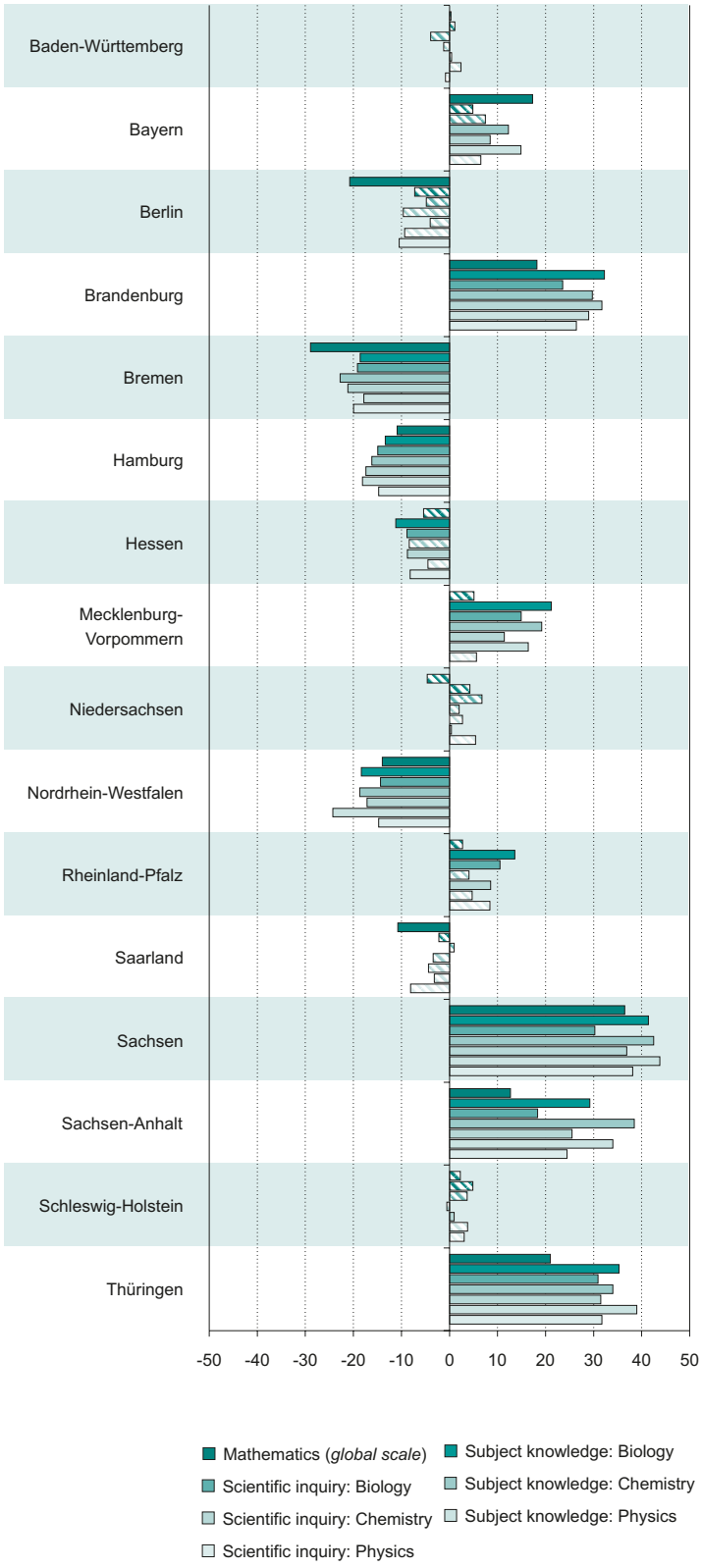
Notes. In mathematics, the results relate to all ninth-graders taught based on the educational standards, regardless of the school certificate studied for. In the science subjects, only students studying for the MSA are included.
Hatched bars indicate statistically non-significant differences.

- In 2018, nearly 45 percent of students achieve or exceed the normative standard for the MSA in mathematics (*global scale*) by the end of grade 9. Around 24 percent of all ninth-graders nationwide have not yet achieved the minimum standard for the MSA. However, these percentages also include students who are only studying for the HSA.
- In the science domains of *subject knowledge* and *scientific inquiry*, nearly 71/60 percent (biology), around 56/nearly 64 percent (chemistry), and some 69/nearly 77 percent (physics) of ninth-graders studying for the MSA nationwide achieve or exceed the normative standards for the MSA. Some 5/nearly 8 percent (biology), nearly 17/nearly 11 percent (chemistry), and nearly 9/nearly 6 percent (physics) of students fail to meet the minimum standard for the MSA in the two proficiency domains.
- The results of the individual states for 2018 are shown in Figure 3.3, and reveal great variation.
- In Bayern and Sachsen, students prove to be particularly successful in securing the normative and minimum standards across the board.
- In Berlin, meanwhile, the normative standards are achieved or exceeded less frequently, and students more frequently fail to meet the minimum standards, in all assessed subjects and proficiency domains than is the case for Germany as a whole.
- Predominantly unfavorable patterns of results are also evident for Bremen, Hamburg, and Hessen, as well as for Nordrhein-Westfalen in terms of achievement of normative standards. Particularly large are the disadvantages found for students in Bremen in mathematics.
- In the other states with significant deviations from the nationwide results, this usually relates to mathematics.

4. Average proficiency level

4.1 Review: Mean proficiency in 2012

Figure 4.1: Deviation in the **mean proficiencies** achieved by ninth-graders in the German states in **2012** from the national mean (in points on the reporting metric)

