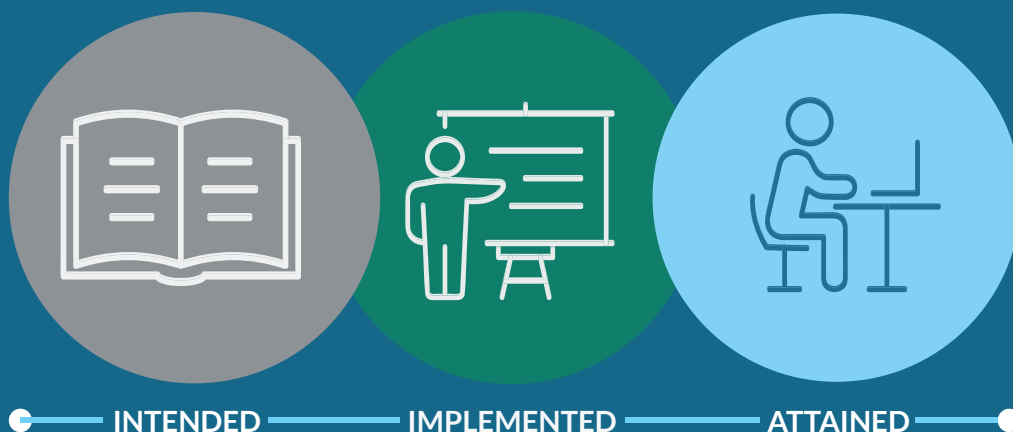


Intended, Implemented, and Attained Mathematics and Science Curricula at the Eighth Grade: Findings from TIMSS 2023

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Bethany Fishbein, Eugenio Gonzalez, Matthias von Davier*





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Intended, Implemented, and Attained Mathematics and Science Curricula at the Eighth Grade: Findings from TIMSS 2023

Introduction

The goals of education systems worldwide influence the priorities and organizational structures through which teaching and learning processes take place. Curriculum is central to these goals, specifying the educational content to be taught and learned within particular subjects or grade levels. The curriculum, specified through various documents, serves as the academic foundation for students' educational experiences, making its contribution to student learning worthy of investigation.

TIMSS is a curriculum-based study, designed to measure how well students have learned the mathematics and science knowledge and skills they are taught in school. The TIMSS assessment frameworks, which specify the content for the mathematics and science assessments, are developed and updated each cycle based on the topics that participating countries report to be included in their own national mathematics and science curricula.^{a,1,2} The frameworks are the basis for developing assessment items, ensuring that the instruments broadly reflect participating countries' curricula and adequately represent the knowledge and skills that students should demonstrate in mathematics and science at the fourth and eighth grades. In turn, this helps ensure that international comparisons of student achievement are made on as fair a basis as possible.

Countries regularly update their mathematics and science curricula as national expectations for student learning change over time.^{3,4,5} For example, 23 of the 47 education systems that participated in TIMSS 2023 at the eighth grade were in the process of revising both their mathematics and science curricula when reporting for the [TIMSS 2023 Encyclopedia](#). Curricular changes must be implemented effectively in classrooms to have the desired effects. However, some research has found that a significant portion of intended curriculum content often goes unimplemented.^{6,7} Conceptually complex or abstract topics, along with reasoning tasks,

^a Many countries participating in TIMSS 2023 report having mathematics and science curricula specified at the national level, while others may have curricula specified at a state or provincial level. See the [TIMSS 2023 Encyclopedia](#) for additional information.

technology-integrated components, experimental or hands-on activities, end-of-year content, and material not aligned with high-stakes assessments, are least likely to be implemented.^{8,9,10}

This TIMSS Insights report uses TIMSS 2023 data to investigate the extent to which countries' curricular expectations are implemented in classrooms, and whether varied emphasis on instruction topics relates to students' achievement in relevant content areas. Focusing on eighth-grade mathematics and science, it applies the TIMSS Curriculum Model¹¹ to data from the TIMSS 2023 Curriculum and Teacher Questionnaires to investigate the relationship between reports on intended and implemented curriculum content and student achievement outcomes. The report begins by briefly explaining the theoretical foundation and components of the TIMSS Curriculum Model, as well as the sources of curriculum-related data in TIMSS 2023. It then presents an overview of TIMSS assessment topics included in each participating country's curricula for mathematics and science as reported by country representatives in the TIMSS 2023 Curriculum Questionnaire. This is followed by an examination of the alignment between country-level and teacher-level reports of what TIMSS mathematics and science topics have been taught to students (from the TIMSS 2023 Teacher Questionnaires). Finally, seeking insight into whether students' achievement aligns with curricular expectations and reported practices, these reports are correlated with eighth-grade student achievement in each of the mathematics and science content domains. The report concludes by summarizing key takeaways and offering suggestions for future research on curriculum analysis using TIMSS data.

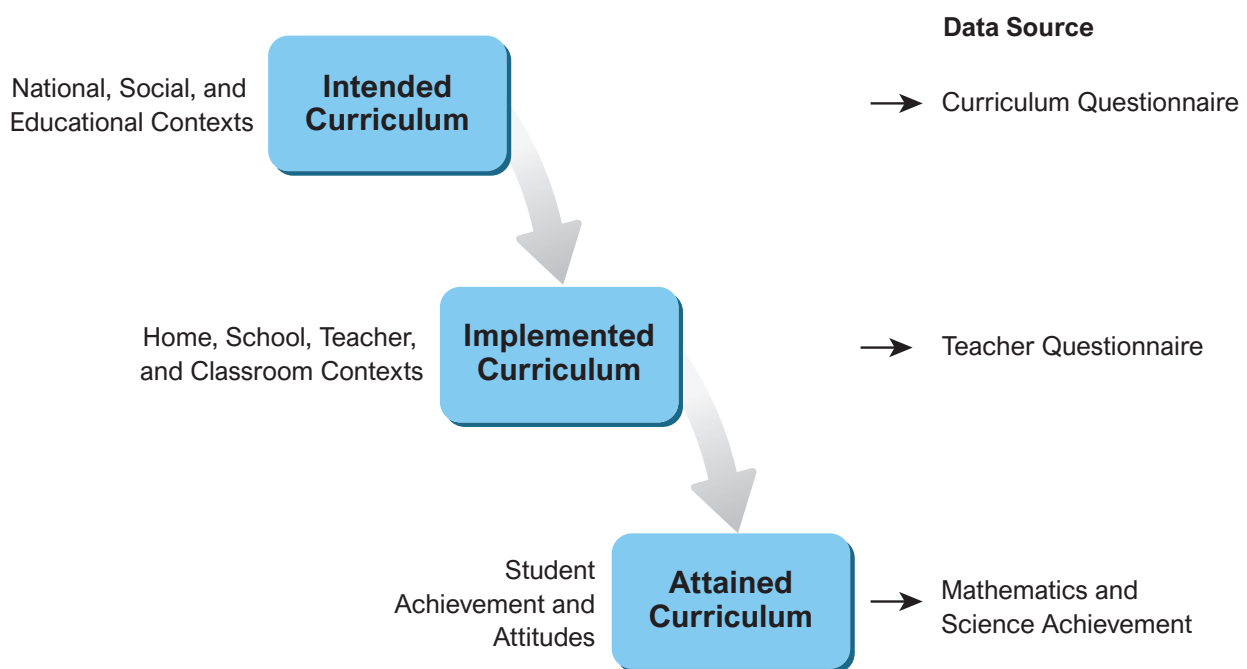
Background

The TIMSS Curriculum Model

Curriculum has long been considered a multifaceted concept, encompassing not only the content students should learn, but also how such learning should be organized and sequenced, including specification of key learning experiences.¹² The TIMSS Curriculum Model, articulated in the Second International Mathematics Study (SIMS),¹³ aims to reflect this complexity, defining three levels of curriculum: intended, implemented, and attained. At the highest level is the *intended curriculum*, which is based on formal, officially sanctioned educational goals and standards established by national or regional authorities. As noted above, these can contain specific content and skills policymakers expect students to master by a given grade level, as well as information about how learning experiences related to these should be organized.^b The next level, the *implemented curriculum*, refers to the actual instructional practices and learning experiences that occur within the classroom. This encompasses teachers' professional interpretation of stated learning goals, their selection of specific content matter and instructional materials, and the teaching strategies applied during instruction.¹⁴ Finally, the *attained curriculum* represents the demonstrable knowledge, skills, and competencies that students have acquired. This outcome is typically measured by student performance on various types of assessments and can be considered a measure of the effectiveness of both the intended and implemented curricula. Exhibit 1 provides a visual representation of the TIMSS Curriculum Model, along with the data sources for information regarding each level that are used in this report.

^b It is important to note that there is variation among countries in the format and specificity of curricular documents. See the [TIMSS 2023 Encyclopedia](#) for more information.

Exhibit 1: The TIMSS Curriculum Model



Curriculum Alignment

Opportunity to Learn (OTL) is one theoretical framework that can be used to examine relationships among the intended curriculum, the implemented curriculum, and student achievement.^{15,16,17,18} There is no single definition of OTL, and it is sometimes considered to be quite expansive, encompassing factors such as content coverage/or exposure, instructional quality, time on task, teacher quality, and resources.

An important aspect of OTL is content coverage across different levels of the curriculum. Researchers often operationalize content coverage for policy purposes through the concept of *alignment*.^{19,20,21} Alignment refers to the degree of coherence among the curriculum, instructional practices, and assessment processes—specifically, how accurately instructional and assessment materials reflect curricular objectives and how faithfully teachers implement those objectives in practice.^{22,23} Alignment studies offer a means to examine the coherence among curriculum, instruction, and assessment, helping to determine whether these components work together to support the intended learning outcomes.^{24,25} As such, alignment studies can be useful for informing investigations of curriculum levels in the TIMSS Curriculum Model.

Disparities between the intended and implemented curricula (i.e., a lack of alignment), stemming from the complex interaction between more centrally defined policy directives and their enactment in local contexts, can be an issue in countries' education systems. Even when a common curricular framework is established at the national level, its interpretation and adaptation at regional, school, or classroom levels can generate substantial variation in what students experience. As a result, the enacted curriculum often diverges from the original design and exhibits greater heterogeneity than envisioned. Teachers play a central role in this process, as their instructional decisions and classroom practices shape how the curriculum is realized in practice.²⁶

Reasons for lack of alignment between the intended and implemented curriculum may vary across contexts, and may not always be undesirable.²⁷ For example, education systems in some countries are characterized by decentralization or greater autonomy for teachers, which may lead to greater variation in curriculum implementation.²⁸ However, various systemic constraints within schools, such as inadequate resources, overcrowded classrooms, and the pressures associated with centralized examinations, may impede the translation of curricular intentions into classroom practice.²⁹ In addition, challenges encountered during curriculum implementation in educational settings, such as developing teachers' pedagogical skills and inadequate professional development opportunities, can substantially hinder the effective delivery of instructional content.

Information about Curriculum in TIMSS 2023

The TIMSS 2023 mathematics and science assessment frameworks are organized into two complementary dimensions: content domains and cognitive domains.³⁰ The **content domains** specify the subject matter to be assessed. In eighth-grade mathematics, the content domains are: Number, Algebra, Geometry and Measurement, and Data and Probability. For eighth-grade science, the content domains are: Biology, Chemistry, Physics, and Earth Science. Each content domain is further divided into topics and topic areas that describe the specific knowledge and skills assessed. The **cognitive domains**—Knowing, Applying, and Reasoning—specify the thinking processes to be evaluated, ranging from knowing basic facts and procedures to applying concepts in new situations and reasoning through complex, multi-step problems. Together, these domains ensure that the assessment reflects the breadth and depth of what students typically are expected to learn by the end of lower secondary education and provide a comprehensive structure for assessment item development.

As a curriculum-based study, TIMSS makes extensive use of information about participating countries' mathematics and science curricula in the development of assessment frameworks^{31,32} and, subsequently, in the development of the mathematics and science assessments. National Research Coordinators (NRCs), responsible for implementing TIMSS in participating countries, provide input on the coverage of mathematics and science topics in the assessment frameworks and are invited to suggest revisions during each assessment cycle. However, it should be noted that the frameworks do not comprehensively reflect all countries' mathematics and science curricula. Following the framework and assessment development process, TIMSS also collects information about how the mathematics and science framework topics are addressed within each country's curriculum through two sources: 1) the Curriculum Questionnaire, and 2) the Test-Curriculum Matching Analysis (TCMA).^c

The Curriculum Questionnaire, completed by NRCs in consultation with national curriculum specialists, represents the *intended curriculum* in this study. As part of this questionnaire, NRCs indicate whether students should have been taught each of the mathematics and science topics specified in the [TIMSS 2023 Assessment Frameworks](#) by the end of eighth grade, according to the official mathematics and science curriculum. It should be noted that, because some content areas covered by curricula in some countries are not covered by the TIMSS assessments, the data may not provide complete information about the content of these countries' curricula or how

^c The TIMSS Test-Curriculum Matching Analysis re-estimates student achievement based on NRCs' identification of assessment items with reflecting content explicitly included in the national curriculum. Typically, differences between these estimates and the achievement estimates based upon all items are small and uniform across countries. These data are available through the [TIMSS 2023 International Database](#). Results are summarized in [Appendix D](#) of *TIMSS 2023 International Results in Mathematics and Science*.

well these contents are covered in TIMSS. It is also important to note that curricula vary in scope, structure, and specificity across countries. While many countries participating in TIMSS 2023 have national curricula for mathematics and science, others have differing curricula across states or provinces. Further details are available in the country chapters of the [TIMSS 2023 Encyclopedia](#).

The subject-specific TIMSS Teacher Questionnaires are completed by the mathematics and science teachers of students sampled to participate in TIMSS.^d Teachers are asked to indicate whether specific topics, concepts, or skills in the TIMSS assessment frameworks have been covered in their own instruction to the sampled students, have been taught to the students in previous years of schooling, or have not yet been taught. This information serves to assess the *implemented curriculum*. It is important to note that teachers do not necessarily report topics they themselves have taught when responding to these items; if a teacher reports a topic was taught “mostly before this year,” it may have been taught by a different teacher. Consequently, teacher responses should be interpreted as indicators of topics that *have been taught to students in that school*, not necessarily of topics that *they themselves have taught to the students in that school year*.

Student achievement in mathematics and science can be considered representative of the *attained curriculum*. In TIMSS, student achievement is reported in the form of plausible values for mathematics and science overall, as well as for the individual content and cognitive domains within each subject.

Alignment Between the Intended, Implemented, and Attained Curricula in TIMSS 2023

This section and its subsections present the results of the curriculum alignment analysis for countries participating in TIMSS 2023 at eighth grade.^e Results for mathematics are presented first, followed by science. Findings are further organized by content domain within each subject, following the [TIMSS 2023 Assessment Frameworks](#). Brief overviews of the content domains and their associated Curriculum and Teacher Questionnaire items appear at the start of each section.

Each set of results begins with an overview of countries’ coverage of the TIMSS framework topics in their intended curricula, as represented by NRCs’ responses to the relevant items in the Curriculum Questionnaire. These overviews are presented graphically, showing NRCs’ responses across the Curriculum Questionnaire items within a particular content domain. Although beyond the scope of this report, information to contextualize these responses can be found in additional Curriculum Questionnaire comments and in the country chapters of the [TIMSS 2023 Encyclopedia](#). Given the variation in organization of curriculum across countries, readers are encouraged to consult these comments for any countries of interest.

The results then present a visual representation of the alignment between the intended and implemented curricula, using data from both the Curriculum and Teacher Questionnaires reporting on topics covered in the TIMSS assessments. A preliminary step in these analyses was to evaluate the correspondence between the items in these questionnaires and the assessment frameworks. Although the items are not identical across the two questionnaires, both sets of items reflect the content of the TIMSS 2023 Mathematics and Science Frameworks and were considered

^d Because of this, teachers who complete the TIMSS Teacher Questionnaire are not a nationally representative sample of teachers.

^e Not all participating countries are included in every set of results. For more information about country exclusions see [Appendix E: Technical Details](#).

sufficiently similar for comparison in assessing topic coverage. The results of this process are presented in [Appendix B: Curriculum and Teacher Questionnaire Framework Mapping](#). Data from both the Curriculum and Teacher Questionnaires were recoded for this analysis, and teachers' questionnaire responses are summarized at the student level.^f Readers are encouraged to review [Appendix E: Technical Details](#) for more information about data preparation and analysis.

After presenting the results of the intended and implemented curriculum for each content domain, the relationship between the implemented and attained curricula is examined for all domains. For each country, Pearson's correlation coefficients were calculated between the average percentage of topics taught to students as reported by teachers and student achievement within each content domain. Student achievement is represented by content-domain subscale scores in mathematics and science. Countries' average student achievement in each content domain is provided in [Appendix D](#) to further contextualize these results.

Eighth-Grade Mathematics

As noted above, the [TIMSS 2023 Mathematics Framework](#) specifies four content domains at the eighth grade: Number, Algebra, Geometry and Measurement, and Data and Probability. Exhibit 2.1 presents an overview of the eighth-grade mathematics content domains, topic areas, and their representation in the Curriculum and Mathematics Teacher Questionnaires. It is important to note that the number of items in the Curriculum Questionnaire and Teacher Questionnaire does not always directly correspond to the number of topics in the framework (See [Appendix B](#)).

Exhibit 2.1: Overview of Eighth-Grade Mathematics Content Domains

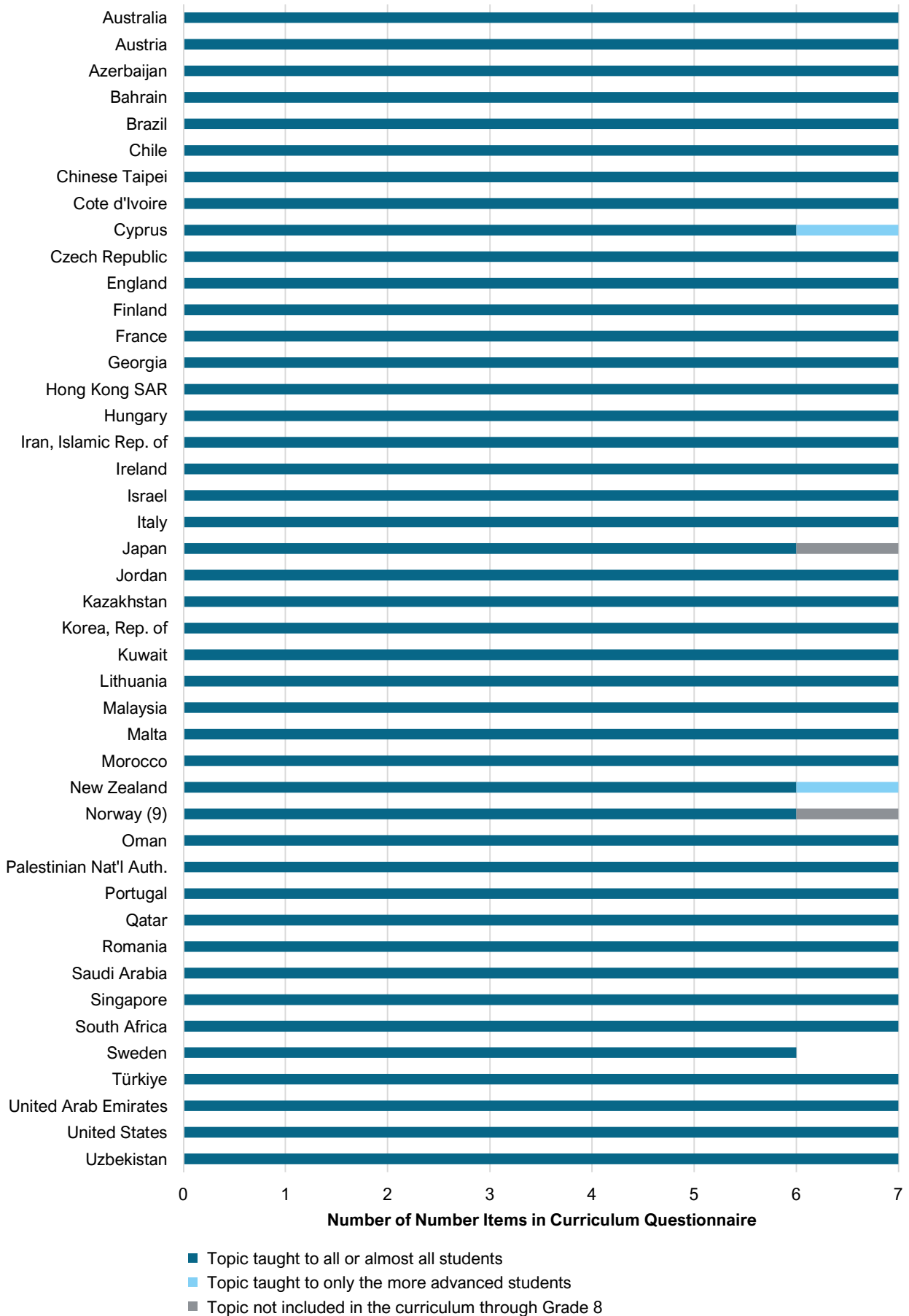
Content Domains (Target Assessment Percentages)	Topic Areas	Number of Curriculum Questionnaire Items	Number of Teacher Questionnaire Items
Number (30%)	<ul style="list-style-type: none"> Integers Fractions and decimals Proportions, ratios, and percentages 	7	7
Algebra (30%)	<ul style="list-style-type: none"> Expressions, operations, and equations Relationships and functions 	6	8
Geometry and Measurement (20%)	<ul style="list-style-type: none"> Geometry and measurement 	5	6
Data and Probability (20%)	<ul style="list-style-type: none"> Data Probability 	5	4

^f This means that these responses should be interpreted as the average percent of topics taught to students according to their teachers—not directly as a percentage of teachers or a percentage of topics.

Number Domain Topics

Exhibit 2.2 shows the coverage of TIMSS Number topics in countries' intended mathematics curricula, as reported by NRCs. The Curriculum Questionnaire asked NRCs to indicate the proportion of eighth-grade students expected to be taught each topic or skill: "all or almost all students," "only the more advanced students," or "not included in the curriculum through Grade 8." In most countries, NRCs reported that all seven Number topics listed in the questionnaire were expected to be taught to all or almost all students by the end of eighth grade. Only Cyprus and New Zealand designated any topics in the Number content domain as taught only to more advanced students, and only Japan and Norway indicated that one topic in the Number content domain was not included in the curriculum through eighth grade.

Exhibit 2.2: Intended Curriculum Coverage of Number Topics



Note: Sweden had valid responses for only 6 items.

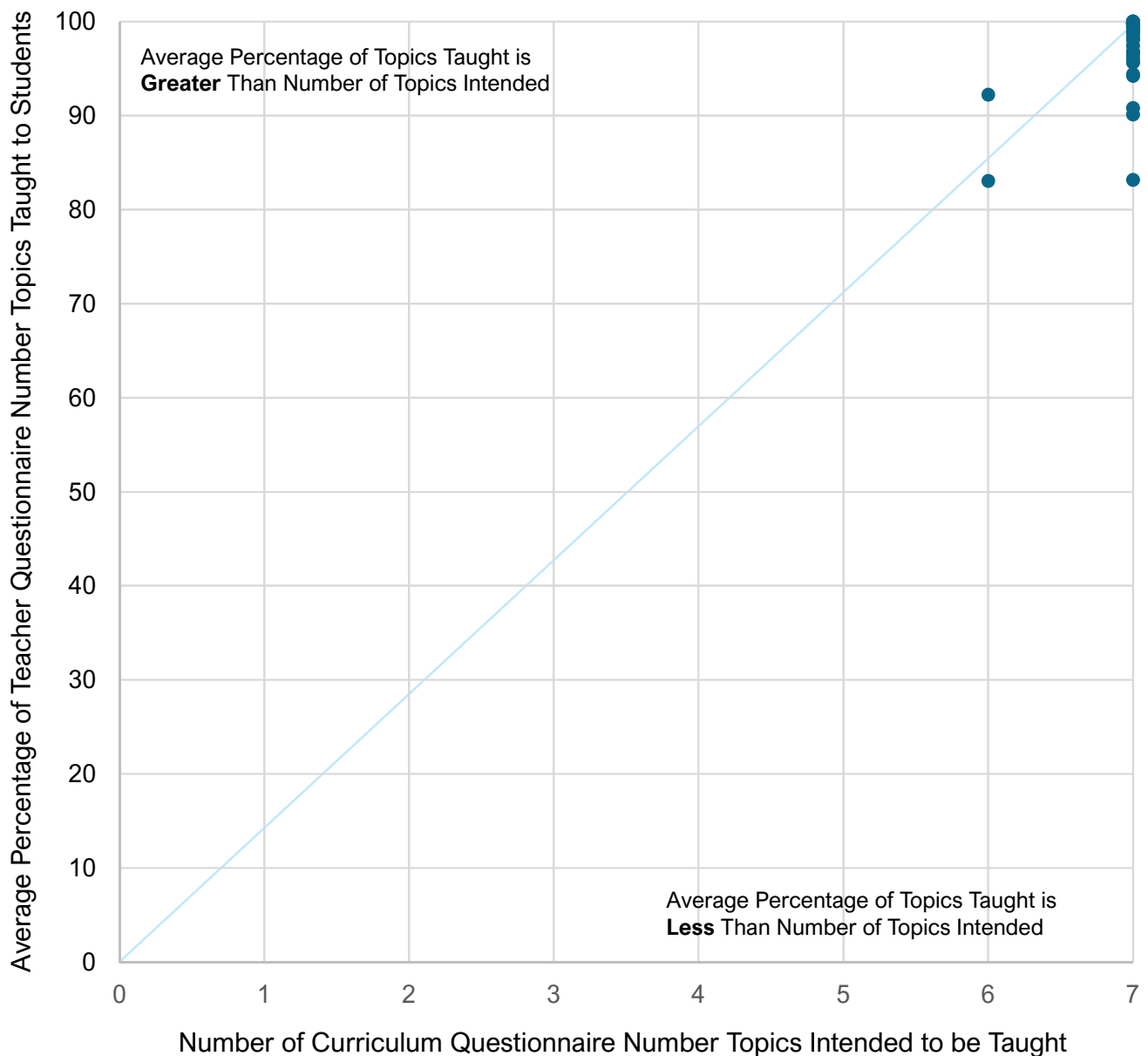
Exhibit 2.3 shows the relationship between NRC and teacher reports of curriculum coverage. NRC responses to the Curriculum Questionnaire are represented on the x-axis, which shows the total number of Curriculum Questionnaire topic items within the Number domain. Teacher responses are shown on the y-axis, represented as the average percentage of topics reported as taught to students within the Number domain.⁹ Each point in the scatterplot represents a country. Countries are not labeled within these scatterplots to facilitate observation of overall patterns; however, the underlying data are available in [Appendix C: Scatterplot Data Tables](#). In the scatterplot, points below the diagonal can be interpreted as having relatively broad intended curricula covering many topics, while teachers reported covering a somewhat smaller range of topics in practice. Countries above the diagonal are systems in which teachers report covering a slightly broader or different set of topics than those emphasized in the intended curriculum.

Overall, the scatter plot suggests a high degree of alignment between the intended and implemented curricula in the Number content domain. Most data points appear in the upper-right corner of Exhibit 2.3 because of the high coverage of Number topics in both intended and implemented curricula across countries. In most participating education systems, all topics within the Number content domain were reported as covered in the intended curriculum, and many were also reported as covered in the implemented curriculum. On average, students had been taught a set of Number topics broadly consistent with the intended curriculum, according to their teachers' reports.

As will be seen in subsequent sections, this very high degree of topic coverage (and subsequent concentration of points in the upper-right corner of the scatterplot) within both the intended and implemented curricula across all countries is unique to the Number content domain; more variation is apparent in the other mathematics content domains and in the science content domains. This may be related to the foundational nature of topics in the Number domain; mastery of these topics is often a prerequisite for engagement with more advanced mathematics content.

⁹ See [Appendix E: Technical Details](#) for further information about this calculation.

Exhibit 2.3: Intended vs. Implemented Curriculum Coverage of Number Topics



Algebra Domain Topics

Exhibit 2.4 indicates that the curricula of most countries include all six Algebra topics covered in the Curriculum Questionnaire items, showing substantial alignment with the algebra content assessed in the TIMSS framework. Japan stands out for reporting only half of these topics as part of its curriculum. A further three countries (Côte d'Ivoire, Oman, Palestinian National Authority) reported that one-third of the Algebra topics were absent from their curricula. Aside from a small group of countries—Cyprus, Iran, Malta, New Zealand, and Singapore—the practice of designating Algebra topics solely for advanced students appears uncommon.

Exhibit 2.4: Intended Curriculum Coverage of Algebra Topics

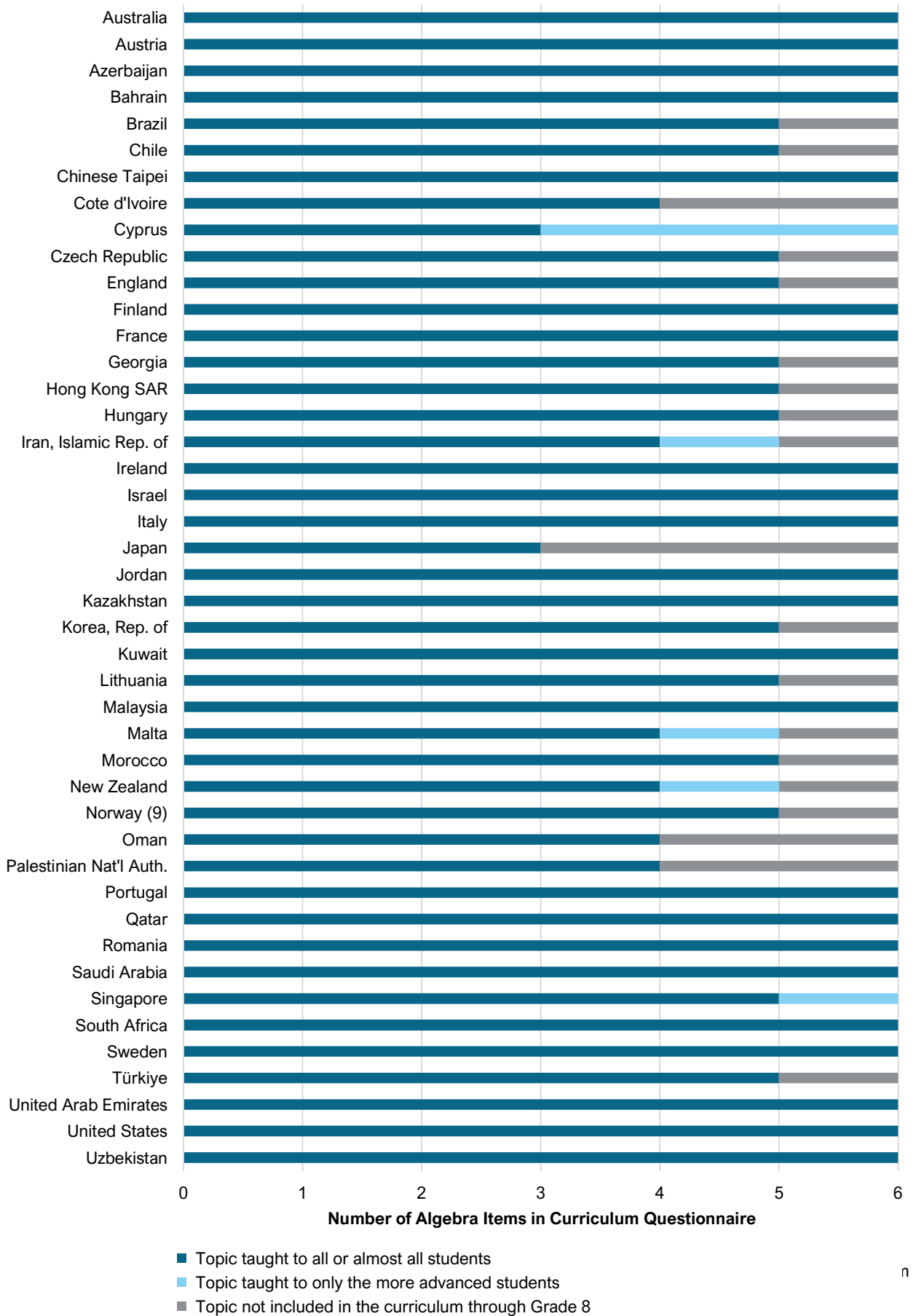
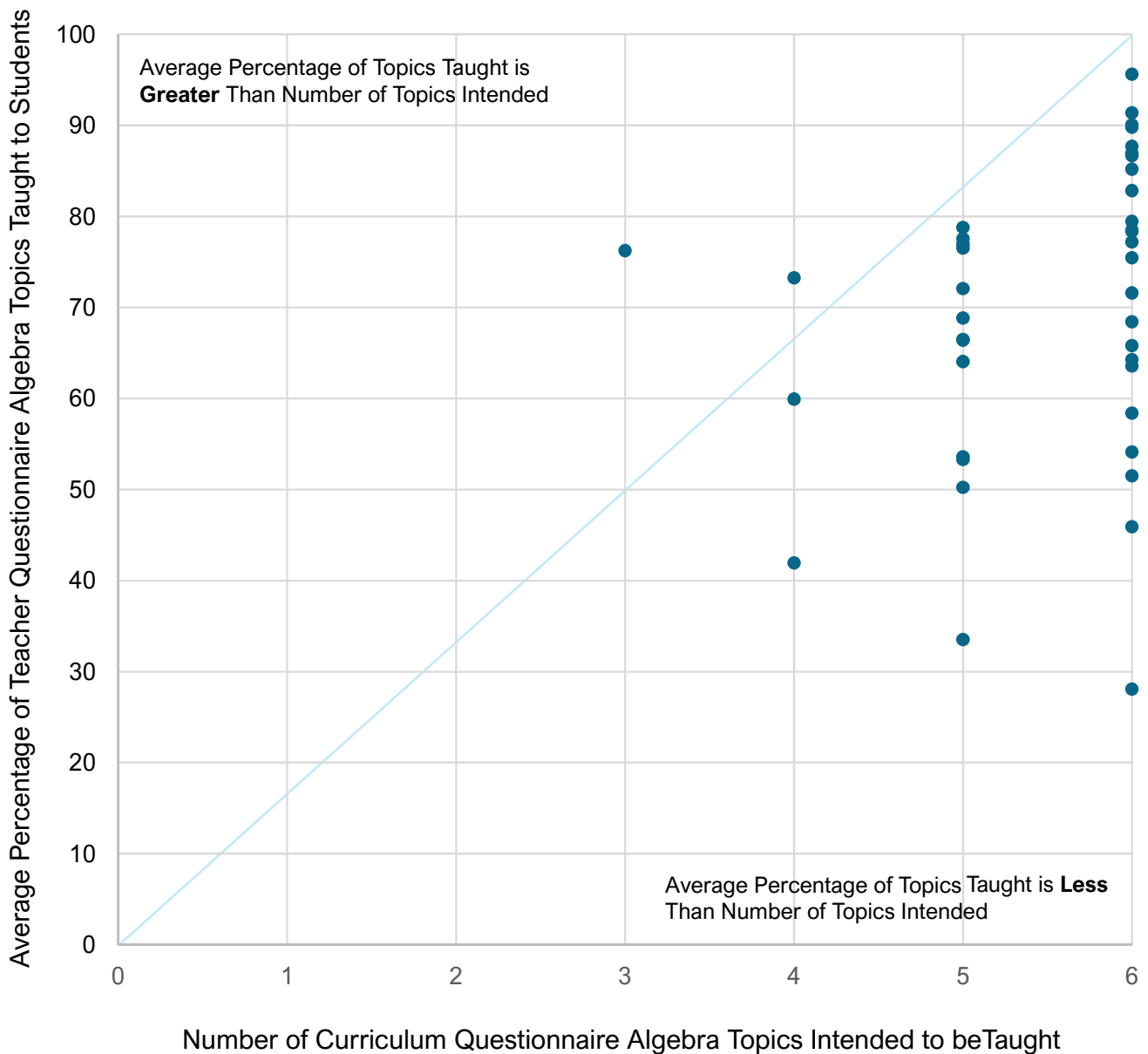


Exhibit 2.5 illustrates how the coverage of Algebra topics varies across countries, reflecting the information provided by NRCs and teachers. The scatter plot for Algebra topics shows some heterogeneity across countries in alignment between the intended and implemented curricula. Points located along the diagonal reference line indicate strong correspondence between NRCs' and teachers' reports. In contrast, departures from the diagonal reflect differences in reporting across respondent groups. Notably, many points lie below the diagonal, indicating cases where countries' intended curricula appear to have specified greater topic coverage than teachers reported their students were taught. Many points represent countries in which all Algebra topics were reported as included in the intended curriculum (along the rightmost vertical line in the exhibit), but not necessarily in the implemented curriculum. Conversely, the two points positioned above the diagonal indicate that in two countries, the curriculum prescribed a narrower set of Algebra topics, whereas teachers reported that a broader range of content had been taught to students.