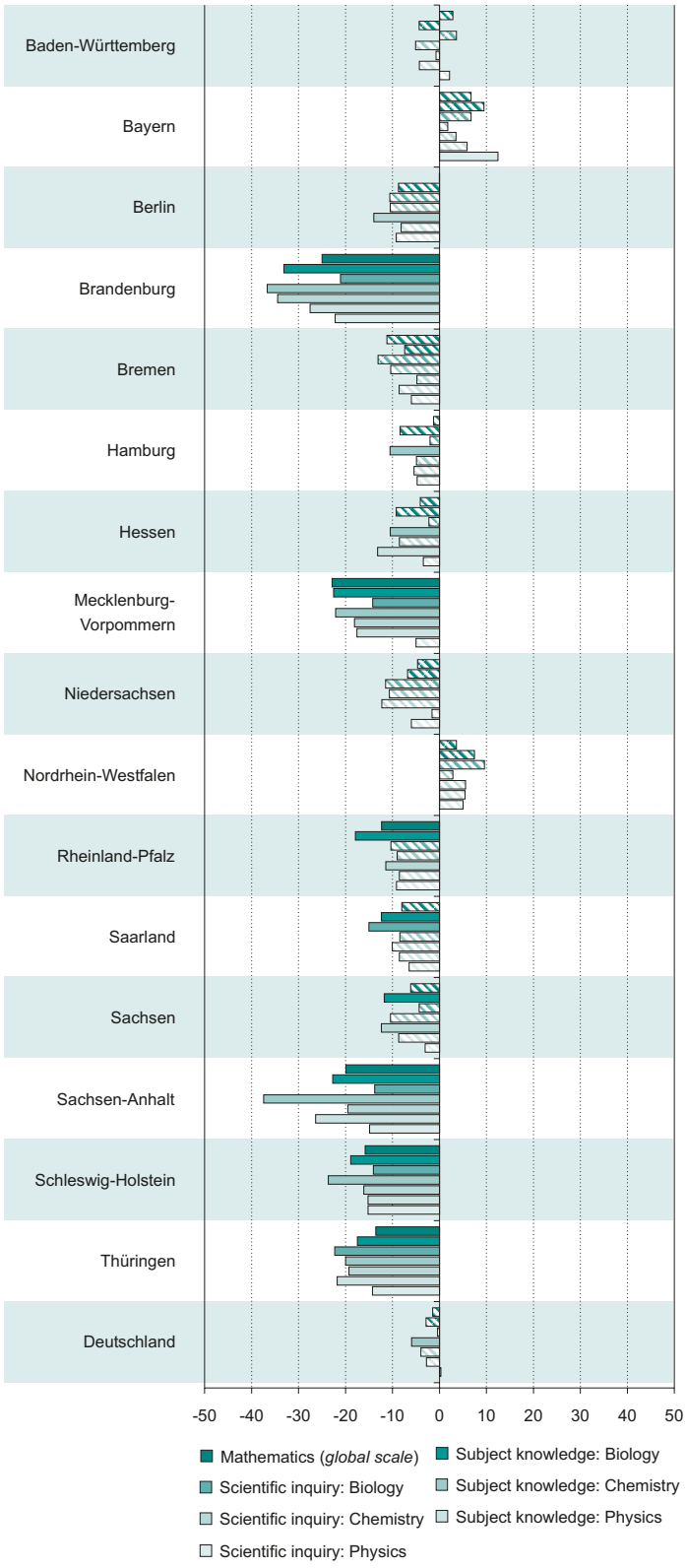


Note. Hatched bars indicate statistically non-significant differences.

- In addition to the distributions of students across the proficiency levels, the average proficiencies achieved were also assessed. For these analyses, all ninth-graders were included in all of the subjects.
- Figure 4.1 provides a review of the results of the IQB National Assessment Study 2012 in terms of the means achieved in each state.
- A right-pointing bar indicates that the respective state mean is higher than the German national mean.
- The higher number of cases in these analyses means there are more statistically significant differences here than in the comparisons relating to the achievement of educational standards.

4.2 Trends: Changes in mean proficiency

Figure 4.2: **Changes** in the **mean proficiencies** of ninth-graders between 2012 and 2018 (in points on the reporting metric)



Note. Hatched bars indicate statistically non-significant differences.

- The results for the means are also more frequently significant for the trend estimates (cf. Fig. 4.2) than for the achievement of educational standards.
- The average proficiencies achieved by ninth-graders largely remained stable nationwide.
- Within certain states, however, there are some statistically significant unfavorable trends for both mathematics and the science subjects. With the exception of Sachsen, this is the case in all territorial states in Eastern Germany, as well as in Schleswig-Holstein.
- In some cases, negative trends can also be observed in Berlin, Hamburg, Hessen, Rheinland-Pfalz, Sachsen, and Saarland.
- Due to the very high proficiency means in 2012 in some cases (cf. Fig. 4.1), however, the unfavorable changes do not necessarily result in below-average results in 2018 (cf. Fig. 4.3).
- The only significant positive trend is observed in Bayern in physics (*scientific inquiry*).

4.3 Mean proficiency in 2018

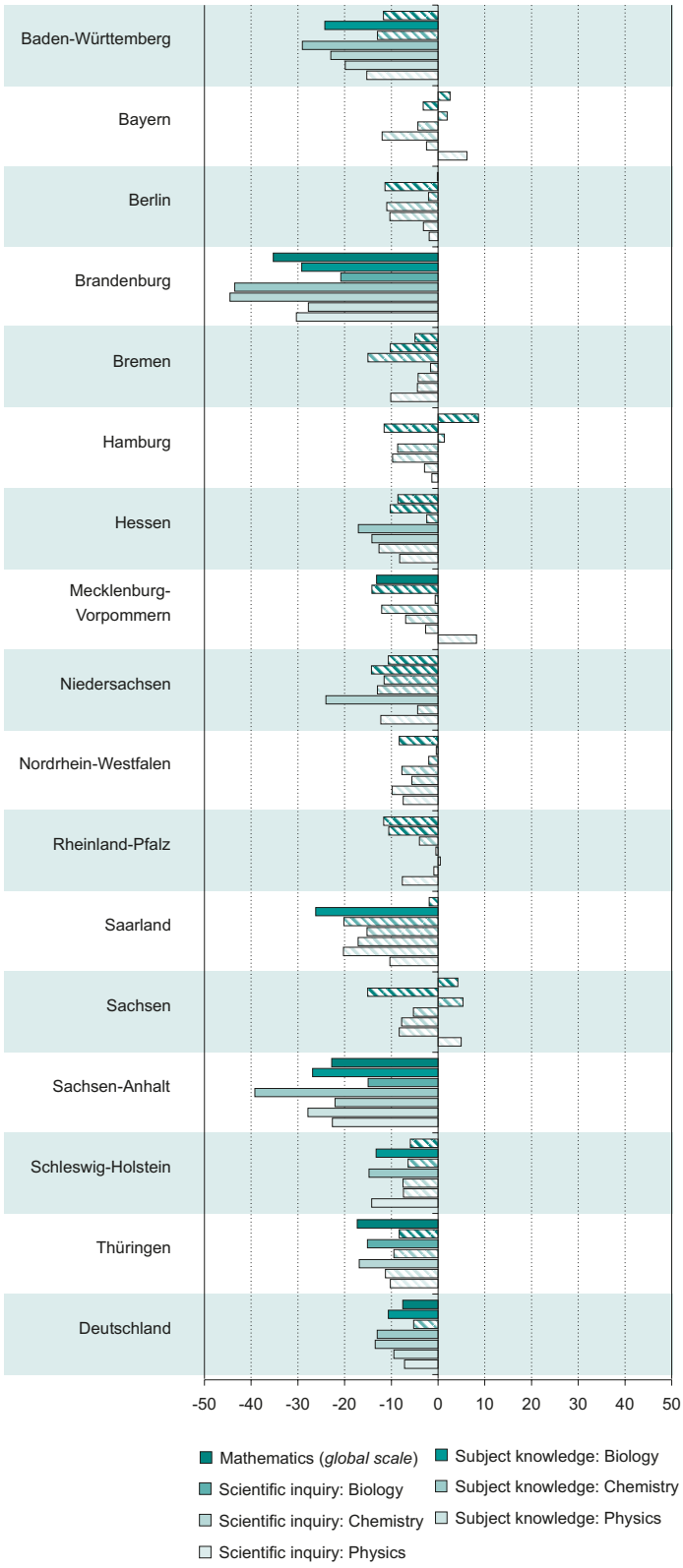
Figure 4.3: Deviation in the **mean proficiencies** achieved by ninth-graders in the German states in **2018** from the national mean (in points on the reporting metric)

Note. Hatched bars indicate statistically non-significant differences.