Exhibit 2.5: Intended vs. Implemented Curriculum Coverage of Algebra Topics



Geometry and Measurement Domain Topics

Exhibit 2.6 shows that the intended curricula of most participating education systems covered the Geometry and Measurement topics in the Curriculum Questionnaire. The curricula of 25 countries encompassed all topics within the Geometry and Measurement domain. However, Côte d'Ivoire's curriculum included only two of the five topics. Cyprus included two topics in its curriculum and designated one additional topic for more advanced students. Seventeen other countries indicated that one or two topics were only taught to more advanced students or were not included at all.

Exhibit 2.6: Intended Curriculum Coverage of Geometry and Measurement Topics

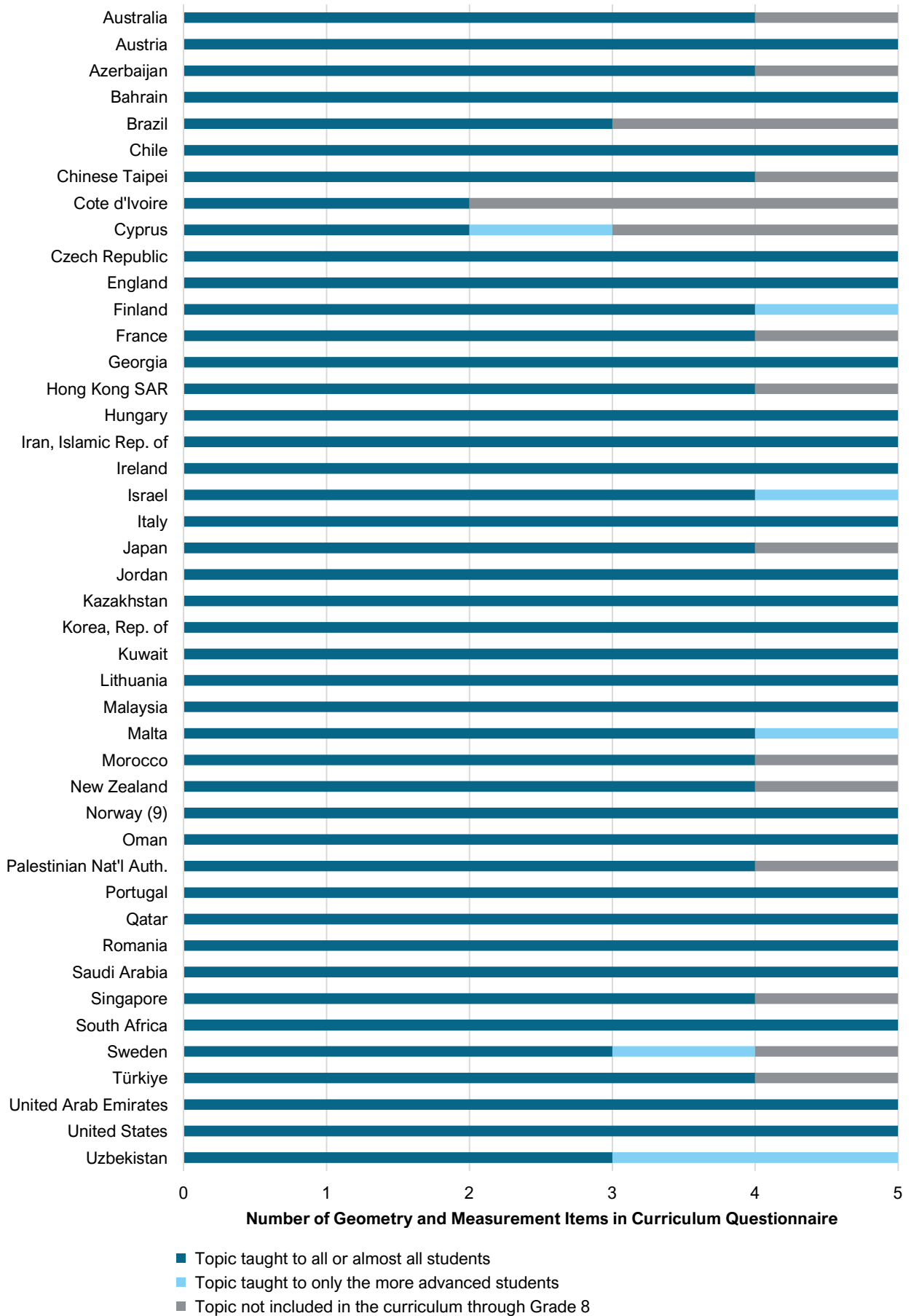
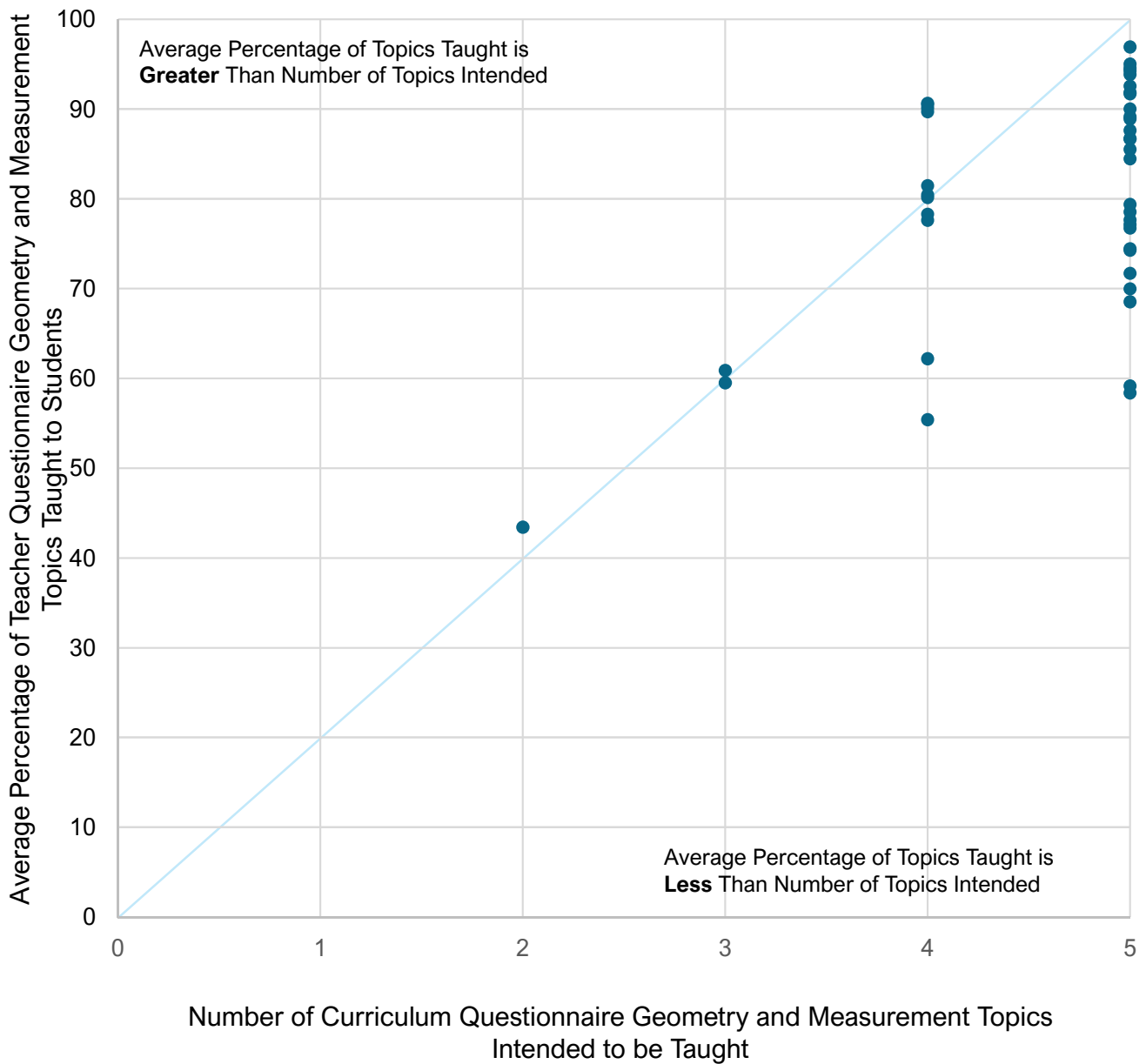


Exhibit 2.7 compares reports on the intended and implemented curricula in Geometry and Measurement across education systems. Several points near the diagonal represent countries with close alignment between NRCs’ and teachers’ reports, suggesting that the discrepancy between the intended and implemented curricula is relatively small. However, other countries show larger differences. Many countries reported including all Geometry and Measurement topics in their intended curricula (points along the rightmost line of the exhibit), but the distribution of points along this vertical line shows variation in the extent to which students’ teachers reported that they were taught these topics. Teachers’ reports often indicated that Geometry and Measurement topics were covered less extensively in practice than in the intended curriculum.

Exhibit 2.7: Intended vs. Implemented Curriculum Coverage of Geometry and Measurement Topics



Data and Probability Domain Topics

Exhibit 2.8 shows that the Data and Probability domain exhibits the greatest variation in coverage among the mathematics content areas. While 18 countries include all Data and Probability topics in the Curriculum Questionnaire in their national curricula for all students, the curricula of Côte d'Ivoire and South Africa omit these topics entirely. Uzbekistan, by contrast, assigns four of the five Data and Probability topics exclusively to more advanced students.

Exhibit 2.8: Intended Curriculum Coverage of Data and Probability Topics

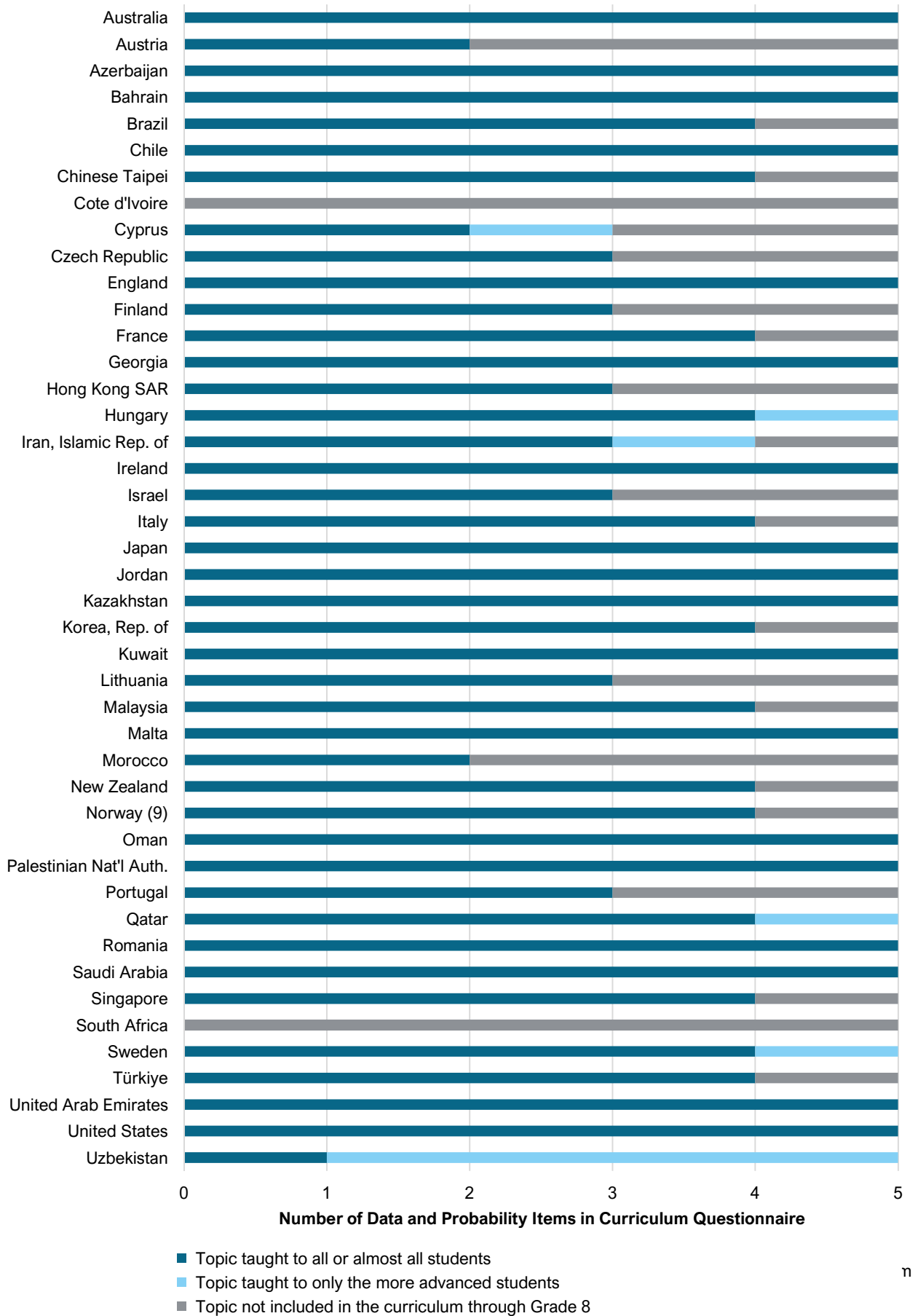
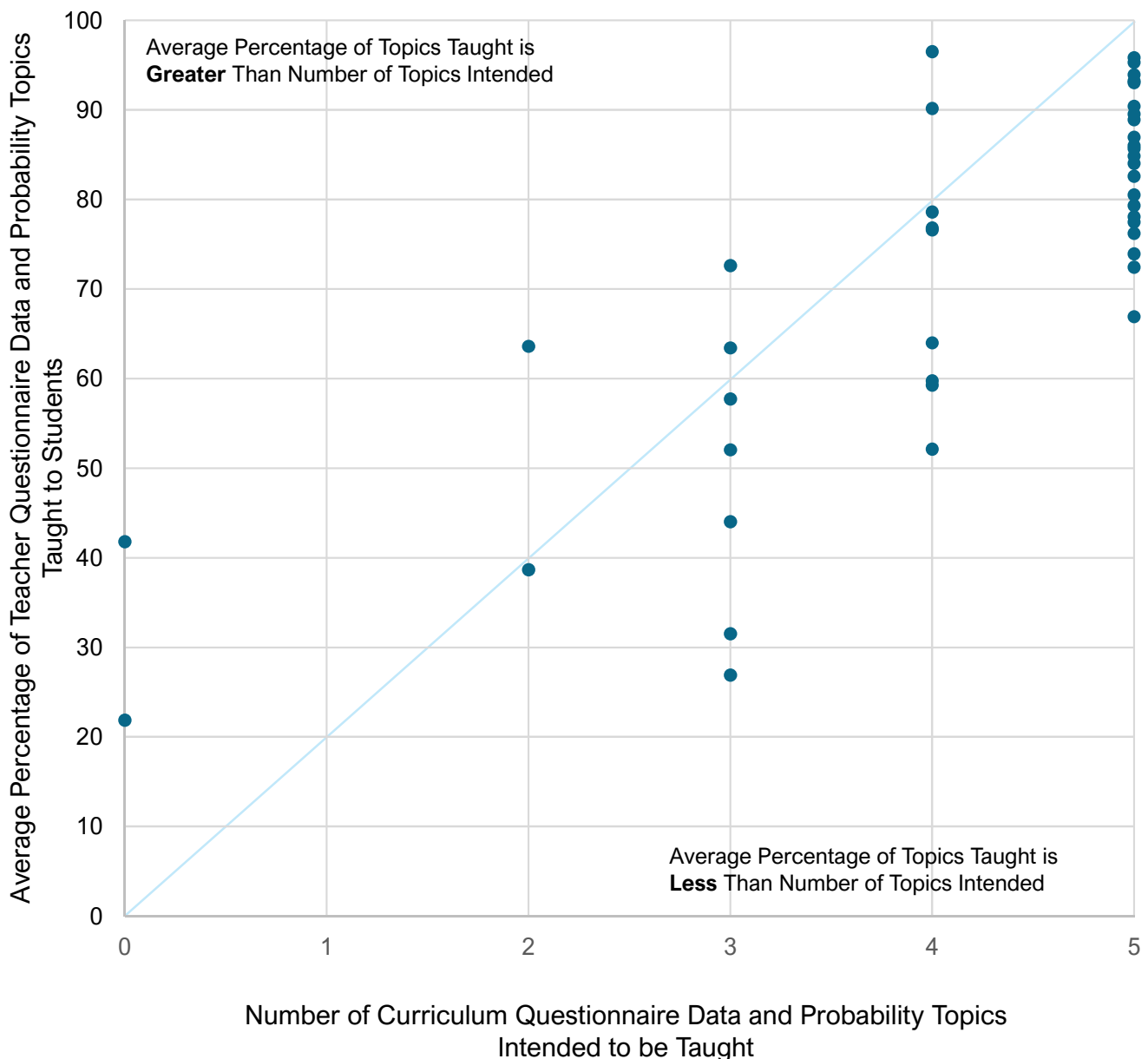


Exhibit 2.9 presents the number of Data and Probability topics included in national curricula, along with the average percentage of these topics taught to students as reported by teachers. It is important to note that the number of items related to the Data and Probability content domain in the Mathematics Teacher Questionnaire was relatively small compared with other content domains (see Exhibit 2.1).