- Similar to Figure 4.1, Figure 4.3 shows the results for the mean proficiencies in 2018.
- Bayern and Sachsen have once again consistently above-average results, as has Thüringen.
- For the sciences favorable results are also observed in Sachsen-Anhalt.
- The means in Berlin, Bremen, Hamburg, Hessen and Schleswig-Holstein, on the other hand, are significantly below the national average across the board. The same is true – but for a few exceptions – in Saarland and Nordrhein-Westfalen.
- The mean proficiencies in mathematics in Mecklenburg-Vorpommern and RheinlandPfalz are also significantly lower than across Germany as a whole.
- In some cases, the extent of the significant deviations varies substantially between states.
- Depending on the subject and proficiency domain, the differences between the highest and lowest mean proficiency achieved in the states approximately equate to between 1.5 and 2.5 school years of learning time.

4.4 Trends in mean proficiency at *Gymnasien* (grammar schools)

Figure 4.4: **Changes** in the **mean proficiencies** of ninth-graders at ***Gymnasien*** between 2012 and 2018 (in points on the reporting metric)



Note. Hatched bars indicate statistically non-significant differences.

- *Gymnasien* (grammar schools) display unfavorable developments in the trend analyses in Germany as a whole (cf. Fig. 4.4).
- In 2018, an average of 8 points less are achieved in mathematics, 11 points less in biology, 13 points less in chemistry, and 7-9 points less in physics compared to 2012. Only in the proficiency domain of *scientific inquiry* in physics are there no significant changes to report.
- The unfavorable trends cannot be attributed to changes in *Gymnasium* attendance rates, as these remained stable during the assessment period.
- Among the states, Brandenburg and Sachsen-Anhalt in particular exhibit unfavorable developments at *Gymnasien*, despite barely changing attendance rates.
- Significant unfavorable developments in more than one proficiency domain are also observed in Baden-Württemberg, Hessen, Schleswig-Holstein, and Thüringen.

5. Gender disparities

Figure 5.1: Comparison of the mathematics proficiencies achieved by boys and girls, respectively, in 2012 and 2018 (*global scale*)

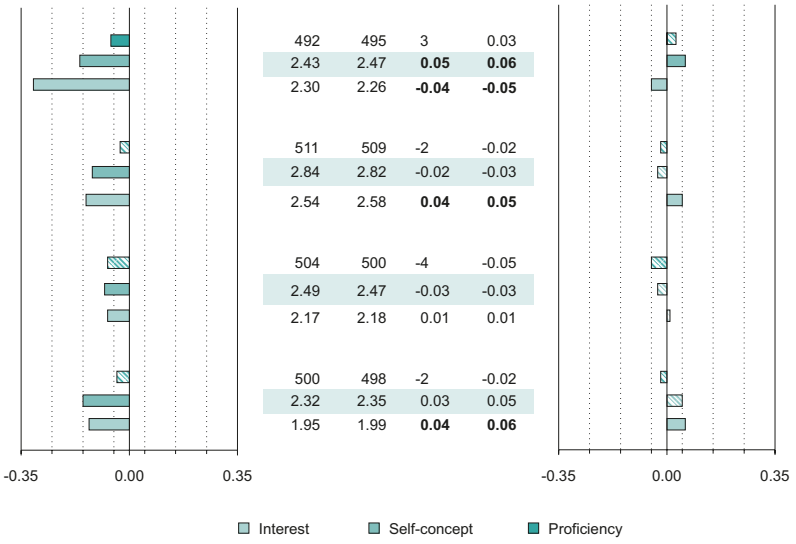
	Boys			2018–2012 trend for boys	Girls			2018–2012 trend for girls
	M_{2012}	M_{2018}	ΔM		M_{2012}	M_{2018}	ΔM	
Baden-Württemberg	504	510	5		496	495	-1	
Bayern	**524**	**525**	1		**511**	**523**	12	
Berlin	**482**	**482**	0		**476**	**475**	-1	
Brandenburg	**528**	**491**	**-37**		**507**	494	-12	
Bremen	**480**	**466**	-14		**461**	**457**	-4	
Hamburg	499	**489**	-10		**479**	490	11	
Hessen	**494**	495	1		496	**487**	-8	
Mecklenburg-Vorpommern	510	**488**	**-22**		500	**477**	**-24**	
Niedersachsen	500	495	-5		491	487	-4	
Nordrhein-Westfalen	502	494	-8		**470**	**485**	**15**	
Rheinland-Pfalz	508	494	**-14**		496	**487**	-10	
Saarland	497	**483**	-14		482	**480**	-2	
Sachsen	**550**	**535**	-15		**525**	**525**	0	
Sachsen-Anhalt	**519**	493	**-26**		**506**	492	**-14**	
Schleswig-Holstein	514	**487**	**-26**		488	485	-3	
Thüringen	**530**	**514**	**-16**		**512**	501	-11	
Deutschland	508	502	**-6**		492	495	3	

Notes. The values in the table are rounded. As a result, the difference in means may deviate from the difference presented (ΔM).
M = Mean; ΔM = Mean difference; *SE* = Standard error. Means in bold differ statistically significantly from the mean for boys/girls in Germany as a whole ($p < .05$). Mean differences in bold are statistically significant ($p < .05$). Hatched bars indicate a statistically non-significant mean difference between 2018 and 2012.

- Separate trend analyses for the proficiencies achieved by boys and girls show that no significant changes were observed in Baden-Württemberg, Bayern, Bremen, and Hamburg between 2012 and 2018.
- Significant positive trends are found only in Nordrhein-Westfalen, and these are limited to girls only.
- In the remaining states, a significant decline in proficiency is observed in at least one proficiency domain for boys and/or girls.
- Particularly in mathematics (cf. Fig. 5.1), but also in almost all assessed scientific subjects and proficiency domains, boys more frequently exhibit significantly unfavorable developments than girls.
- In Brandenburg, Sachsen-Anhalt, Schleswig-Holstein, and Thüringen, the average proficiencies achieved by boys in all assessed subjects and proficiency domains are significantly lower in 2018 than in 2012, with Brandenburg showing the most pronounced changes.
- A similarly consistent decline in proficiencies for girls is not evident in any state.
- In mathematics, the proficiency differences between boys and girls have declined significantly in Germany as a whole and in several states (Brandenburg, Hamburg, Nordrhein-Westfalen, and Schleswig-Holstein) since 2012, while they have risen significantly in the sciences in two states (Brandenburg and Thüringen). These trends are predominantly due to unfavorable developments in the proficiencies achieved by boys.