Overall, the exhibit highlights that translating formal curricular expectations into classroom practice is varied in this domain. Points positioned below the diagonal represent countries where NRCs indicated that their curricula call for broader coverage of the TIMSS topics than teachers reported teaching on average to their students, suggesting potential implementation gaps. As in the Algebra and the Geometry and Measurement content domains, these types of observations are relatively common. A smaller set of points appears above the diagonal; teachers in these countries reported that students had been taught Data and Probability topics at levels exceeding those specified in the national curricula. In such cases, teachers may supplement the curriculum or interpret its expectations more broadly.

Exhibit 2.9: Intended vs. Implemented Curriculum Coverage of Data and Probability Topics



Relationship Between Implemented and Attained Curricula in Eighth-Grade Mathematics

This section examines the relationship between the implemented and attained curriculum for the four mathematics content domains. The average percentage of topics taught to students in each content domain, as reported by teachers, reflects the implemented curriculum, whereas student achievement in the mathematics content domains reflects the attained curriculum. The correlation between these measures is presented in Exhibit 2.10 for each mathematics content domain. To distinguish larger correlation coefficients, those with absolute values exceeding ± 2 standard deviations from the mean of the correlation coefficient distribution across countries are highlighted and shown in **bold** for each content domain.

Exhibit 2.10: Mathematics Teachers' Reports of Percentages of Topics Taught to Students and Relationship With Achievement by Content Domain

	Number		Algebra		Geometry and Measurement		Data and Probability	
	Average Percentage of Topics Taught	Correlation with Average Achievement	Average Percentage of Topics Taught	Correlation with Average Achievement	Average Percentage of Topics Taught	Correlation with Average Achievement	Average Percentage of Topics Taught	Correlation with Average Achievement
Australia	r 97 (0.8)	0.11 (0.04)	r 58 (1.9)	0.15 (0.06)	r 81 (1.5)	0.12 (0.06)	r 90 (1.4)	0.02 (0.04)
Austria	98~	~	68 (1.8)	0.00 (0.04)	93 (0.9)	0.04 (0.06)	64 (2.2)	-0.02 (0.04)
Azerbaijan	100~	~	90 (0.8)	0.02 (0.04)	91 (0.8)	0.03 (0.04)	94 (0.9)	0.00 (0.03)
Bahrain	100~	~	83 (1.3)	-0.17 (0.04)	95 (0.6)	-0.15 (0.04)	89 (1.5)	-0.07 (0.03)
Ψ Brazil	94 (0.5)	--	53 (1.6)	--	61 (1.4)	--	52 (2.0)	--
Chile	96 (1.0)	0.10 (0.04)	66 (2.1)	0.01 (0.04)	78 (2.2)	0.01 (0.04)	74 (2.8)	0.07 (0.05)
Chinese Taipei	99~	~	88 (0.7)	0.04 (0.04)	80 (1.1)	-0.04 (0.04)	64 (1.8)	0.00 (0.03)
* Cote d'Ivoire	83 (1.1)	--	42 (1.7)	--	43 (1.6)	--	22 (1.9)	--
Cyprus	97 (0.4)	0.06 (0.02)	64 (1.2)	0.00 (0.06)	60 (1.4)	0.22 (0.06)	63 (2.1)	0.02 (0.04)
Czech Republic	100~	~	33 (1.1)	0.15 (0.03)	84 (1.0)	-0.05 (0.03)	27 (1.8)	0.07 (0.04)
England	s 98~	~	s 72 (1.8)	0.06 (0.07)	s 74 (2.3)	0.05 (0.07)	s 83 (2.8)	0.01 (0.06)
Finland	97 (0.5)	0.10 (0.03)	52 (0.9)	0.02 (0.04)	69 (1.3)	0.00 (0.03)	32 (3.0)	-0.01 (0.03)
France	91 (0.9)	0.19 (0.06)	28 (1.5)	0.08 (0.04)	80 (1.4)	0.13 (0.04)	59 (2.6)	0.08 (0.04)
Georgia	100~	~	77 (1.0)	-0.06 (0.04)	77 (1.2)	0.00 (0.04)	78 (1.9)	-0.01 (0.04)
Hong Kong SAR	r 100~	~	r 66 (1.8)	-0.07 (0.07)	r 91 (1.0)	-0.01 (0.07)	r 52 (1.7)	0.13 (0.06)
Hungary	100~	~	77 (0.9)	0.00 (0.05)	95 (0.7)	-0.08 (0.04)	85 (1.7)	-0.12 (0.04)
Ψ Iran, Islamic Rep. of	98~	~	54 (1.9)	0.03 (0.04)	92 (0.9)	-0.05 (0.03)	79 (2.1)	0.02 (0.04)
Ireland	97 (0.7)	0.00 (0.06)	72 (1.3)	0.18 (0.03)	59 (2.1)	0.08 (0.05)	76 (1.9)	-0.02 (0.04)
Israel	90 (0.8)	0.10 (0.04)	78 (0.8)	0.18 (0.05)	79 (1.0)	0.09 (0.05)	44 (2.6)	0.03 (0.05)
Italy	99~	~	46 (1.4)	0.04 (0.04)	88 (1.1)	0.02 (0.04)	77 (2.3)	0.04 (0.04)
Japan	92 (0.9)	0.05 (0.03)	76 (1.2)	0.09 (0.04)	78 (1.2)	0.05 (0.03)	93 (1.7)	-0.01 (0.04)
Jordan	99~	~	87 (1.1)	-0.09 (0.05)	97 (0.7)	0.01 (0.04)	86 (2.1)	0.04 (0.04)
Kazakhstan	100~	~	96 (0.7)	0.02 (0.06)	72 (1.4)	-0.01 (0.04)	79 (1.7)	0.01 (0.04)
Korea, Republic of	94 (1.0)	0.01 (0.04)	79 (0.7)	0.04 (0.04)	89 (1.0)	0.00 (0.04)	77 (1.2)	0.00 (0.03)
Ψ Kuwait	100~	~	66 (2.0)	0.09 (0.06)	94 (0.9)	-0.19 (0.05)	95 (1.2)	-0.14 (0.05)
Lithuania	100~	~	69 (0.8)	0.08 (0.04)	70 (1.1)	0.02 (0.03)	73 (1.3)	0.03 (0.05)
Malaysia	100~	~	85 (1.2)	0.01 (0.05)	79 (1.7)	0.02 (0.04)	60 (2.5)	-0.05 (0.04)
Malta	r 96 (0.1)	0.37 (0.01)	r 64 (0.1)	0.24 (0.01)	r 58 (0.1)	0.26 (0.01)	r 72 (0.1)	0.23 (0.01)
Morocco	96 (0.6)	0.00 (0.04)	50 (1.4)	0.04 (0.04)	62 (1.5)	0.07 (0.05)	39 (2.4)	0.03 (0.05)
Oman	99~	~	73 (0.9)	-0.03 (0.04)	87 (1.1)	-0.01 (0.03)	90 (1.4)	0.02 (0.03)
Ψ Palestinian Nat'l Auth.	100~	--	60 (1.4)	--	90 (1.0)	--	86 (1.7)	--
Portugal	100~	~	64 (1.1)	0.03 (0.03)	92 (0.9)	0.01 (0.05)	58 (2.1)	0.04 (0.04)
Qatar	100~	~	75 (1.6)	-0.14 (0.05)	86 (1.7)	-0.04 (0.05)	80 (2.3)	0.02 (0.05)
Romania	r 100~	--	r 91 (1.0)	-0.07 (0.06)	r 94 (0.9)	-0.05 (0.05)	r 96 (1.2)	-0.04 (0.04)
Saudi Arabia	99~	~	78 (1.5)	0.01 (0.05)	89 (1.0)	0.00 (0.04)	93 (1.1)	-0.18 (0.03)
Singapore	100~	--	90 (1.0)	0.57 (0.04)	90 (0.7)	0.14 (0.06)	90 (1.3)	-0.02 (0.06)
Ψ South Africa	r 99~	~	r 77 (1.7)	-0.01 (0.06)	r 77 (1.6)	0.04 (0.04)	r 42 (3.5)	0.04 (0.04)
Sweden	83 (1.0)	0.03 (0.03)	54 (1.4)	0.05 (0.03)	55 (1.5)	0.03 (0.03)	67 (2.8)	0.02 (0.03)
Türkiye	100~	--	78 (1.6)	0.08 (0.05)	78 (1.9)	0.06 (0.05)	96 (0.8)	0.04 (0.05)
United Arab Emirates	99~	~	79 (0.9)	-0.13 (0.03)	90 (0.7)	-0.07 (0.03)	87 (0.8)	0.07 (0.02)
United States	99~	~	87 (0.9)	0.23 (0.04)	87 (1.5)	0.06 (0.05)	84 (1.8)	0.07 (0.04)
Uzbekistan	100~	~	87 (1.2)	-0.07 (0.05)	74 (1.6)	-0.08 (0.05)	77 (1.9)	0.00 (0.05)
International Average	97 (0.1)	0.09 (0.01)	70 (0.2)	0.04 (0.01)	80 (0.2)	0.02 (0.01)	72 (0.3)	0.01 (0.01)
New Zealand	s 92 (1.2)	0.13 (0.04)	s 58 (3.0)	0.17 (0.07)	s 66 (2.4)	0.06 (0.08)	s 62 (4.4)	0.02 (0.07)
Norway (9)	--	--	--	--	--	--	--	--

Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

A dash (-) indicates comparable data not available. A tilde (~) indicates result not reported because estimation is not reliable.

Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.

* Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

New Zealand did not satisfy guidelines for minimum school participation rates. Achievement could not be reliably estimated for Côte d'Ivoire.

An "r" indicates teacher questionnaire data are available for at least 70% but less than 85% of the students.

An "s" indicates teacher questionnaire data are available for at least 50% but less than 70% of the students.

On average across countries, students were taught 97 percent of the Number topics, showing strong alignment between the intended and implemented curricula in this domain of the assessment framework. Teachers' reports indicate that most Number topics were taught to students on average, with many countries having nearly 100 percent implemented coverage of the topics. Compared to the Number content domain, the other three content domains show more variation across countries in the average percentage of topics taught to students. In Algebra, the average percentage of topics reported to be taught ranges from 28 percent in France to 96 percent in Kazakhstan, with an international average of 70 percent that represents the lowest international average among the four mathematics content domains. For Geometry and Measurement, the reported percentages range from 43 percent (Côte d'Ivoire) to 97 percent (Jordan), and the international average is 80 percent. In Data and Probability, these values range from 22 percent in Côte d'Ivoire to 96 percent in Türkiye, with an international average of 72 percent. These figures are based on averages across all students within participating countries. Individual students may have been taught a greater or lesser number of topics within the mathematics content domains.

The country-level correlation coefficients between average number of topics taught to students and their achievement are often low. Some countries show negative estimated correlations, but these are generally small in absolute terms. The correlation coefficient is a standardized measure of the extent to which both variables vary together. When nearly all students have teachers reporting that all topics have been taught, the correlation between the implemented curriculum and student achievement naturally approaches zero because this near uniformity in reported topic coverage leaves little variability to support a meaningful association between the two variables. Therefore, correlations are not reported for any country in which more than 97.5 percent of students are taught the average number of topics. Exhibit 2.10 shows that this issue is particularly prevalent in the Number content domain. In Romania, Singapore, and Türkiye, all students had teachers who reported that all Number topics were taught, so the correlation coefficient cannot be calculated. In 24 additional countries, the average percentage of topics taught to students was so high that the correlation coefficient could not be reliably estimated.^h

Across all four content domains, the correlation coefficients are relatively small. In the Number content domain, the average correlation across countries is 0.09. However, this is based on only 12 countries for which correlation coefficients could be reliably estimated. The relationship between the average percentage of topics taught in the Number content domain and student achievement in the Number topics is relatively high for Malta compared to other countries ($r = 0.37$).

In the Algebra content domain, the average correlation across countries is 0.04, showing that there is not a strong relationship between the implemented and attained curriculum in this content domain, on average. The largest correlation in Exhibit 2.10 is observed for Singapore in the Algebra content domain ($r = 0.57$). On average, students in Singapore were reported to have been taught about 90 percent of the Algebra topics, and no substantive gap was observed between the intended and implemented curricula (see Exhibit 2.5). The observed correlations are much lower in the other content domains for Singapore; further investigation is needed to determine whether this is unique to Algebra or whether the results were influenced by factors such as a small sample size or the presence of an outlier.

^h Romania, Singapore, and Türkiye have dashes (-) in Exhibit 2.10 because the correlation coefficient cannot be calculated. When rounded to the nearest whole number, some additional countries appear as having 100% of students with teachers who reported all Number topics as taught. These countries have tildes (~) in Exhibit 2.10.

For the Geometry and Measurement domain and the Data and Probability domain, the international average correlations are 0.02 and 0.01, respectively. Only Cyprus ($r = 0.22$) and Malta ($r = 0.26$) showed comparatively higher correlation coefficients in Geometry and Measurement compared to other countries. These countries, which reported low average percentages of topics taught, tended to exhibit higher positive correlations. This pattern also holds for Malta ($r = 0.23$) in the Data and Probability domain. In contrast, Kuwait showed some low-level negative correlation in Geometry and Measurement ($r = -0.19$), and both Kuwait ($r = -0.14$) and Saudi Arabia ($r = -0.18$) showed low-level negative correlations in Data and Probability. These countries had high average percentages of topics taught according to teachers' reports.

Low and negative correlation coefficients may suggest that there is little relationship between the implemented and the attained curriculum in many countries. However, as noted earlier in this report, content coverage is only one component of the implemented curriculum and students' opportunity to learn mathematics and science content. Other components, such as instructional strategies, teacher experience, and school or classroom resources, also play an important role but are beyond the scope of this report. Lastly, it is important to acknowledge the possibility of discrepancies between teachers' reports of topics taught to students and those taught in practice. For example, teachers may have incomplete information about whether topics were taught in previous years of schooling or have felt pressure to respond in particular ways to the questionnaire items, so their responses may not accurately reflect what students were taught. Further, these results cover only the topics assessed by TIMSS and may not fully reflect the mathematics curricula of all participating countries.

The higher correlations observed occasionally may be due to differences in implemented curricula across a few schools compared to most schools, or to a small number of teachers who were unable to implement the intended range of topics. The presence or absence of correlations, or the occasional observation of small negative correlations, does not necessarily indicate a problem or defect in the implemented or intended curricula. These data points are descriptive statistical associations found in the sample of schools. They are not absolute but rather are estimates of association and warrant further examination at the country level by national experts. They should not be used as sole evidence for policymaking.

Eighth-Grade Science

The [TIMSS 2023 Science Framework](#) includes four eighth-grade content domains: Biology, Chemistry, Physics, and Earth Science. Each content domain is assessed by a target percentage of score points in the science assessment, and is further broken down into topic areas, topics, and objectives, providing additional specificity about the science knowledge and skills that students are prompted to demonstrate in the assessment. Exhibit 3.1 presents an overview of the eighth-grade science content domains, topic areas, and their representation in the Curriculum and Science Teacher Questionnaires. As in mathematics, the number of items in the Curriculum Questionnaire and Teacher Questionnaire does not always directly correspond to the number of topics in the framework (See [Appendix B](#)).