Figure 5.2: Changes in the proficiencies achieved by boys/girls, their subject-specific self-concept, and their subject-specific interest between 2012 and 2018

	Boys				2018–2012 trend for boys (*d*)	Girls				2018–2012 trend for girls (*d*)
	M_{2012}	M_{2018}	ΔM	*d*		M_{2012}	M_{2018}	ΔM	*d*	
Mathematics										
Global scale	508	502	**-6**	**-0.06**		492	495	3	0.03	
Self-concept	2.85	2.72	**-0.13**	**-0.16**		2.43	2.47	**0.05**	**0.06**	
Interest	2.66	2.41	**-0.25**	**-0.31**		2.30	2.26	**-0.04**	**-0.05**	
Biology										
Subject knowledge	489	486	-3	-0.03		511	509	-2	-0.02	
Self-concept	2.80	2.72	**-0.09**	**-0.12**		2.84	2.82	-0.02	-0.03	
Interest	2.48	2.37	**-0.11**	**-0.14**		2.54	2.58	**0.04**	**0.05**	
Chemistry										
Subject knowledge	496	489	-7	-0.07		504	500	-4	-0.05	
Self-concept	2.65	2.59	**-0.06**	**-0.08**		2.49	2.47	-0.03	-0.03	
Interest	2.39	2.33	**-0.06**	**-0.07**		2.17	2.18	0.01	0.01	
Physics										
Subject knowledge	500	497	-3	-0.04		500	498	-2	-0.02	
Self-concept	2.75	2.64	**-0.11**	**-0.15**		2.32	2.35	0.03	0.05	
Interest	2.48	2.38	**-0.11**	**-0.13**		1.95	1.99	**0.04**	**0.06**	

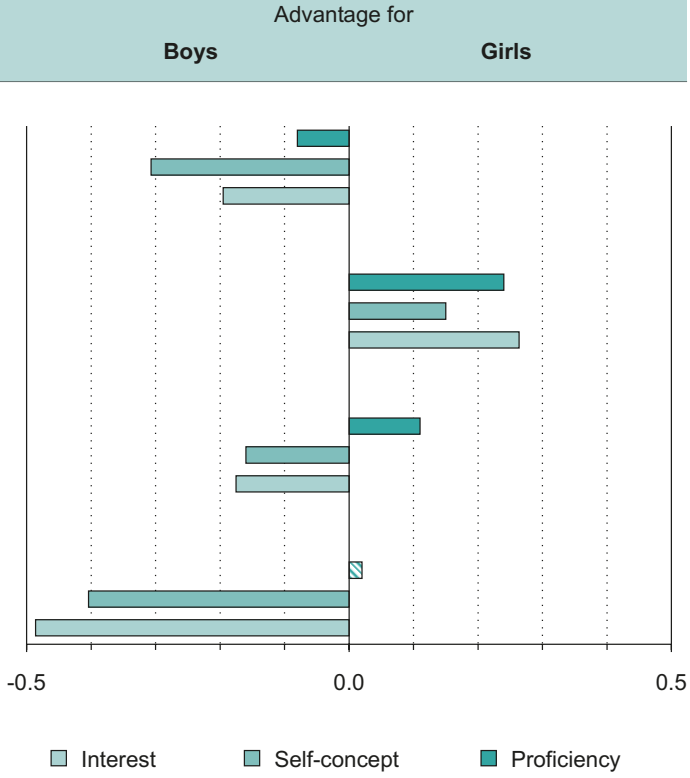


Notes. *M* = Mean; ΔM = Mean difference
d = Effect size Cohen's *d*.
Values in bold are statistically significant ($p < .05$).
Hatched bars indicate a statistically non-significant difference.

- The subject-specific self-concepts (self-assessment of one's own abilities in the respective subject) and interests also developed unfavorably for boys in Germany as a whole between 2012 and 2018 (cf. Fig. 5.2). For girls, on the other hand, these motivational aspects remained largely stable.
- On average, boys' assessments of their own abilities and interests in mathematics, biology, chemistry, and physics are significantly lower in 2018 than in 2012, with mathematics exhibiting the greatest changes.
- The unfavorable trends among boys in the assessed motivational aspects match the partially unfavorable changes in the proficiencies achieved by boys in Germany as a whole and in the states, respectively.

Figure 5.3: Differences between boys and girls in the proficiencies achieved, in the subject-specific self-concepts, and in subject-specific interests in 2018

	d
Mathematics	
Global scale	**-0.08**
Self-concept	**-0.31**
Interest	**-0.20**
Biology	
Subject knowledge	**0.24**
Self-concept	**0.15**
Interest	**0.26**
Chemistry	
Subject knowledge	**0.11**
Self-concept	**-0.16**
Interest	**-0.18**
Physics	
Subject knowledge	0.02
Self-concept	**-0.40**
Interest	**-0.49**



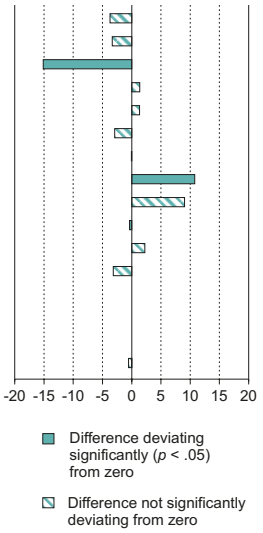
Notes. *d* = Effect size Cohen's *d*.
Values in bold are statistically significant ($p < .05$).
Hatched bars indicate a statistically non-significant difference.

- Although the subject-specific self-concepts and interests developed unfavorably among boys between 2012 and 2018, they continue, on average, to be significantly more pronounced than for girls in mathematics, chemistry, and particularly physics in 2018 (cf. Fig. 5.3). Only in biology do girls rate themselves, on average, to be more capable and interested than boys.
- The gender differences in the motivational aspects only partly align with the gender disparities in the corresponding proficiencies. While the results for the achieved proficiencies barely, if at all, fit the stereotype of mathematics and physics being "male subjects", this continues to be the case for self-concept and interest. Even in chemistry, where girls exhibit a significant performance advantage, the boys report a higher self-concept and interest.
- Only in the subject of biology are both the mean proficiency and mean self-concept and interest significantly higher for girls than for boys.

6. Social disparities

Figure 6.1: Comparing social gradients in mathematics (*global scale*) in 2012 and 2018

State	2012 Intercept *a*	2012 Strength of social gradient *b*	2012 Explained variance R^2	2018 Intercept *a*	2018 Strength of social gradient *b*	2018 Explained variance R^2	2018–2012 Δb
Baden-Württemberg [1]	499	43	19.8	504	40	19.7	-4
Bayern [1]	516	37	14.5	522	34	11.4	-3
Brandenburg	516	49	24.8	494	34	12.1	**-15** [a]
Hessen	493	40	19.4	491	41	18.5	1
Mecklenburg-Vorpommern [1]	508	35	14.0	488	36	13.5	1
Niedersachsen	495	36	17.1	491	33	14.8	-3
Nordrhein-Westfalen [1, 2]	489	41	16.7	492	41	17.1	0
Rheinland-Pfalz [1, 2]	503	35	13.3	491	45	20.0	**11** [a]
Sachsen	537	33	12.2	529	42	17.4	9
Sachsen-Anhalt	519	39	16.2	498	39	13.1	0
Schleswig-Holstein [1, 2]	502	40	17.7	487	42	16.4	2
Thüringen	521	33	12.7	508	29 [a]	9.3	-3
Berlin	-	-	-	471	46 [a]	19.6	-
Bremen	-	-	-	464	42	21.7	-
Saarland [2]	-	-	-	485	37	14.2	-
Deutschland	500	40	16.8	499	39	15.3	-1



Notes. The table shows rounded values, meaning the difference in unstandardized regression coefficients may differ slightly from the difference Δb shown. *a* = Intercept; *b* = Unstandardized regression coefficient; Δb = Difference in unstandardized regression coefficients; R^2 = Determination coefficient.
[1] The findings for 2012 should be interpreted with caution due to a large percentage of missing data (20-30%) (cf. Ch. 3.1).
[2] The findings for 2018 should be interpreted with caution due to a large percentage of missing data (20-30%) (cf. Ch. 3.1).
[a] Value differs significantly ($p < .05$) from the value for Germany as a whole.
No results for social disparities can be reported for Hamburg, as the necessary information is only available for less than 70% of students (cf. Ch. 3.1).
No trend-analysis results for social disparities can be reported for Berlin, Bremen, and Saarland, as the necessary information is only available for less than 70% of students for 2012 (cf. Ch. 3.1).
The strength of the social gradient is significantly different from 0 ($p < .05$) for each state and for Germany as a whole.
Differences printed in bold type are statistically significant ($p < .05$).

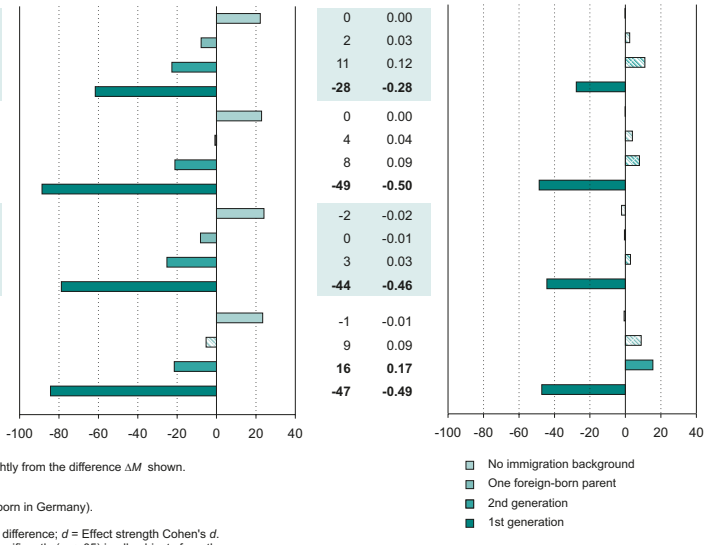
- The link between the proficiencies achieved by ninth-graders and the social status of their families (social disparities), which is determined using social gradients[1], continues to be substantial both nation-wide and in the various states included in the analyses in 2018: In all assessed subjects and proficiency domains, a higher socioeconomic status goes along with higher proficiencies.
- The social gradients barely differ between the assessed subjects and proficiency domains in 2018.
- In some cases, however, the social gradients vary significantly between the states included in the analyses. Close correlations exist almost across the board in Berlin, while they are particularly small in Brandenburg, especially in biology and chemistry. Furthermore, the social gradient in mathematics is significantly smaller in Thüringen than in Germany as a whole.
- The trend analyses show that the social disparities have not changed significantly in mathematics (cf. Fig. 6.1) or the science subjects in Germany as a whole. Even among the states, but for a few exceptions, the social gradients remained largely stable. In Brandenburg, the link between the students' mathematical proficiency and the socioeconomic status of their families decreased, whereas it increased in Rheinland-Pfalz.

1 Social gradients describe the linear relationship between the families' socioeconomic status and the proficiencies achieved by the students, whereby higher gradient values indicate a closer link. More detailed information on interpreting social gradients can be found in Chapter 8 of the report.

7. Immigration-related disparities

Figure 7.1: A comparison of mean proficiency scores by immigration status in 2012 and 2018, as well as deviations from the German national mean in 2018

Proficiency domain	%	+/-	2012 M	2012 d	2018 M	2018 d	Difference 2018–2012 ΔM	Difference 2018–2012 d
Mathematics (global scale)	67.1	-6.0	521		521		0	0.00
	12.2	1.5	488	0.34	491	0.32	2	0.03
	14.4	2.5	465	0.59	476	0.49	11	0.12
	6.2	2.0	465	0.59	437	0.87	**-28**	**-0.28**
Biology Subject knowledge	66.7	-6.8	520		520		0	0.00
	12.2	1.8	492	0.28	496	0.26	4	0.04
	14.7	2.4	468	0.55	476	0.50	8	0.09
	6.4	2.6	457	0.64	409	1.20	**-49**	**-0.50**
Chemistry Subject knowledge	66.7	-6.8	520		518		-2	-0.02
	12.2	1.8	486	0.35	486	0.36	0	-0.01
	14.7	2.4	466	0.57	469	0.55	3	0.03
	6.4	2.6	460	0.63	415	1.12	**-44**	**-0.46**
Physics Subject knowledge	66.7	-6.8	521		521		-1	-0.01
	12.2	1.8	483	0.39	492	0.32	9	0.09
	14.7	2.4	460	0.64	476	0.51	**16**	**0.17**
	6.4	2.6	460	0.64	413	1.16	**-47**	**-0.49**



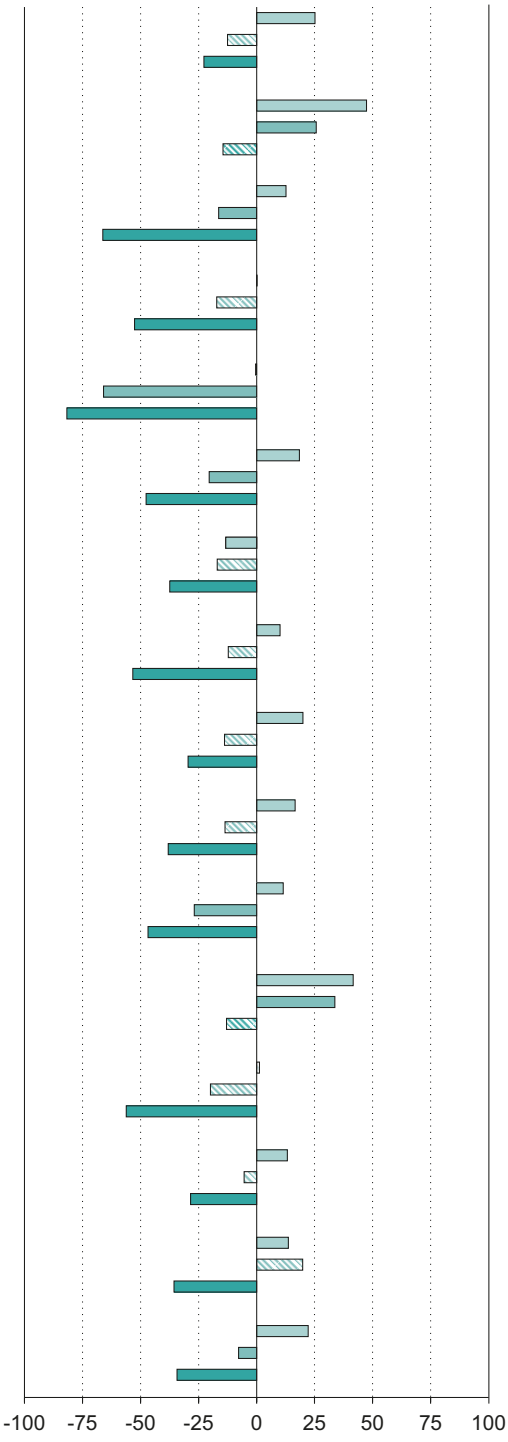
Notes. The table shows rounded values. As a result, the difference in means may deviate slightly from the difference ΔM shown.
Line 1: Students without an immigration background (both parents born in Germany).
Line 2: Students with one foreign-born parent.
Line 3: 2nd-generation students (both parents foreign-born, but the students themselves are born in Germany).
Line 4: 1st-generation students (both parents and the students are foreign-born).
+/- = Change compared to the IQB National Assessment Study 2012; *M* = Mean; ΔM = Mean difference; *d* = Effect strength Cohen's *d*.
In both years, the proficiencies achieved by students with an immigration background differ significantly ($p < .05$) in all subjects from those achieved by students without an immigration background.
Values printed in bold are statistically significant ($p < .05$).
Hatched bars indicate statistically non-significant differences.