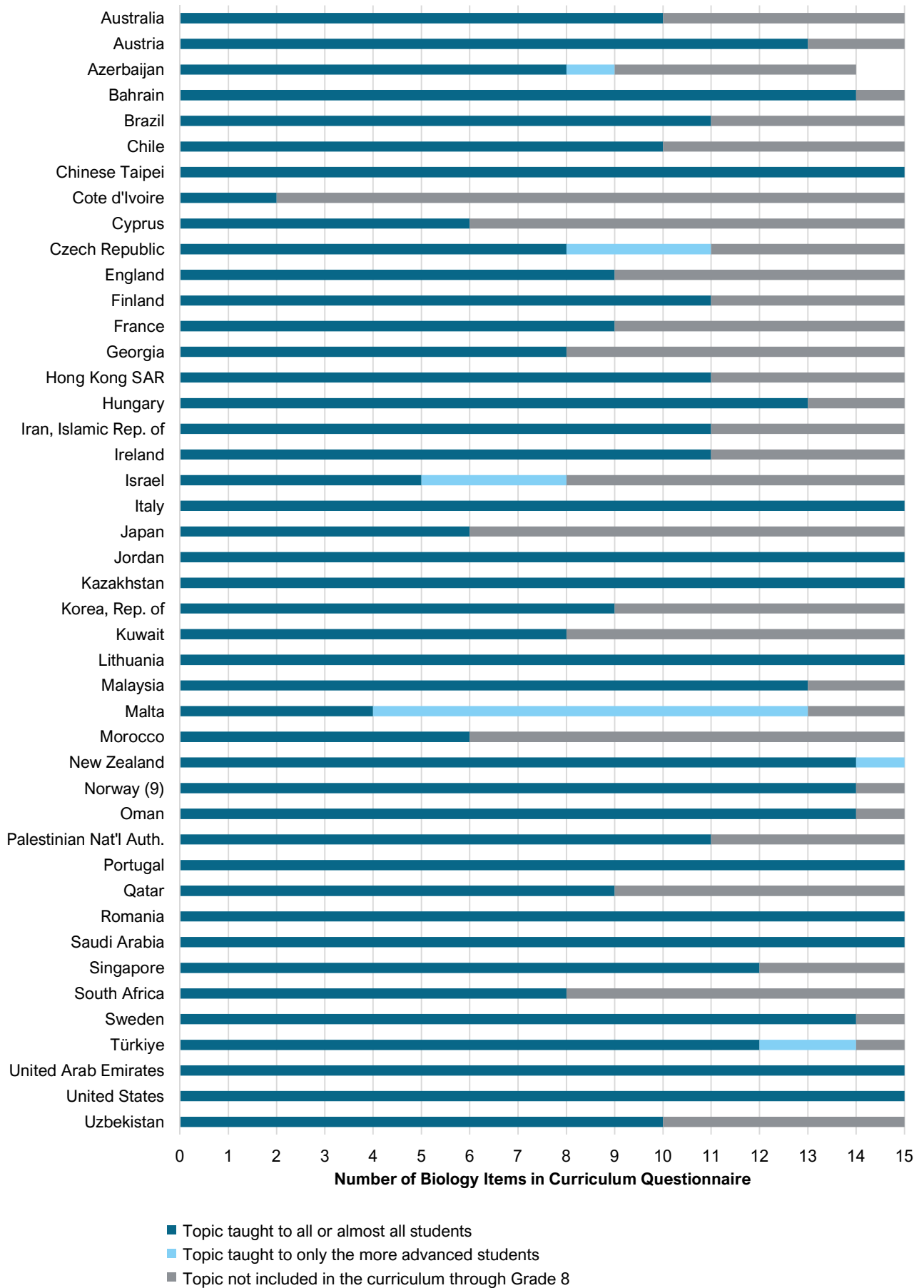
Exhibit 3.1: Overview of Eighth-Grade Science Content Domains

Content Domains (Target Assessment Percentages)	Topic Areas	Number of Curriculum Questionnaire Items	Number of Teacher Questionnaire Items
Biology (35%)	<ul style="list-style-type: none"> • Characteristics and life processes of organisms • Cells and their functions • Life cycles, reproduction, and heredity • Diversity, adaptation, and natural selection • Ecosystems • Human health 	15	16
Chemistry (20%)	<ul style="list-style-type: none"> • Composition of matter • Properties of matter • Chemical change 	11	10
Physics (25%)	<ul style="list-style-type: none"> • Physical states and changes in matter • Energy transformation and transfer • Light and sound • Electricity and magnetism • Motion and forces 	12	13
Earth Science (20%)	<ul style="list-style-type: none"> • Earth's structure and physical features • Earth's processes, cycles, and history • Earth's resources, their use, and conservation • Earth in the Solar System and the universe 	10	12

Biology Domain Topics

Exhibit 3.2 shows the coverage of Biology topics in countries' intended science curricula, as reported by NRCs in the Curriculum Questionnaire. The Biology domain includes the largest number of topics in the TIMSS framework, with 16 topics assessed and 15 corresponding items in the curriculum questionnaire. There was substantial international variation in the extent to which countries covered these Biology topics. According to NRC reports, curricula from 10 countries included all Curriculum Questionnaire topics within the Biology domain for all or almost all students. In contrast, Côte d'Ivoire, Cyprus, Japan, and Morocco included fewer than half of the assessed topics. Some education systems also differentiate content by student ability. For example, in Malta, nine of the 13 Biology topics in the curriculum are designated for advanced students, while in Israel, three of the eight topics are designated for advanced students.

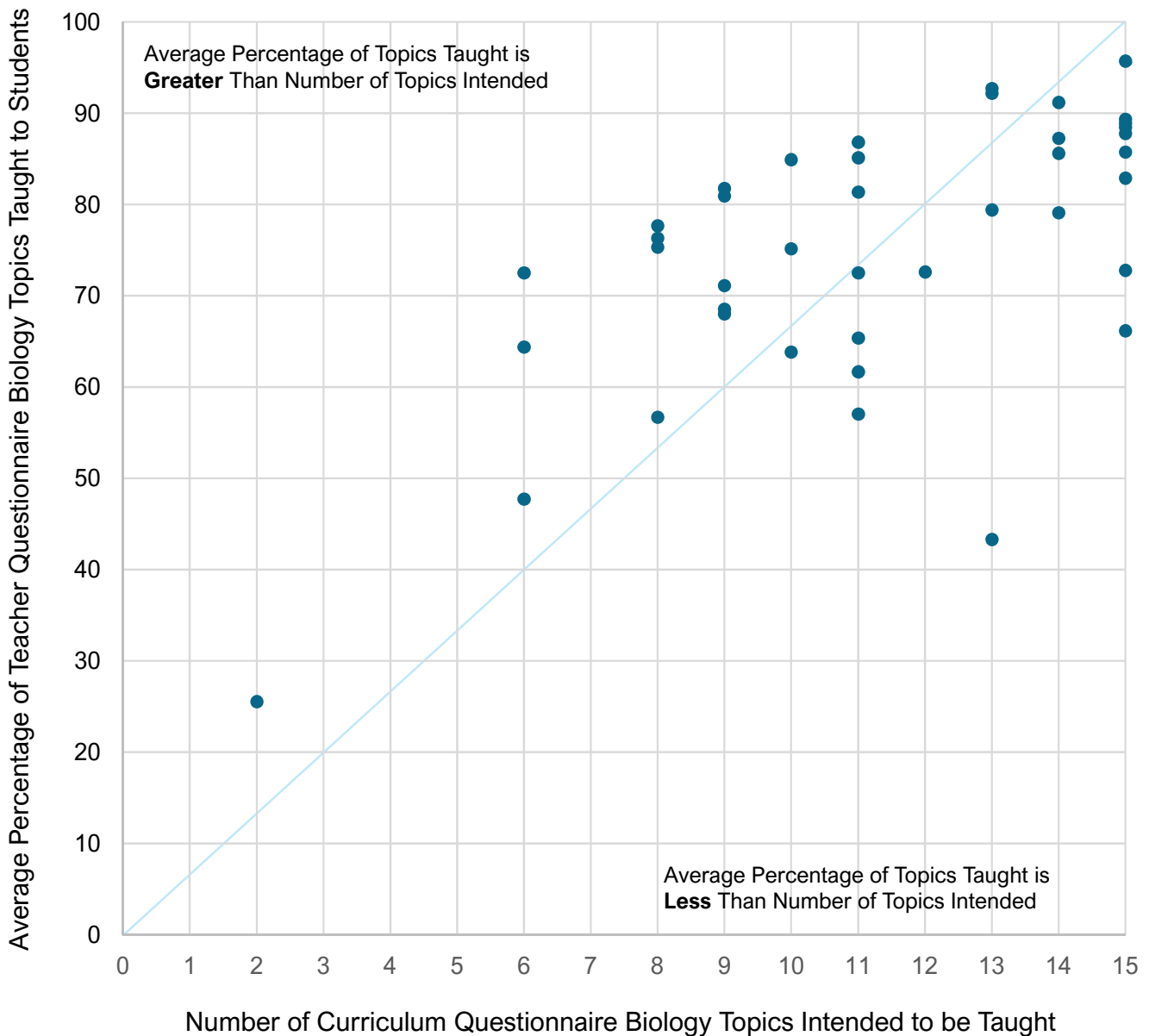
Exhibit 3.2: Intended Curriculum Coverage of Biology Topics



Note: Azerbaijan had valid responses for only 14 items.

Exhibit 3.3 illustrates the convergence of the intended and implemented biology curricula across countries. Most points in Exhibit 3.3 are clustered in the upper-right quadrant, indicating relatively high levels of both intended and implemented content coverage. Overall, teachers reported that the set of Biology topics taught to their students was aligned with the intended curriculum. Points below the diagonal reflect countries where teachers reported that students were taught a narrower set of topics than those in the intended curriculum, in contrast to points above the diagonal, indicating that teachers reported a broader set of topics as being taught to students compared to what was explicated in the intended curriculum. Differences between NRC and teacher reports may not necessarily indicate curriculum gaps; rather, they may reflect an internally coherent system consistent with the country's curricular design and objectives. This is particularly plausible in countries where several topics were reported as taught only to more advanced students (such as Malta).

Exhibit 3.3: Intended vs. Implemented Curriculum Coverage of Biology Topics



Chemistry Domain Topics

Exhibit 3.4 illustrates substantial cross-national variation in the coverage of Chemistry topics. Among the 44 participating education systems, 13 included all Chemistry topics from the Curriculum Questionnaire in their curricula for all or almost all students. By contrast, Brazil, Côte d'Ivoire, Cyprus, Hong Kong SAR, Korea, and Morocco did not include more than half of the Chemistry topics in the curriculum questionnaire. Malta represents a distinctive case: Although its curriculum covered eight of the 11 Chemistry topics, all eight were designated for more advanced students.

Exhibit 3.4: Intended Curriculum Coverage of Chemistry Topics

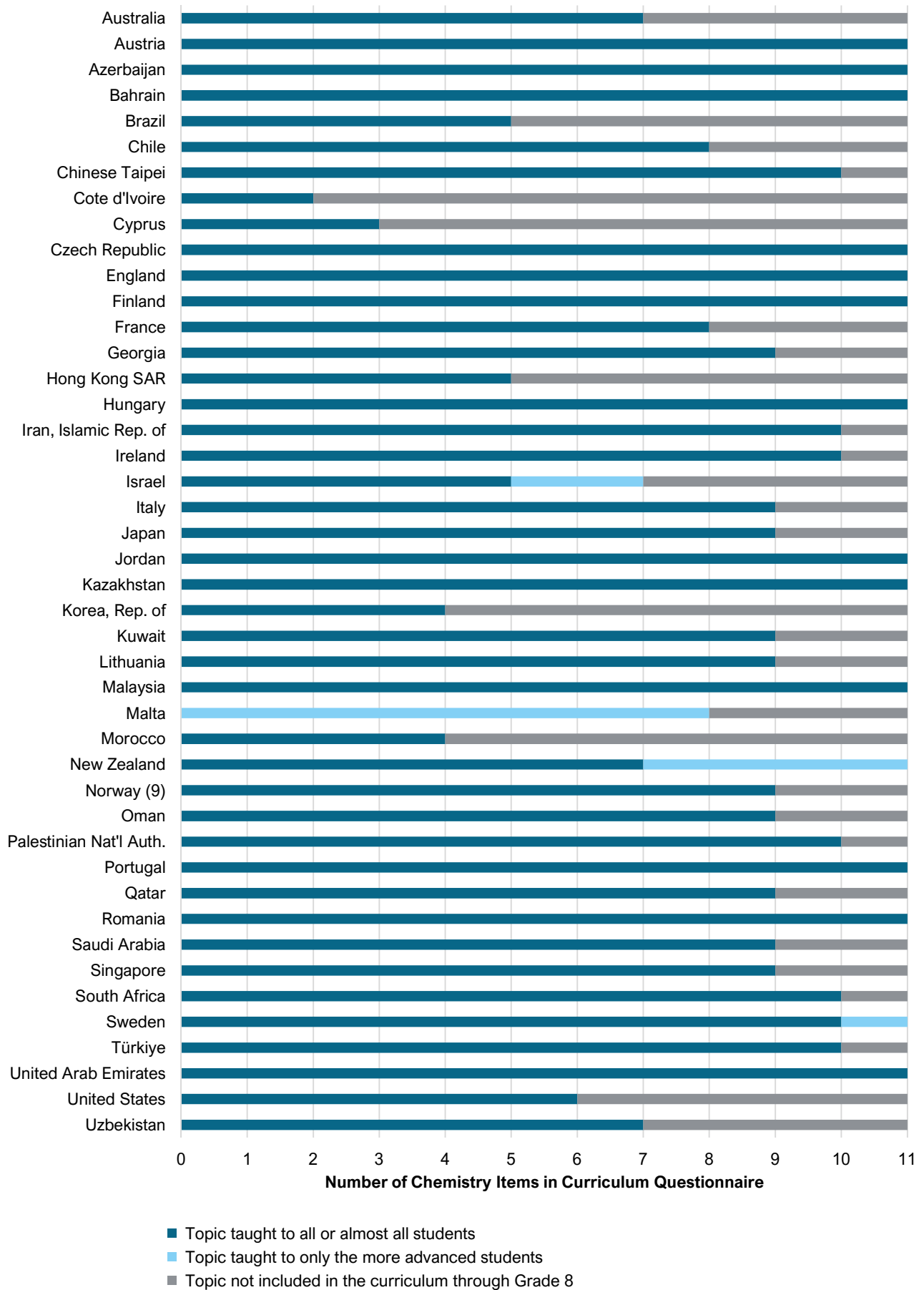
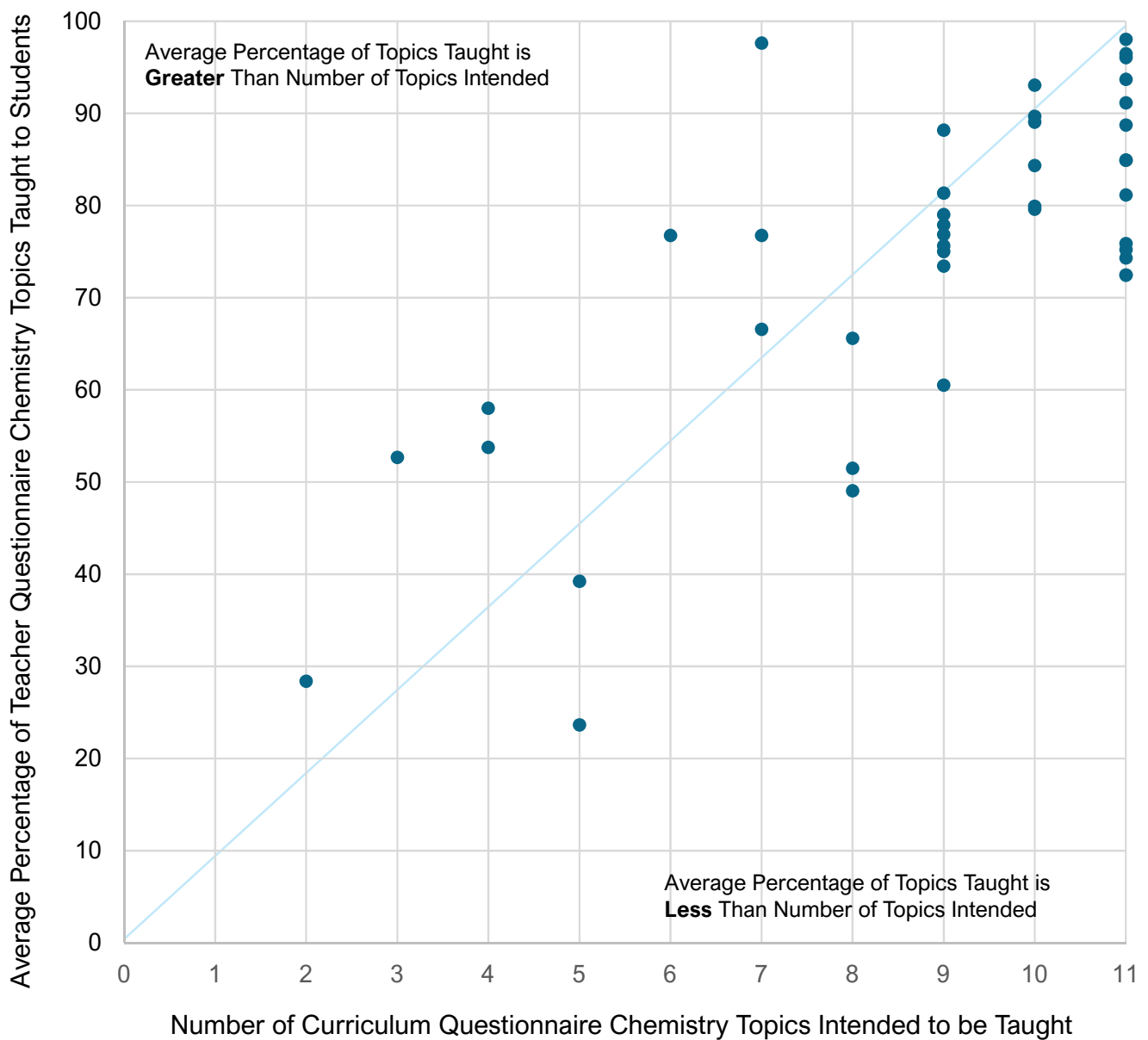


Exhibit 3.5 illustrates the degree of alignment between the intended and implemented chemistry curricula. Although the coverage of Chemistry topics varied across countries, teacher reports generally indicated that instructional content taught to students aligned with the intended curricula. Many points in the scatterplot appear close to the diagonal, showing this alignment. Points positioned below the diagonal represent countries where the intended curriculum specified broader topic coverage than teachers reported was reflected in classroom instruction. In these education systems, teachers reported that students were taught a narrower or different set of topics, possibly indicating a gap in curriculum implementation. There are also several points above the diagonal, representing countries where teachers reported that students have been taught more Chemistry topics than those specified in the intended curriculum.

Exhibit 3.5: Intended vs. Implemented Curriculum Coverage of Chemistry Topics



Physics Domain Topics

Exhibit 3.6 illustrates the coverage of Physics topics in countries' intended physics curricula. In most countries, physics curricula are largely aligned with the Physics topics in the Curriculum Questionnaire. Nevertheless, Côte d'Ivoire, Cyprus, Morocco, Norway, and Uzbekistan did not include more than half of the 12 assessed Physics topics in their intended curricula through eighth grade.

Exhibit 3.6: Intended Curriculum Coverage of Physics Topics

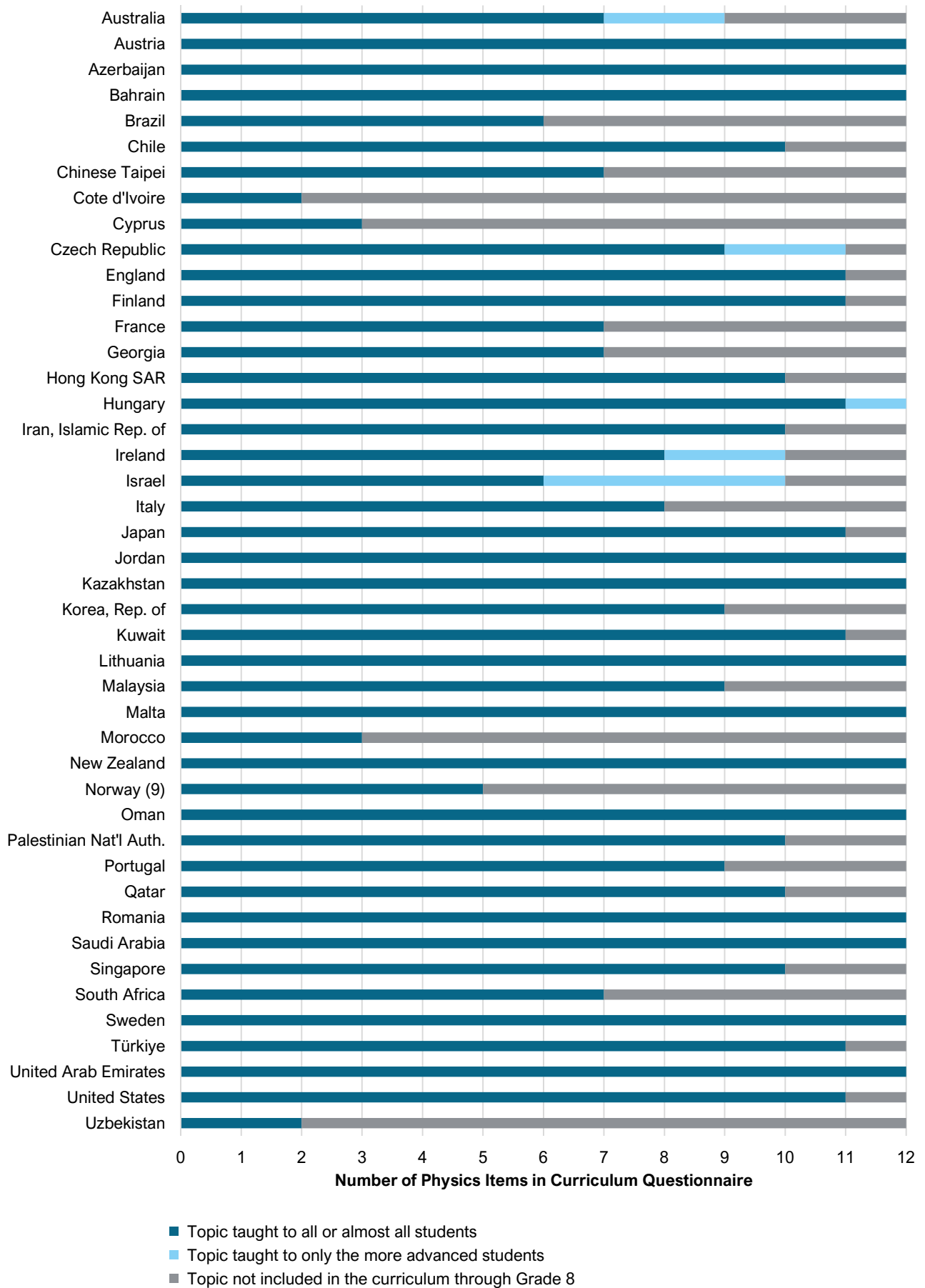
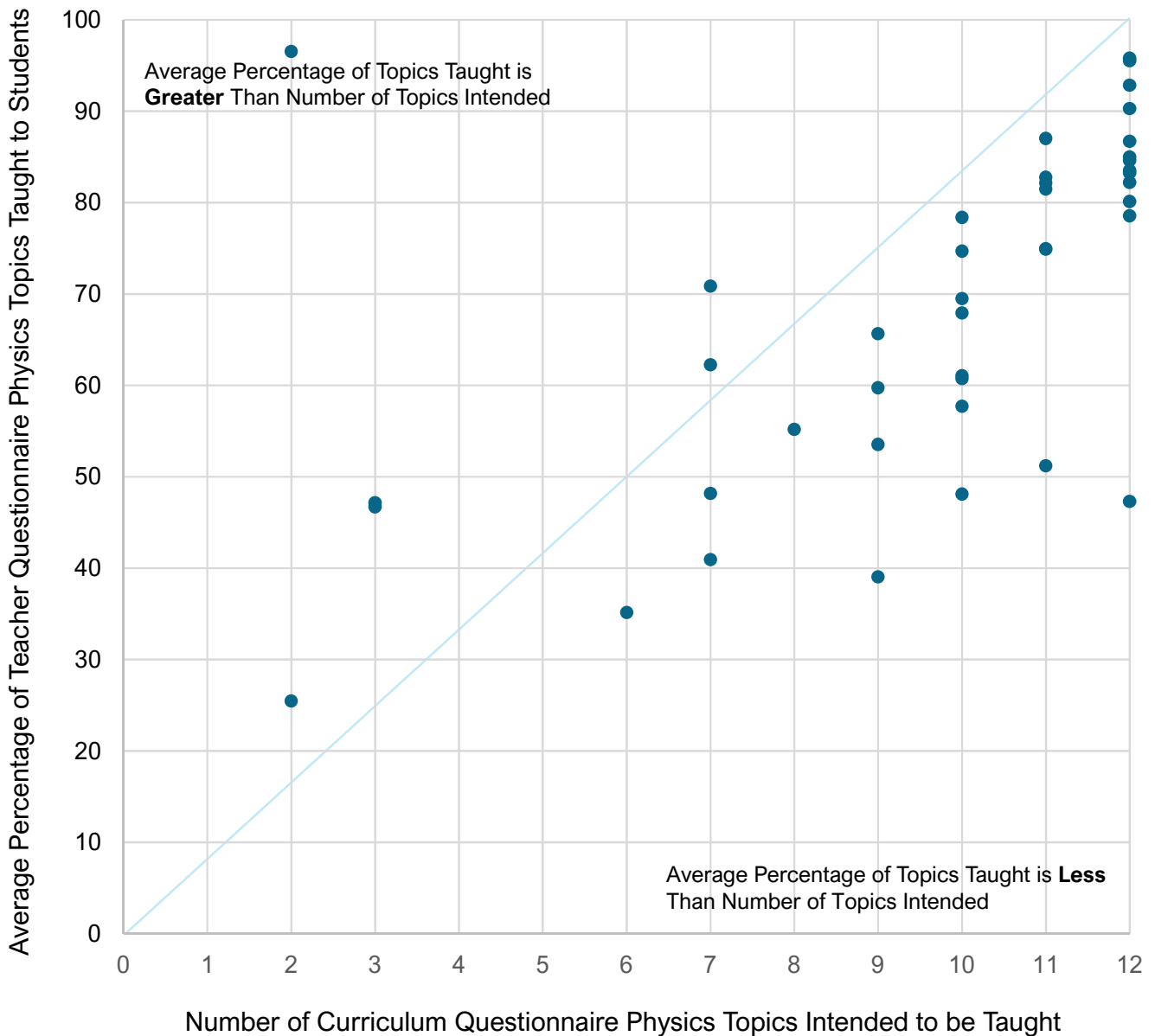


Exhibit 3.7 shows discrepancies between the intended and implemented physics curricula across countries. Student-level data derived from their teachers' reports suggest that instructional delivery in physics aligned less consistently with intended curricula than in the other three science content domains. Many points in the scatterplot are positioned below the diagonal. This indicates that teachers reported fewer Physics topics being taught to their students than what was specified in the intended curriculum in these countries. There are a few exceptions to this pattern, represented by the points above the diagonal.

Exhibit 3.7: Intended vs. Implemented Curriculum Coverage of Physics Topics



Earth Science Domain Topics

Exhibit 3.8 shows that countries' intended science curricula were less aligned with the TIMSS Earth Science topic items in the Curriculum Questionnaire than in the other three content domains. The Earth Science domain showed the greatest diversity across countries among the science content areas in the extent to which topics were included in the intended curricula. Twenty participating education systems included all the Earth Science topics in their curricula for all or almost all students. In contrast, three systems—Côte d'Ivoire, Japan, and Uzbekistan—did not include any Earth Science topics in their curricula. England, Kuwait, Singapore, and South Africa did not include more than half of the ten Earth Science topics in their curricula through the eighth grade. In addition, six Earth Science topics included in Oman's curriculum were designated only for the more advanced students.

Exhibit 3.8: Intended Curriculum Coverage of Earth Science Topics

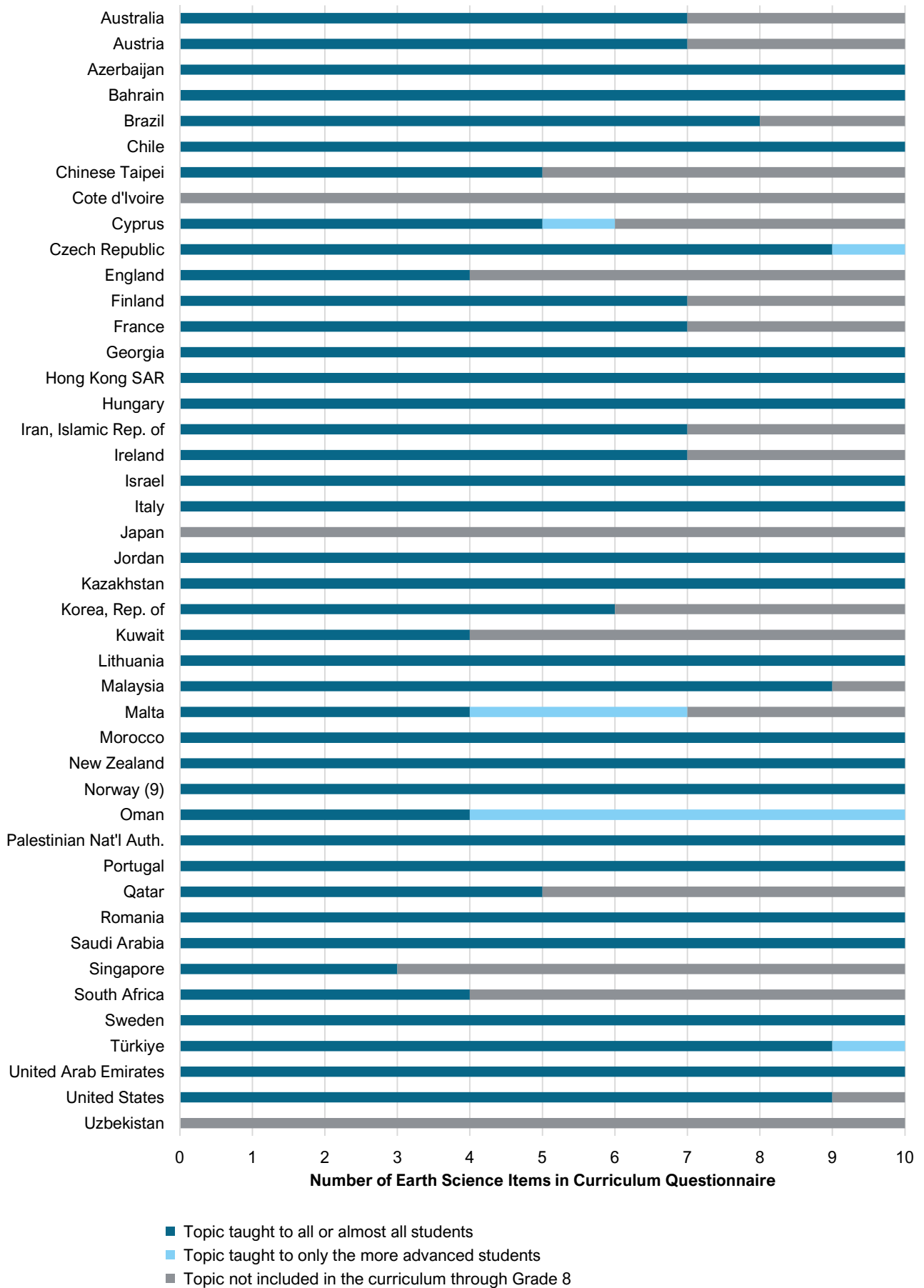
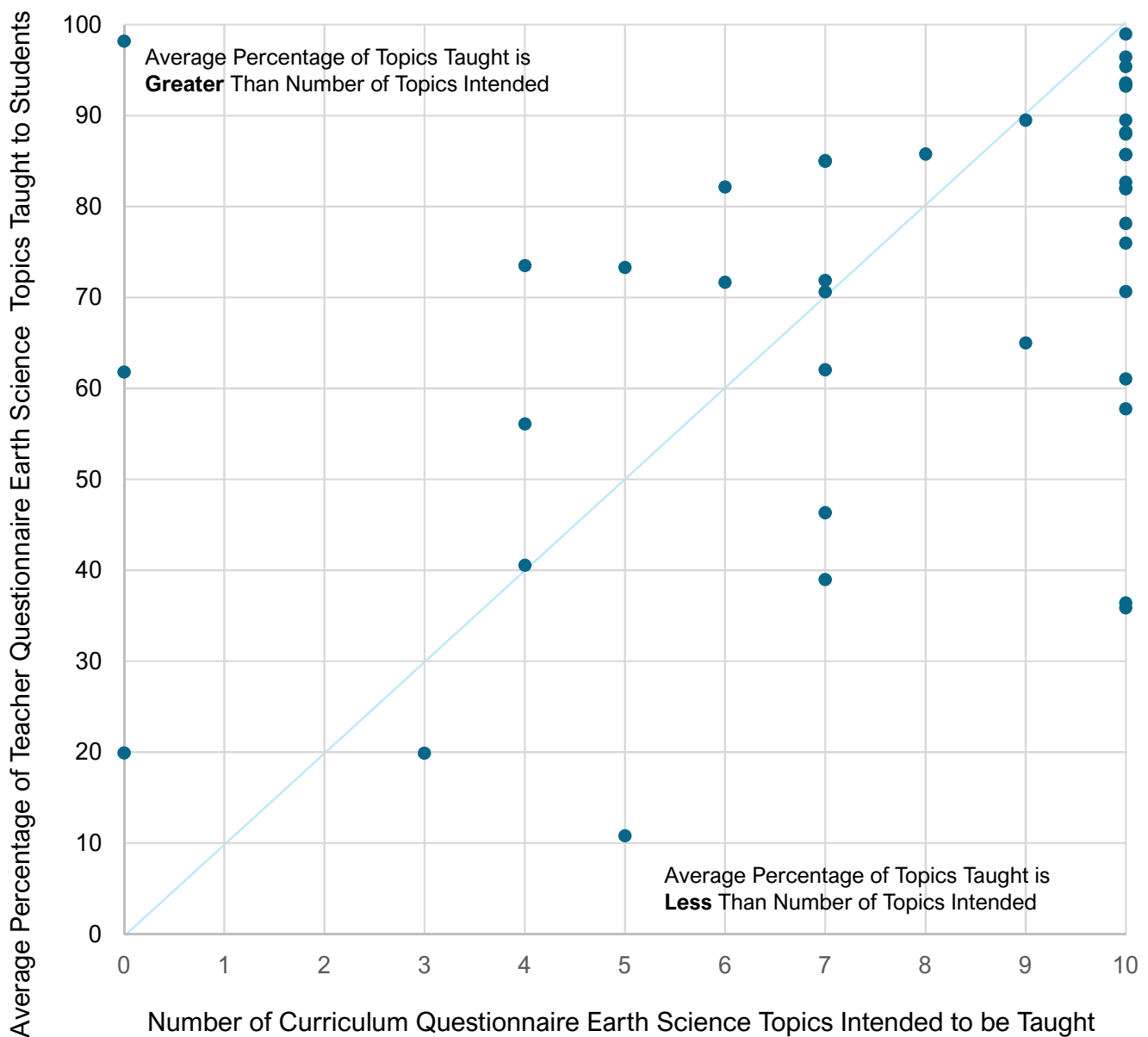


Exhibit 3.9 illustrates the alignment between the intended and implemented earth science curricula across countries. Many points in the scatterplot lie below the diagonal, indicating that, on average, teachers reported that students were taught a narrower or different set of topics than those specified in national curricula. While this was the case in many countries, it is worth noting that two countries (Japan and Uzbekistan), where no Earth Science topics were reported in the intended curriculum, showed relatively high coverage in the implemented curriculum, as reported by students' teachers (see [Appendix C](#) for details). The [TIMSS 2023 Encyclopedia](#) can shed some further light on these findings. In [Uzbekistan](#), TIMSS topics in Earth Science are covered in the geography curriculum. By contrast, in [Japan](#), the relevant content area is designated “life and earth science,” which appears to encompass Earth Science topics.

Exhibit 3.9: Intended vs. Implemented Curriculum Coverage of Earth Science Topics



Relationship Between Implemented and Attained Curriculum in Eighth-Grade Science

The average percentage of topics taught to students in each content domain, as reported by teachers, reflects the implemented science curriculum, whereas student achievement in those domains reflects the attained curriculum. These results are presented in Exhibit 3.10. As in Exhibit 2.10 for mathematics, correlation coefficients with absolute values exceeding ± 2 standard deviations from the correlation coefficient distribution's mean across countries are highlighted and shown in **bold** for each content domain.