- The percentage of ninth-graders with an immigration background (at least one foreign-born parent) has increased by nearly 7 percentage points in Germany as a whole since 2012, and in 2018 is around 34 percent (cf. also Tab. 2.2). Among the three different immigrant groups (one foreign-born parent, first generation, second generation[2]), the increase is between 2 and 2.5 percentage points. Around 26 percent of first-generation students came to Germany as refugees in 2014 or later.
- All assessed subjects and proficiency domains show significant disadvantages for students from immigrant families across Germany as a whole. These are more apparent in the scientific proficiency domains (particularly biology) than in mathematics.
- Trend analyses (cf. Fig. 7.1) show positive developments in some scientific proficiency domains for second-generation students (cf. also the results for the *scientific inquiry* proficiency domain in Chapter 9 of the report), meaning the disparities for this group decreased in some cases between 2012 and 2018. For the first generation, meanwhile, the disparities have increased; this finding is largely also true even when refugees are excluded from the analyses.
- The immigration-related disparities can partially be attributed to differences in the social background of the families. The results of the IQB Trends in Student Achievement 2018 also once again underline the importance of the language spoken at home, and show how important it is to assist children and adolescents in acquiring and further developing proficiencies in academic language.

2 First generation: Both parents and the students are foreign-born; Second generation: Both parents are foreign-born, but the students are born in Germany.

Figure 7.2: Means and standard deviations of proficiency scores by immigration status in mathematics (*global scale*) in the German states, as well as deviations from the German national mean in 2018

State	*N*	*M*	*SD*	*d*
Baden-Württemberg[1]	947	524	89	
	264	486	93	-0.42 [a]
	459	476	93	-0.53 [a]
Bayern[1]	1 191	546	89	
	182	524	99	-0.23 [a]
	259	484	103	-0.64 [a]
Berlin	1 137	511	98	
	385	482	103	-0.29 [a]
	568	432	96	-0.82 [a]
Brandenburg	1 230	499	90	
	65	481	82	-0.20
	102	446	97	-0.56 [a]
Bremen	423	498	100	
	152	433	88	-0.70 [a]
	313	417	81	-0.89 [a]
Hessen	992	517	89	
	257	478	95	-0.42 [a]
	460	451	93	-0.73 [a]
Mecklenburg-Vorpommern[1]	1 407	485	95	
	50	482	89	-0.04
	105	461	110	-0.24
Niedersachsen	872	509	79	
	131	486	81	-0.28 [a]
	254	445	93	-0.74 [a]
Nordrhein-Westfalen[1]	1 041	518	90	
	239	485	95	-0.36 [a]
	386	469	96	-0.53 [a]
Rheinland-Pfalz[1]	816	515	98	
	150	485	100	-0.31 [a]
	260	461	86	-0.59 [a]
Saarland	644	510	91	
	119	472	85	-0.44 [a]
	216	452	99	-0.61 [a]
Sachsen	1 250	540	94	
	67	532	92	-0.09
	100	486	103	-0.55 [a]
Sachsen-Anhalt	1 104	500	98	
	63	479	95	-0.22
	102	442	115	-0.54 [a]
Schleswig-Holstein[1]	892	512	95	
	101	493	95	-0.20
	136	470	97	-0.44 [a]
Thüringen	1 150	512	90	
	39	518	82	0.07
	77	463	107	-0.50 [a]
Deutschland	15 693	521	91	
	2 437	491	96	-0.32 [a]
	4 102	464	97	-0.60 [a]

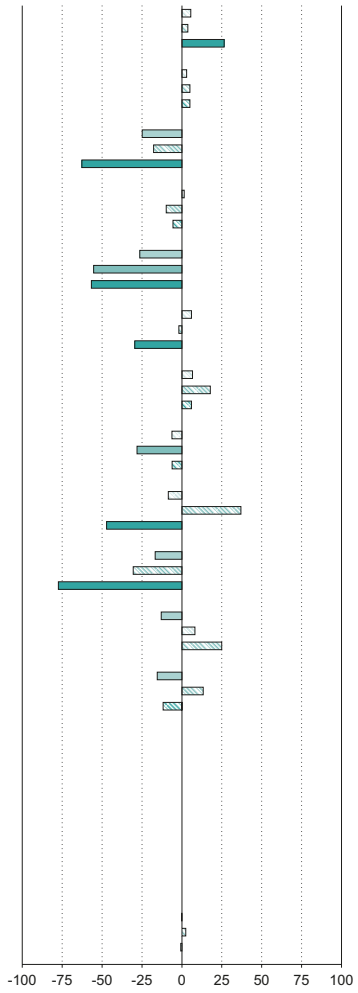


Notes. Line 1: Students without an immigration background (both parents born in Germany).
Line 2: Students with one foreign-born parent.
Line 3: Students with two foreign-born parents.
+/-= Change compared to the IQB National Assessment Study 2012; *N* = Number of students in the sample; *M* = Mean; *SD* = Standard deviation; *d* = Effect size Cohen's *d*.
[1] The findings should be interpreted with caution due to a large percentage (20-30%) of missing data (cf. Chapter 3.1).
[a] Significant difference ($p < .05$) from students without an immigration background.
Values printed in bold are statistically significant ($p < .05$). Hatched bars indicate statistically non-significant differences.
No results can be reported for Hamburg regarding immigration-related disparities, as the necessary information is only available for less than 70% of students (cf. Chapter 3.1).

- In most states, students with two foreign-born parents achieve, on average, proficiency scores below those obtained by students without an immigration background, and below the overall mean for all ninth-graders. However, the extent of these differences varies considerably between the states (cf. Fig. 7.2 for results in mathematics).
- In the case of students with one foreign-born parent, most states did not show any significant differences from the German national mean, and in some states there were also no significant differences compared to students without an immigration background.
- The proficiency scores achieved by students without an immigration background are above the German national mean in almost all states, with the extent of the deviations once again varying considerably.

Figure 7.3: Proficiency scores by immigration status in mathematics (*global scale*) in the German states in 2012 and 2018

State	%	+/-	2012 N	2012 M	2012 d	2018 N	2018 M	2018 d	Difference 2018–2012 ΔM	Difference 2018–2012 d
Baden-Württemberg[1]	56.8	-14.0	743	518		947	524		6	0.06
	15.7	3.4	144	482	0.37 [a]	264	486	-0.42 [a]	4	0.04
	27.5	10.7	159	449	0.74 [a]	459	476	-0.53 [a]	**26**	**0.30**
Bayern[1]	71.1	-4.1	1 176	543		1 191	546		3	0.03
	11.7	1.4	149	519	0.24 [a]	182	524	-0.23 [a]	5	0.05
	17.2	2.7	215	479	0.66 [a]	259	484	-0.64 [a]	5	0.05
Brandenburg	87.9	-3.9	1 081	524		1 230	499		**-25**	**-0.26**
	5.1	-0.3	60	499	0.24	65	481	-0.20	-18	-0.20
	7.0	4.1	35	509	0.14	102	446	-0.56 [a]	**-63**	**-0.58**
Hessen	55.3	-8.3	1 240	516		992	517		1	0.02
	14.8	2.0	252	488	0.30 [a]	257	478	-0.42 [a]	-10	-0.11
	29.9	6.3	460	457	0.64 [a]	460	451	-0.73 [a]	-6	-0.06
Mecklenburg-Vorpommern[1]	90.6	-1.5	1 012	512		1 407	485		**-26**	**-0.28**
	3.1	-0.6	43	537	0.29	50	482	-0.04	**-55**	**-0.66**
	6.3	2.1	40	518	0.07	105	461	-0.24	**-57**	**-0.56**
Niedersachsen	66.5	-10.5	888	503		872	509		6	0.07
	11.6	2.7	98	488	0.16	131	486	-0.28 [a]	-2	-0.02
	21.9	7.8	154	475	0.31 [a]	254	445	-0.74 [a]	**-30** [a]	**-0.32**
Nordrhein-Westfalen[1, 2]	61.4	-4.9	1 148	512		1 041	518		7	0.07
	14.2	2.4	200	467	0.45 [a]	239	485	-0.36 [a]	18	0.18
	24.4	2.5	374	463	0.50 [a]	386	469	-0.53 [a]	6	0.06
Rheinland-Pfalz[1, 2]	66.3	-8.6	885	521		816	515		-6	-0.07
	12.0	1.7	122	513	0.09	150	485	-0.31 [a]	**-28**	**-0.28**
	21.7	6.9	178	467	0.60 [a]	260	461	-0.59 [a]	-6	-0.07
Sachsen	88.4	-1.6	826	549		1 250	540		-9	-0.09
	5.3	-0.3	43	495	0.52 [a]	67	532	-0.09	37	0.36
	6.3	1.8	39	533	0.19	100	486	-0.55 [a]	**-47**	**-0.54**
Sachsen-Anhalt	87.3	-5.7	1 045	517		1 104	500		**-17**	**-0.17**
	4.8	0.9	56	509	0.08	63	479	-0.22	-30	-0.32
	7.9	4.8	33	520	0.04	102	442	-0.54 [a]	**-77** [a]	**-0.77**
Schleswig-Holstein[1, 2]	77.8	-5.0	908	525		892	512		**-13**	**-0.14**
	9.8	1.7	81	485	0.45 [a]	101	493	-0.20	8	0.09
	12.4	3.2	100	445	0.78 [a]	136	470	-0.44 [a]	25	0.24
Thüringen	89.9	-2.3	976	528		1 150	512		**-15**	**-0.17**
	3.8	-1.0	41	505	0.28	39	518	0.07	13	0.18
	6.3	3.3	40	475	0.58 [a]	77	463	-0.50 [a]	-12	-0.12
Berlin	52.9	-9.9	704	-	-	1 137	511		-	-
	19.3	4.1	163	-	-	385	482	-0.29 [a]	-	-
	27.8	5.7	253	-	-	568	432	-0.82 [a]	-	-
Bremen			333	-	-	423	498		-	-
			85	-	-	152	433	-0.70 [a]	-	-
			150	-	-	313	417	-0.89 [a]	-	-
Saarland[2]			461	-	-	644	510		-	-
			47	-	-	119	472	-0.44 [a]	-	-
			69	-	-	216	452	-0.61 [a]	-	-
Deutschland			14 166	521		15 693	521		0	0.00
			1 778	488	0.34 [a]	2 437	491	-0.32 [a]	2	0.03
			2 711	465	0.59 [a]	4 102	464	-0.60 [a]	-1	-0.01

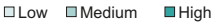


Notes. The table shows rounded values. As a result, the difference in means may differ slightly from the difference shown (Δ*M*).
Line 1: Students without an immigration background (both parents born in Germany).
Line 2: Students with one foreign-born parent.
Line 3: Students with two foreign-born parents.
+/-= Change compared to the IQB National Assessment Study 2012; *N* = Number of students in the sample; *M* = Mean; *d* = Effect size Cohen's *d*; Δ*M* = Mean difference.
[1] The findings for 2012 and the trend should be interpreted with caution due a the large percentage (20-20%) of missing data (cf. Chapter 3.1).
[2] The findings for 2018 and the trend should be interpreted with caution doe a large percentage 20-30%) of missing data (cf. Chapter 3.1).
[a] Significant difference ($p < .05$) compared to students without an immigration background.
Values printed in bold are statistically significant ($p < .05$). Hatched bars indicate statistically non-significant differences.
Results for immigration-related disparities can only be reported for 2018 in the states of Berlin, Bremen, and Saarland, as the necessary information for 2012 is available for less than 70% of students (cf. Chapter 3.1).
No results can be reported for Hamburg regarding immigration-related disparities, as the necessary information is only available for less than 70% of students (cf. Chapter 3.1).

- The extent to which students with an immigration background and those without an immigration background show differences in mean proficiency between 2012 and 2018 varies between the states (cf. Fig. 7.3 for results in mathematics).
- In cases of significant changes, these constitute unfavorable developments. The only state with a significant positive change is Baden-Württemberg. This positive change concerns students with two foreign-born parents.

Figure 7.4: Means and standard deviations for social integration in the classroom and school satisfaction by immigration status in 2018

Aspect		*M*	*SD*	Δ*M*	*d*
Social intergration					
No immigration background	3% 17% 80%	3.26	0.50		
One foreign-born parent	3% 18% 79%	3.24	0.51	**-0.03**	**-0.05**
2nd generation	3% 18% 79%	3.24	0.51	**-0.02**	**-0.05**
1st generation, non-refugee	5% 24% 72%	3.14	0.56	**-0.12**	**-0.23**
Refugee	6% 34% 60%	3.03	0.57	**-0.23**	**-0.44**
School satisfaction					
No immigration background	3% 22% 74%	3.19	0.51		
One foreign-born parent	4% 26% 71%	3.15	0.53	**-0.04**	**-0.08**
2nd generation	4% 25% 71%	3.16	0.53	**-0.03**	**-0.06**
1st generation, non-refugee	5% 35% 60%	3.04	0.55	**-0.15**	**-0.29**
Refugee	7% 43% 50%	2.93	0.55	**-0.26**	**-0.49**



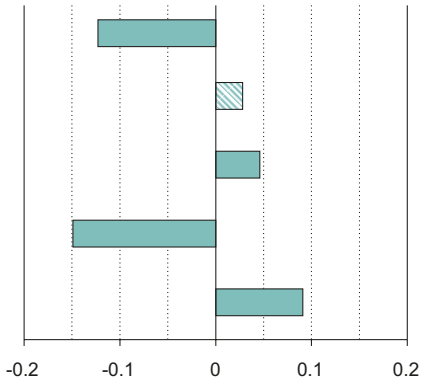
Notes. The bars show the percentage of students with low (scale value ≤ 2), medium (scale value > 2 and < 3) and high (scale value ≥ 3) social integration/school satisfaction. The graph shows rounded values, so the total percengages may deviate slightly from 100, and the differences in means may deviate slightly from the difference Δ*M* shown.
2nd generation: Both parents foreign-born, but the students themselves born in Germany; 1st generation: Both parents and the students foreign-born; *M* = Mean; *SD* = Standard deviation; Δ*M* = Difference in means between students without an immigration background and students with an immigration background; *d* = Effect size Cohen's *d*.
Differences printed in bold are statistically significant ($p < .05$).