Exhibit 3.10: Science Teachers' Reports of Percentages of Topics Taught to Students and Relationship With Achievement by Content Domain

	Biology		Chemistry		Physics		Earth Science	
	Average Percentage of Topics Taught	Correlation with Average Achievement	Average Percentage of Topics Taught	Correlation with Average Achievement	Average Percentage of Topics Taught	Correlation with Average Achievement	Average Percentage of Topics Taught	Correlation with Average Achievement
Australia	s 64 (1.6)	-0.04 (0.04)	s 67 (1.5)	0.06 (0.04)	s 54 (1.6)	0.00 (0.04)	s 62 (2.2)	-0.08 (0.04)
Austria	79 (1.6)	-0.01 (0.06)	81 (1.9)	0.02 (0.04)	85 (1.9)	-0.02 (0.04)	85 (1.5)	0.06 (0.07)
Azerbaijan, Republic of	82 (1.6)	-0.03 (0.04)	98 ~	~ ~	90 (1.1)	0.06 (0.08)	95 (0.7)	-0.07 (0.03)
Bahrain	87 (1.4)	-0.10 (0.04)	76 (1.4)	0.01 (0.04)	83 (0.9)	-0.10 (0.04)	88 (1.3)	-0.07 (0.04)
Brazil	85 (0.9)	0.04 (0.03)	24 (1.4)	0.04 (0.03)	35 (1.6)	0.02 (0.05)	86 (1.1)	0.06 (0.03)
Chile	75 (1.7)	-0.14 (0.04)	66 (2.0)	-0.09 (0.05)	61 (2.2)	-0.11 (0.05)	83 (1.8)	-0.10 (0.05)
Chinese Taipei	73 (3.5)	-0.05 (0.03)	93 (0.8)	0.01 (0.04)	48 (1.3)	0.06 (0.04)	11 (1.9)	-0.01 (0.04)
* Cote d'Ivoire	s 26 (2.3)	--	r 28 (1.7)	--	r 25 (1.6)	--	s 20 (2.2)	--
Cyprus	64 (1.5)	0.01 (0.04)	53 (1.5)	0.04 (0.04)	47 (1.8)	0.08 (0.05)	82 (1.3)	-0.18 (0.05)
Czech Republic	87 (0.9)	-0.07 (0.03)	85 (1.1)	0.01 (0.03)	87 (0.9)	-0.04 (0.03)	93 (0.8)	-0.04 (0.04)
England	s 71 (2.3)	-0.01 (0.05)	s 74 (2.5)	-0.04 (0.08)	s 75 (2.6)	-0.02 (0.06)	s 56 (3.5)	-0.05 (0.06)
Finland	73 (0.9)	-0.05 (0.03)	91 (0.7)	0.02 (0.03)	75 (1.3)	0.04 (0.03)	85 (0.9)	-0.02 (0.03)
France	69 (1.3)	0.12 (0.04)	49 (1.4)	0.06 (0.04)	41 (1.4)	0.12 (0.04)	71 (1.8)	0.08 (0.05)
Georgia	75 (1.7)	0.04 (0.03)	81 (1.3)	0.02 (0.04)	71 (1.6)	0.02 (0.03)	96 (0.6)	0.01 (0.03)
Hong Kong, SAR	s 65 (2.3)	0.04 (0.07)	s 39 (2.9)	0.21 (0.10)	s 61 (1.8)	0.03 (0.07)	s 36 (2.6)	0.03 (0.09)
Hungary	92 (1.1)	-0.07 (0.07)	96 (0.7)	-0.09 (0.04)	96 (0.6)	-0.11 (0.06)	93 (0.9)	-0.12 (0.04)
Iran, Islamic Rep. of	62 (1.7)	-0.11 (0.04)	84 (1.0)	-0.08 (0.04)	70 (1.2)	-0.07 (0.04)	72 (1.5)	-0.09 (0.04)
Ireland	57 (1.2)	-0.01 (0.04)	80 (1.1)	0.08 (0.05)	58 (1.1)	0.02 (0.05)	r 46 (1.7)	-0.04 (0.03)
Israel	57 (1.8)	-0.05 (0.05)	77 (1.4)	0.06 (0.05)	48 (1.8)	0.00 (0.05)	36 (2.2)	-0.11 (0.04)
Italy	83 (1.2)	-0.02 (0.04)	73 (1.8)	-0.07 (0.03)	55 (1.8)	-0.08 (0.03)	71 (1.7)	-0.08 (0.03)
Japan	48 (0.8)	0.04 (0.03)	61 (1.2)	0.01 (0.03)	51 (1.0)	0.02 (0.03)	62 (1.4)	-0.01 (0.03)
Jordan	88 (1.2)	-0.12 (0.05)	89 (1.2)	-0.08 (0.05)	85 (1.7)	-0.06 (0.05)	82 (2.0)	-0.05 (0.05)
Kazakhstan	96 (0.8)	-0.07 (0.03)	96 (0.6)	-0.04 (0.04)	93 (0.9)	-0.05 (0.04)	99 ~	~ ~
Korea, Republic of	68 (1.6)	0.03 (0.02)	58 (1.9)	0.09 (0.03)	66 (1.3)	0.08 (0.03)	72 (1.7)	0.03 (0.03)
Kuwait	78 (1.5)	-0.05 (0.07)	88 (1.4)	-0.22 (0.08)	83 (1.2)	-0.09 (0.07)	74 (2.3)	-0.02 (0.06)
Lithuania	86 (1.4)	-0.01 (0.04)	75 (1.6)	0.06 (0.04)	84 (1.4)	0.06 (0.03)	94 (1.6)	0.02 (0.05)
Malaysia	93 (0.7)	0.00 (0.05)	72 (1.4)	0.00 (0.04)	60 (1.8)	0.04 (0.04)	65 (2.1)	0.01 (0.04)
Malta	s 43 (0.6)	0.22 (0.02)	s 52 (0.6)	0.31 (0.02)	r 47 (0.3)	0.20 (0.03)	s 39 (0.7)	0.20 (0.03)
♯ Morocco	73 (1.3)	0.03 (0.06)	54 (1.8)	0.02 (0.05)	47 (1.6)	0.04 (0.05)	76 (1.6)	0.09 (0.04)
Oman	86 (0.9)	-0.05 (0.03)	78 (1.2)	-0.05 (0.03)	80 (1.1)	-0.05 (0.03)	78 (1.8)	0.05 (0.03)
Palestinian Nat'l Auth.	81 (1.1)	0.03 (0.03)	90 (0.8)	-0.01 (0.03)	78 (1.4)	0.00 (0.03)	86 (1.2)	0.00 (0.03)
Portugal	66 (1.2)	0.02 (0.03)	75 (1.3)	0.08 (0.05)	39 (1.3)	0.02 (0.03)	82 (1.3)	0.03 (0.03)
Qatar	81 (1.5)	-0.03 (0.04)	76 (1.9)	0.05 (0.06)	75 (1.9)	0.09 (0.04)	73 (2.2)	0.02 (0.05)
Romania	r 96 (1.5)	0.01 (0.04)	r 94 (1.7)	-0.06 (0.04)	r 96 (1.5)	-0.06 (0.04)	s 58 (5.7)	0.03 (0.06)
Saudi Arabia	89 (1.0)	0.01 (0.04)	77 (1.8)	0.02 (0.04)	82 (1.4)	0.08 (0.03)	90 (1.5)	0.07 (0.04)
Singapore	73 (1.4)	0.21 (0.06)	79 (1.2)	0.42 (0.05)	68 (1.0)	0.20 (0.06)	20 (1.4)	-0.04 (0.05)
♯ South Africa	s 76 (1.7)	0.03 (0.04)	s 80 (1.6)	0.09 (0.05)	s 62 (2.1)	0.14 (0.04)	s 41 (2.8)	0.27 (0.05)
Sweden	79 (1.1)	0.02 (0.03)	72 (1.6)	-0.03 (0.04)	r 79 (1.2)	0.02 (0.04)	r 61 (2.5)	-0.01 (0.04)
Türkiye	91 (1.0)	-0.08 (0.05)	89 (0.8)	-0.03 (0.05)	81 (1.3)	-0.07 (0.05)	86 (1.2)	-0.12 (0.05)
United Arab Emirates	88 (0.6)	0.00 (0.02)	r 85 (0.6)	0.06 (0.03)	87 (0.6)	-0.01 (0.02)	r 88 (0.6)	-0.03 (0.02)
United States	89 (1.0)	0.06 (0.04)	77 (2.2)	-0.06 (0.05)	82 (1.8)	-0.08 (0.04)	90 (1.6)	0.00 (0.04)
Uzbekistan	85 (1.6)	-0.01 (0.05)	98 ~	~ ~	97 (0.7)	-0.02 (0.05)	98 ~	~ ~
International Average	76 (0.2)	-0.01 (0.01)	75 (0.2)	0.02 (0.01)	69 (0.2)	0.01 (0.01)	71 (0.3)	-0.01 (0.01)
New Zealand	s 48 (2.8)	0.04 (0.07)	s 50 (3.2)	0.12 (0.08)	s 42 (2.7)	0.14 (0.09)	s 39 (3.9)	-0.01 (0.07)
Norway (9)	--	--	--	--	--	--	--	--

Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

A dash (-) indicates comparable data not available. A tilde (~) indicates result not reported because estimation is not reliable.

♯ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.

✱ Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

New Zealand did not satisfy guidelines for minimum school participation rates. Achievement could not be reliably estimated for Côte d'Ivoire.

An "r" indicates teacher questionnaire data are available for at least 70% but less than 85% of the students.

An "s" indicates teacher questionnaire data are available for at least 50% but less than 70% of the students.

The average percentage of topics that students' teachers reported being taught varies across countries and content domains. In Biology, the average percentage of topics reported ranges from 26 percent in Côte d'Ivoire to 96 percent in Kazakhstan and Romania and, with an international average of 76 percent. In Chemistry, the international average is 75 percent, ranging from 24 percent (Brazil) to 98 percent (Azerbaijan and Uzbekistan). The international average for Physics is 69 percent, which is the lowest among the four science content domains and ranges from 25 percent (Côte d'Ivoire) to 97 percent (Uzbekistan). Compared to the other three science content domains, Earth Science shows more variation across countries in the average percentage of topics taught to students. In Earth Science, the average percentage of topics reported to be taught is 71 percent, ranging from 11 percent (Chinese Taipei) to 99 percent (Kazakhstan). As with mathematics, it is important to note that these are averages. Individual students within countries may have been taught different percentages of topics within each content domain.

Across the four science content domains, international average correlations between the percentage of topics taught and student achievement remained close to zero, though notable country-level differences emerged. Malta and Singapore had small to moderate positive relationships for Biology ($r = 0.22$; $r = 0.21$), Chemistry ($r = 0.31$; $r = 0.42$), and Physics ($r = 0.20$ for both). Kuwait showed a small negative correlation in Chemistry ($r = -0.22$). In Earth Science, South Africa showed a moderate positive relationship ($r = 0.27$), Malta had a small positive relationship ($r = 0.20$), and a small negative correlation was observed for Cyprus ($r = -0.18$).

Malta exhibits higher correlations across all science content domains compared to other countries. It is among the few countries where NRCs reported that topics in these domains are taught only to more advanced students, according to the intended curriculum. Because of this, the curriculum implemented in Malta may show greater variation across students than in other countries. Follow-up investigations revealed that this pattern is clearly reflected in the broader distributions of the percentages of topics taught across students. Another country with higher correlations than many other countries across the Biology, Chemistry, and Physics content domains is Singapore. Unlike Malta, however, Singapore's NRC did not report any topics in these domains as being taught only to more advanced students, and the data did not show particularly wide distributions of responses. As noted earlier in this report, further investigation may provide more insight into the distinctive results for Singapore.

Possible Contributing Factors to Low or Negative Correlations

Multiple factors may contribute to the low or negative associations observed between the implemented and attained curricula across the four content domains. As noted in the mathematics section, correlation analysis depends on the extent to which two variables vary together. When high average percentages of topics are taught to students, the resulting lack of variability in reported coverage naturally drives the correlation toward zero, as there is insufficient variation to produce a meaningful association with student achievement. This issue is less prevalent in the science content domains than in the Number content domain of mathematics, but the average percentages of topics taught in the science content domains are still quite high in many countries.

Moreover, when NRCs' reports on the intended curriculum closely correspond to teachers' reports of topic coverage within a given content domain, the correlation between the implemented and attained curricula might be expected to be low. Although the average coverage at the content domain level may appear low, teachers may be internally consistent in their reports. For example, students' teachers tend to consistently report that they have been taught the same set of intended

topics, so variation in topic coverage across students is minimal. Consequently, the limited variability constrains the observed association with student achievement.

Conversely, when NRCs' reports on the intended curriculum diverge from teachers' reports of the average percentage of topics taught to students, this gap may reflect the systematic omission of topics scheduled for the end of the instructional period across classrooms within a country. It is also important to acknowledge the possibility of a discrepancy between what teachers report as having been taught to their students and what students have been taught. As a result, the correlation between the implemented and attained curricula would again be expected to be low, and occasional estimates of negative correlations may occur. This pattern may help explain the low country-level correlation values; however, it should be examined in greater detail for each country by national experts.

In addition, topic coverage is only a single component of the implemented curriculum. Other classroom factors also shape student learning. Further, countries' curricula may cover additional topics not measured in TIMSS.

It is also worth noting that the relatively low correlations observed in mathematics and science are consistent with previous research examining the relationship between curriculum and student achievement using TIMSS data. Research conducted in the Dinaric region using TIMSS 2019 fourth-grade data found no significant association between the proportion of students exposed to specific mathematics and science topics and national mean achievement.³³ Similarly, an analysis of TIMSS 2015 eighth-grade data reported no evidence of a positive relationship between opportunity to learn and science achievement at either the between-country or within-country levels.³⁴

As stated above for mathematics, these correlations should not be used in isolation to inform policymaking. They are statistical associations that merit further investigation at the country level. The presence or absence of correlations, or the occasional occurrence of small negative correlations, does not necessarily indicate problems in the implemented or intended curricula.

Key Takeaways

- 1. The content in the TIMSS 2023 Mathematics and Science Assessment Frameworks is largely covered by the intended curricula of participating countries.** This was the case for both subjects, although alignment between the framework topics and national curricula was stronger within mathematics than within science. Alignment in mathematics was particularly strong in the Number content domain across all education systems, whereas alignment within the Data and Probability domain showed greater variation across countries. In science, the greatest heterogeneity was observed in Earth Science, which may be due to these topics being included in other subjects' curricula in some countries.
- 2. Within-country alignment between the intended and implemented curricula varied across content domains for both mathematics and science.** In mathematics, the Number domain showed the highest degree of alignment, followed closely by Geometry and Measurement. However, in some education systems, particularly in Algebra and in Data and Probability topics, the curricula specified broader coverage than teachers reported teaching students, indicating a potential implementation gap. In science, within-country alignment was generally high for Biology and for Chemistry. In Physics,

many national curricula covered a broader set of topics than teachers reported teaching to students, perhaps reflecting the challenging nature of the subject. Lower within-country alignment between the intended and implemented curricula was also observed in the Earth Science content domain for many countries.

- 3. The observed relationship between reports on implemented curriculum and attained curriculum (i.e., student achievement) is generally small to moderate, with some variation across countries and across content domains in both mathematics and science.** In mathematics, the Number content domain showed uniformly high reported topic coverage and is accompanied by low correlations. Correlations between the percentage of topics taught and student achievement remain generally weak across all four mathematics content domains, although there are some exceptions. However, these exceptions need further examination at the country level and should not be used as the sole basis for any decision making. In science, Earth Science shows the greatest variation in the average percentage of topics taught across countries. In most countries, correlations between these averages and student achievement within the content domains are low, though some exceptions exist. Consistent with other research in the area, breadth of topic coverage alone does not appear to be a driver of student achievement in many countries.

Future Directions

The results presented in this TIMSS Insights report suggest several areas warranting further investigation regarding the opportunity to learn curricular topics and their relationship to student achievement. This report represents an important step in examining the different layers of the curriculum and their manifestations across educational systems, as well as the roles played by various stakeholder groups in implementing them.

This study is subject to several limitations that also point to directions for future research. Although the Curriculum and Teacher Questionnaires both reflect the content of the [TIMSS 2023 Assessment Frameworks](#), differences in the number of questionnaire items and formulation of specific topics represent a notable limitation and may contribute to inconsistencies in the findings presented in this report. A more systematic alignment of data sources in future cycles is recommended. Closer coordination between framework topics, Curriculum Questionnaire items, and Teacher Questionnaire items would improve the interpretability of results and support more coherent comparisons across intended, implemented, and attained curricula. Such alignment would ultimately strengthen the validity of inferences about opportunity to learn and its relationship to student achievement. Future research may also conduct a more fine-grained content alignment analysis that examines not only the number of topics but also their complexity, including in relation to cognitive domains.

Further research could also explore the Curriculum Questionnaire and Teacher Questionnaire data in more detail, potentially providing information related to the degree to which different response tendencies across countries may contribute to the results presented here. NRCs could provide comments on their item responses for each content domain within the Curriculum Questionnaire; these comments can shed light on how NRCs approached responding to the items, which is especially important given the differences in specificity of curricula across different countries. Readers interested in the details for specific countries are encouraged to visit the

[TIMSS 2023 Curriculum Questionnaire data page](#). Further examination of the TCMA results might also shed additional light on the findings presented in this report.

As noted earlier, content coverage is only one aspect of opportunity to learn. Some of the findings in this report—for example, the low correlations between teachers’ reports of topics taught and student achievement—might be explained by incorporating additional indicators. For example, the TIMSS 2023 context questionnaires also included items asking about teachers’ use of different instructional practices, as well as students’ reports of their attitudes toward mathematics and science and their experiences of instruction in the subjects. Future research could incorporate these variables to explore how they may moderate the relationship between content coverage and student achievement. Additionally, resources outside the classroom that contribute to achievement could be explored: Future research could examine if students have acquired relevant knowledge outside the formal classroom context, such as through private tutoring, coaching, or other informal learning experiences.

In addition to extending explorations of student achievement, examining contextual factors that may contribute to potential gaps between the intended and implemented curricula would also be beneficial. Such factors may include students’ socioeconomic status or the socioeconomic composition of their schools, class size, allocated instructional time, and challenges in enacting intended instructional activities.³⁵ The impact of these different factors may vary across countries. At the country level, future research could employ qualitative methods, such as in-depth interviews or focus groups with teachers, to provide valuable insights into the mechanisms driving curriculum implementation gaps and offer evidence to inform education policy decisions.

Appendix A: About TIMSS 2023

The 2023 cycle of the Trends in International Mathematics and Science Study (TIMSS 2023) aims to measure and compare the mathematics and science achievement of fourth- and eighth-grade students around the world. TIMSS provides valuable insights into mathematics and science achievement differences across and within countries and helps policymakers and educators understand factors contributing to student learning.

The data presented in this report come from the TIMSS 2023 Teacher and Curriculum Questionnaires, as well as the mathematics and science assessment. TIMSS 2023 also collected context questionnaire data from students, parents, and principals.

Many resources are available for obtaining more information about TIMSS 2023, accessing TIMSS 2023 data, and conducting additional analyses. These resources include the following.