- The results for social integration and school satisfaction among ninth-graders show that they predominantly feel well integrated in their class, and are satisfied with their school, regardless of immigration background (cf. Fig. 7.4).
- While refugees exhibit somewhat lower values, they also state, on average, that they are socially well integrated and satisfied with their school. In view of the difficult circumstances under which these students came to and live in Germany, this can be viewed as a success.
- Assessments by school principals also show that refugee students have integrated well into school life on the whole.

8. Characteristics of instructional quality in mathematics

Figure 8.1: Group means and standard deviations from underlying lesson structures at *Gymnasien* (grammar schools) and other schools in 2018

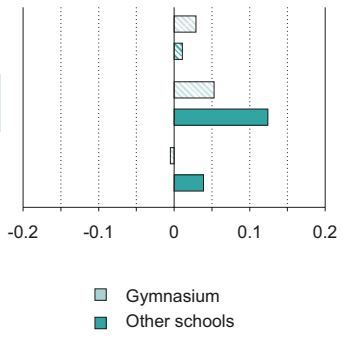
	M	*SD*	Diff. between Gymnasien and other schools $\Delta M_{GY\text{-}nGY}$	Diff. between Gymnasien and other schools *d*
Disruptions [1]	2.22 2.34	0.51 0.49	**-0.12**	**-0.25**
Structure	2.78 2.75	0.40 0.36	0.03	0.07
Error culture	3.12 3.08	0.44 0.45	**0.05**	**0.10**
Student orientation	2.77 2.92	0.39 0.42	**-0.15**	**-0.37**
Cognitive activation	2.88 2.79	0.22 0.24	**0.09**	**0.39**



Notes. Line 1: Gymnasium, Line 2: Other schools.
The table shows rounded values. As a result, the difference in means may deviate slightly from the difference ΔM shown.
M = Mean; *SD* = Standard deviation; $\Delta M_{GY\text{-}nGY}$ = Difference in means between Gymnasien and other schools;
d = Effect size Cohen's *d*.
[1] Higher values indicate a higher frequency of disruptions.
Differences printed in bold are statistically significant ($p < .05$). Hatched bars indicate a statistically non-significant difference.

Figure 8.2: A comparison of group means and standard deviations from underlying lesson structures at *Gymnasien* (grammar schools) and other schools in 2012 and 2018

	2012			2018			Difference 2018–2012	
	M	*SD*	*d*	*M*	*SD*	*d*	ΔM	*d*
Disruptions [1]	2.19 2.33	0.50 0.51	**-0.28**	2.22 2.34	0.51 0.49	**-0.25**	0.03 0.01	0.06 0.02
Structure	2.73 2.63	0.29 0.32	**0.32**	2.78 2.75	0.40 0.36	0.07	0.05 **0.12** [a]	0.15 **0.36**
Cognitive activation	2.88 2.75	0.23 0.27	**0.53**	2.88 2.79	0.22 0.24	**0.39**	-0.01 **0.04** [a]	-0.02 **0.15**



Notes. Line 1: Gymnasium; Line 2: Other schools.
The table shows rounded values. As a result, the difference in means may deviate slightly from the difference ΔM shown. *M* = Mean; *SD* = Standard deviation;
ΔM = Mean difference; *d* = Effect size Cohen's *d*.
[1] Higher values indicate a higher frequency of disruptions.
[a] Value does not differ significantly ($p < .05$) from the Gymnasien value.
Differences printed in bold are statistically significant ($p < .05$). Hatched bars indicate a statistically non-significant difference.

- Due to the importance of teacher instruction for learning success, the IQB Trends in Student Achievement 2018 also examined characteristics of instructional quality. The focus here was on the lessons' so-called "underlying structures", which have proven important in fostering proficiency and motivational aspects. These characteristics were analyzed using perceptions shared by the students in a study group.
- From the students' perspective, mathematics classes at *Gymnasien* (grammar schools) are characterized by a more positive error culture (more respectful and patient handling of errors), are more cognitively activating, and involve less disruptions than at other (non-grammar) schools (cf. Fig. 8.1). On the other hand, student orientation in mathematics classes is rated higher by students at non-grammar schools.
- Trend analyses show that students at non-grammar schools believe that lessons are more structured and cognitively activating in 2018 than in 2012, whereas no changes were found for *Gymnasien* (cf. Fig. 8.2). This development may help increase proficiency levels at non-grammar schools on the long run.

9. Conclusions

- Similar to the IQB Trends in Student Achievement 2016 in primary level, the IQB Trends in Student Achievement 2018 study paints a picture partially indicating stability and partially indicating rather unfavorable changes over time for the proficiency scores obtained by ninth-graders in mathematics and the science subjects.
- When comparing the results for the years 2018 and 2012, student proficiencies are largely unchanged in Germany as a whole. However, the proficiencies achieved by ninth-graders have developed differently from state to state.
- Some states show clearly unfavorable changes, particularly among boys, in both mathematics and the science subjects. Due to the partially very high initial proficiency levels, particularly in the eastern German states, however, this does not always result in below-average results in 2018.
- There are very few significantly positive changes to report, and the differences between states continue to be large with regards to the level of proficiency achieved.
- At *Gymnasien* (grammar schools), almost all examined proficiency domains show unfavorable developments in Germany as a whole, and these vary considerably in degree from state to state.
- The heterogeneity in the composition of the students increased between 2012 and 2018, due in part to the fact that the percentage of students from immigrant families at German schools has continued to rise, and that more students with special educational needs are attending regular schools in 2018. These changes were, however, not more apparent in states with particularly unfavorable developments in the proficiencies obtained, meaning they can hardly help explain the negative trends.
- Also, the generational change in teaching staff in these states between 2012 and 2018 does not yet appear to have reached such an extent that it could have a direct bearing on the observed trends.
- A discussion of the results and conclusions to be drawn must take place within each state by taking into account additional information on the respective education system and changes during the assessment period. The primary question here should be how quality of instruction can be further developed in order to reduce identified weaknesses and counter unfavorable trends.
- Another discussion point should revolve around how boys and girls can each be supported in a more targeted fashion, so as, on the one hand, to counter the unfavorable developments among boys, and on the other to convince girls of their performance potential in STEM subjects and foster their interest in these. This is an important pre-requisite in ensuring that more young women have the confidence to follow careers in these fields.

Further information on the IQB Trends in Student Achievement 2018:

Petra Stanat, Stefan Schipolowski, Nicole Mahler, Sebastian Weirich, Sofie Henschel (Eds.)

IQB-Bildungstrend 2018

Mathematische und naturwissenschaftliche Kompetenzen am Ende der Sekundarstufe I im zweiten Ländervergleich

Münster: Waxmann
2019, 450 pages, pb, 44,90 €
ISBN 978-3-8309-4044-9

http://www.waxmann.com/buch4044

and on the IQB website:

https://www.iqb.hu-berlin.de/bt/BT2018