- [TIMSS 2023 Assessment Frameworks](#): provides information about the TIMSS 2023 mathematics and science assessments, context questionnaires, and assessment design. This includes a special supplement describing the measurement of environmental attitudes and behaviors in the TIMSS 2023 context questionnaires.
- [TIMSS 2023 International Results in Mathematics and Science](#): provides a summary of results about fourth- and eighth-grade students' mathematics and science achievement, as well as information about how contextual factors relate to students' achievement.
- [TIMSS 2023 Encyclopedia](#): contains information about national contexts for countries participating in TIMSS 2023, including a chapter written by each country describing its educational system and responses to the TIMSS 2023 Curriculum Questionnaires.
- [TIMSS 2023 Technical Report: Methods and Procedures](#): details instrument development, sample design and implementation, operations, and analytical procedures.
- [TIMSS 2023 Context Questionnaires](#): show the international versions of the contextual items to which students, parents, school principals, teachers, and National Research Coordinators responded.
- [TIMSS 2023 International Database](#): includes data collected from the mathematics and science assessments and context questionnaires and achievement and contextual scale estimates for the countries and benchmarking entities that participated in TIMSS 2023. The accompanying User Guide provides information about database contents and analysis resources.
- [TIMSS 2023 Insights Series](#): is a set of reports exploring different educational research areas using TIMSS 2023 data. Reports in the series provide an in-depth examination of topics beyond what can be covered in the [International Results](#).

Appendix B: Curriculum and Teacher Questionnaire Framework Mapping

An important precursor to the analyses presented in this report was the mapping of TIMSS 2023 Teacher and Curriculum Questionnaire items. Although both sets of items concern coverage of the TIMSS 2023 Mathematics and Science Framework topics, they are not identical; the mapping exercise served as a check on the feasibility of comparing results across the two data sources, as well as a check on the degree to which they cover the topics in the framework. Although there were some differences in division of mathematics and science framework topics across items within the two questionnaires, and the questionnaires did not contain the same number of items as there are framework topics, the sets of items in each questionnaire broadly represent the contents of the mathematics and science assessment frameworks, and a holistic comparison was deemed appropriate.

Items from each questionnaire were compared to each other, as well as to the Mathematics and Science Frameworks. The results are shown in Exhibits B.1–B.8.

Exhibit B.1: Variable Framework Mapping — Grade 8 Number

Mathematics Framework Topic	Mathematics Framework Topic Area	Curriculum Questionnaire Variable Name	Curriculum Questionnaire Item Text	Teacher Questionnaire Variable Name	Teacher Questionnaire Item Text
Integers	1	MA808AE	Combine two or more properties of numbers or operations to solve a problem	-	-
Integers	1	MA808AA	Multiples, factors, and prime numbers	BTBM19AB	Find and use factors, multiples, positive powers, or square roots of positive whole numbers
Integers	2	MA808AB	Add and subtract with negative numbers	BTBM19AA	Add and subtract positive and negative numbers
Fractions and decimals	1	MA808AC	Compare and order fractions and decimals	BTBM19AC	Compare fractions and decimals
Fractions and decimals	2	MA808AD	Add, subtract, multiply, and divide with fractions and decimals	BTBM19AD	Add, subtract, and multiply with fractions and decimals
Fractions and decimals	2	MA808AD	Add, subtract, multiply, and divide with fractions and decimals	BTBM19AE	Divide fractions and decimals by a whole number
Proportions, ratios, and percentages	1	MA808AF	Ratios and proportions	BTBM19AF	Determine proportions and ratios
Proportions, ratios, and percentages	2	MA808AG	Find percentages; convert between percentages and fractions or decimals	BTBM19AG	Find percentages and convert between percentages and fractions/decimals

A dash (-) indicates no mapped questionnaire variable/item.

Light green shading indicates multiple Teacher Questionnaire items mapped to a single Curriculum Questionnaire item.

Exhibit B.2: Variable Framework Mapping — Grade 8 Algebra

Mathematics Framework Topic	Mathematics Framework Topic Area	Curriculum Questionnaire Variable Name	Curriculum Questionnaire Item Text	Teacher Questionnaire Variable Name	Teacher Questionnaire Item Text
Expressions, operations, and equations	1	MA808BA	Find the value of an expression or formula given values of variables	BTBM19BA	Simplify and compare algebraic expressions
Expressions, operations, and equations	2	MA808BB	Simplify and compare algebraic expressions	BTBM19BA	Simplify and compare algebraic expressions
Expressions, operations, and equations	3	MA808BC	Write expressions to represent problems	BTBM19BE	Write expressions, equations, or inequalities to represent problems
Expressions, operations, and equations	4	MA808BD	Solve linear equations and inequalities	BTBM19BB	Solve simple linear equations
Expressions, operations, and equations	4	MA808BD	Solve linear equations and inequalities	BTBM19BC	Solve simple linear inequalities
Expressions, operations, and equations	4	-	-	BTBM19BD	Solve simultaneous linear equations (two variables)
Relationships and functions	1	MA808BE	Interpret and generate representations of linear functions in tables, graphs, or words	BTBM19BF	Interpret linear functions in graphs, tables, or words
Relationships and functions	2	MA808BF	Interpret and generate representations of simple non-linear functions in tables, graphs, or words	BTBM19BG	Interpret simple non-linear functions (e.g., quadratic, cubic) in graphs, tables, or words
Relationships and functions	2	-	-	BTBM19BH	Generalize linear and non-linear pattern relationships or sequences

A dash (-) indicates no mapped questionnaire variable/item.

Light green shading indicates multiple Teacher Questionnaire items mapped to a single Curriculum Questionnaire item.

Exhibit B.3: Variable Framework Mapping — Grade 8 Geometry and Measurement

Mathematics Framework Topic	Mathematics Framework Topic Area	Curriculum Questionnaire Variable Name	Curriculum Questionnaire Item Text	Teacher Questionnaire Variable Name	Teacher Questionnaire Item Text
Geometry and measurement	1	-	-	BTBM19CA	Read and plot points in the Cartesian plane
Geometry and measurement	1	MA808CA	Recognize and draw different types of angles and lines	BTBM19CB	Recognize and draw different types of angles and lines
Geometry and measurement	2	MA808CC	The Pythagorean Theorem	BTBM19CC	Use geometric properties of polygons to calculate lengths, perimeter, and area (including the Pythagorean Theorem)
Geometry and measurement	2	MA808CB	Recognize two-dimensional shapes and use their properties (e.g., circles, triangles)	BTBM19CC	Use geometric properties of polygons to calculate lengths, perimeter, and area (including the Pythagorean Theorem)
Geometry and measurement	3	MA808CD	Geometric translations, reflections, and rotations	BTBM19CD	Determine the results of geometric translation, reflection, and rotation
Geometry and measurement	3	MA808CD	Geometric translations, reflections, and rotations	BTBM19CE	Use properties of similar and congruent figures
Geometry and measurement	4	MA808CE	Recognize three-dimensional shapes and use their geometric properties	BTBM19CF	Calculate surface area and volume of common three-dimensional shapes

A dash (-) indicates no mapped questionnaire variable/item.

Light blue shading indicates multiple Curriculum Questionnaire items mapped to a single Teacher Questionnaire item.

Light green shading indicates multiple Teacher Questionnaire items mapped to a single Curriculum Questionnaire item.

Exhibit B.4: Variable Framework Mapping — Grade 8 Data and Probability

Mathematics Framework Topic	Mathematics Framework Topic Area	Curriculum Questionnaire Variable Name	Curriculum Questionnaire Item Text	Teacher Questionnaire Variable Name	Teacher Questionnaire Item Text
Data	1	MA808DA	Interpret data from one or more sources (e.g., make comparisons, draw conclusions)	BTBM19DA	Interpret data from one or more data sources
Data	2	MA808DB	Organize and represent data in appropriate figures or tables to help answer questions	BTBM19DB	Represent data in graphs, charts, or plots
Data	3	MA808DC	Summarize data using the mean and median, and recognize the effect of spread	BTBM19DC	Calculate and interpret the mean or median of a data distribution
Probability	1	MA808DD	Determine theoretical and empirical probability for simple events	BTBM19DD	Calculate probabilities of simple and compound events
Probability	1	MA808DE	Determine theoretical and empirical probability for compound events	BTBM19DD	Calculate probabilities of simple and compound events

A dash (-) indicates no mapped questionnaire variable/item.

Light blue shading indicates multiple Curriculum Questionnaire items mapped to a single Teacher Questionnaire item.

Exhibit B.5: Variable Framework Mapping — Grade 8 Biology

Science Framework Topic	Science Framework Topic Area	Curriculum Questionnaire Variable Name	Curriculum Questionnaire Item Text	Teacher Questionnaire Variable Name	Teacher Questionnaire Item Text
Characteristics and life processes of organisms	1	SC808AA	Differences among major taxonomic groups of organisms (e.g., plants, fungi, reptiles, insects)	BTBS22AA	Defining characteristics of major taxonomic groups of organisms
Characteristics and life processes of organisms	2	SC808AB	Structures and functions of major organ systems in humans; how these compare to other organisms	BTBS22AB	Structures and functions of major organs and organ systems
Characteristics and life processes of organisms	3	SC808AC	How animals respond to internal and external changes to maintain stable body conditions (e.g., increased heart rate during exercise, sweating in heat)	BTBS22AC	How animals maintain stable body conditions
Cells and their functions	1	SC808AD	Structures in plants and animal cells and their functions	BTBS22AD	Major structures and functions in plant and animal cells
Cells and their functions	2	SC808AE	Photosynthesis and cellular respiration	BTBS22AE	Basic processes of photosynthesis
Cells and their functions	2	SC808AE	Photosynthesis and cellular respiration	BTBS22AF	Basic processes of cellular respiration
Life Cycles, reproduction, and heredity	1	SC808AF	Life cycles and patterns of development in different types of organisms (e.g., mammals, birds)	BTBS22AG	Life cycles of mammals, birds, amphibians, insects, and plants
Life Cycles, reproduction, and heredity	2	SC808AG	DNA and inheritance in plants and animals	BTBS22AH	Processes for reproduction and inheritance in plants and animals
Diversity, adaptation, and natural selection	1	SC808AH	Variation and natural selection	BTBS22AI	How variation in traits relates to natural selection and changes in life on Earth over time
Diversity, adaptation, and natural selection	2	SC808AI	Fossils as evidence for changes in life on Earth over time	BTBS22AI	How variation in traits relates to natural selection and changes in life on Earth over time
Ecosystems	1	SC808AJ	Flow of energy through ecosystems (e.g., producers, consumers, decomposers)	BTBS22AJ	Interpreting food web diagrams and the flow of energy in ecosystems
Ecosystems	2	SC808AK	Cycling of water, oxygen, and carbon in ecosystems	BTBS22AK	Cycling of water, oxygen, and carbon through ecosystems
Ecosystems	3	SC808AL	Relationships among populations of organisms in an ecosystem (e.g., competition, predation, symbiosis)	BTBS22AL	Predation, competition, and symbiosis in ecosystems
Ecosystems	4	-	-	BTBS22AM	How changes in an ecosystem affect the populations of organisms that live there
Ecosystems	5	SC808AM	Positive and negative impacts of human behavior on the environment	BTBS22AN	How human actions can positively or negatively impact the environment
Human health	1	SC808AN	Causes, transmission, prevention of, and resistance to diseases	BTBS22AO	How to prevent transmission of common diseases among humans
Human health	2	SC808AO	Diet, exercise, and other lifestyle choices for promoting human health	BTBS22AP	Importance of diet, exercise, and lifestyle choices for maintaining good human health

A dash (-) indicates no mapped questionnaire variable/item.

Light blue shading indicates multiple Curriculum Questionnaire items mapped to a single Teacher Questionnaire item.

Light green shading indicates multiple Teacher Questionnaire items mapped to a single Curriculum Questionnaire item.

Exhibit B.6: Variable Framework Mapping — Grade 8 Chemistry

Science Framework Topic	Science Framework Topic Area	Curriculum Questionnaire Variable Name	Curriculum Questionnaire Item Text	Teacher Questionnaire Variable Name	Teacher Questionnaire Item Text
Composition of matter	1	SC808BA	Structure of atoms and molecules (e.g., electrons, protons, neutrons)	BTBS22BA	Structure of atoms (i.e., protons, neutrons, electrons) and molecules
Composition of matter	2	SC808BB	Elements, compounds, and mixtures	BTBS22BB	Differences among elements, compounds, and mixtures
Composition of matter	3	SC808BC	The periodic table of elements as a way of organizing the elements	BTBS22BC	How to interpret the periodic table of elements
Properties of matter	1	SC808BD	Physical and chemical properties of matter (e.g., boiling point, flammability)	-	-
Properties of matter	2	SC808BE	Use of physical and chemical properties to classify matter (e.g., metals, nonmetals)	BTBS22BD	Classifying matter according to physical and chemical properties
Properties of matter	3	SC808BF	Separating mixtures	BTBS22BE	Methods for separating mixtures
Properties of matter	3	SC808BG	Concepts related to solutions (e.g., solvent, solute, concentration)	BTBS22BF	Solution concentration and rate of dissolving
Properties of matter	4	SC808BH	Properties of acids and bases	BTBS22BG	Properties of acids and bases
Chemical change	1	SC808BI	Characteristics of chemical changes (e.g., production of a new substance, color change)	BTBS22BH	Matter and energy in chemical reactions, including evidence of chemical change
Chemical change	2	SC808BJ	Conservation of matter and release/absorption of energy in chemical reactions	BTBS22BH	Matter and energy in chemical reactions, including evidence of chemical change
Chemical change	2	-	-	BTBS22BI	How to change the rate of chemical reactions
Chemical change	3	SC808BK	Chemical bonds between atoms	BTBS22BJ	Chemical bonds (e.g., role of electrons)

A dash (-) indicates no mapped questionnaire variable/item.

Light blue shading indicates multiple Curriculum Questionnaire items mapped to a single Teacher Questionnaire item.

Exhibit B.7: Variable Framework Mapping — Grade 8 Physics

Science Framework Topic	Science Framework Topic Area	Curriculum Questionnaire Variable Name	Curriculum Questionnaire Item Text	Teacher Questionnaire Variable Name	Teacher Questionnaire Item Text
Physical states and changes in matter	1	SC808CA	Motion of particles in solids, liquids, and gases	BTBS22CA	Separation and motion of atoms/molecules in solids, liquids, and gases
Physical states and changes in matter	2	SC808CB	Changes in states of matter (e.g., melting, condensation)	BTBS22CB	Characteristics of matter and energy during state changes
Energy transformation and transfer	1	SC808CC	Forms of energy and energy transformation (e.g., kinetic, potential, thermal)	BTBS22CC	Types of energy (e.g., kinetic, potential, thermal) and examples of energy transformations
Energy transformation and transfer	2	SC808CD	Thermal energy transfer and thermal conductivity of metals	BTBS22CD	Thermal conductivity and the transfer of thermal energy between objects of different temperatures
Light and sound	1	SC808CE	Properties of light (e.g., speed, transmission through media)	BTBS22CE	Reflection, refraction, or absorption of light
Light and sound	2	SC808CF	Properties of sound (e.g., amplitude, frequency)	BTBS22CF	Characteristics of sound (i.e., amplitude, frequency) and its transmission, reflection, and absorption
Electricity and magnetism	1	SC808CG	Conductors and movement of electricity through circuits	BTBS22CG	Electrical conductors and simple electrical circuits
Electricity and magnetism	2	SC808CH	Properties of permanent magnets and electromagnets	BTBS22CH	Polarity, strength, and uses of permanent magnets and electromagnets
Motion and forces	1	SC808CI	Concepts related to motion (e.g., speed, acceleration)	BTBS22CI	Speed as distance changing over time
Motion and forces	1	SC808CI	Concepts related to motion (e.g., speed, acceleration)	BTBS22CJ	Acceleration as speed changing over time
Motion and forces	2	SC808CJ	Common forces and their characteristics (e.g., strength, direction)	BTBS22CK	Effects of common forces on speed and direction of motion
Motion and forces	3	SC808CK	Effects of forces (e.g., floating, sinking, water pressure)	BTBS22CL	Density and buoyancy
Motion and forces	3	SC808CL	Functioning of simple machines (e.g., levers, inclined planes)	BTBS22CM	Functioning of simple machines (e.g., levers, inclined planes, pulleys)

A dash (-) indicates no mapped questionnaire variable/item.

Light green shading indicates multiple Teacher Questionnaire items mapped to a single Curriculum Questionnaire item.

Exhibit B.8: Variable Framework Mapping — Grade 8 Earth Science

Science Framework Topic	Science Framework Topic Area	Curriculum Questionnaire Variable Name	Curriculum Questionnaire Item Text	Teacher Questionnaire Variable Name	Teacher Questionnaire Item Text
Earth's structure and physical features	1	SC808DA	Earth's structure and physical characteristics (e.g., crust, mantle, distribution of water)	BTBS22DA	Earth's structure and distribution of water on its surface
Earth's structure and physical features	2	SC808DB	Makeup of Earth's atmosphere (i.e., nitrogen, oxygen, water vapor, carbon dioxide)	BTBS22DB	Gases present in Earth's atmosphere and their relative abundance
Earth's structure and physical features	2	SC808DB	Makeup of Earth's atmosphere (i.e., nitrogen, oxygen, water vapor, carbon dioxide)	BTBS22DC	Changes in temperature and pressure based on altitude
Earth's processes, cycles, and history	1	SC808DC	Geological processes that have shaped Earth's surface (the rock cycle, formation of fossil fuels)	BTBS22DD	How geological events impact Earth's surface
Earth's processes, cycles, and history	1	SC808DC	Geological processes that have shaped Earth's surface (the rock cycle, formation of fossil fuels)	BTBS22DE	Processes in the rock cycle (e.g., lava cooling, weathering)
Earth's processes, cycles, and history	1	SC808DC	Geological processes that have shaped Earth's surface (the rock cycle, formation of fossil fuels)	BTBS22DF	How fossils form and what they show about Earth's history
Earth's processes, cycles, and history	2	SC808DD	Earth's water cycle	BTBS22DG	Processes in Earth's water cycle
Earth's processes, cycles, and history	3	SC808DE	Differences between weather and climate and evidence for climate change	BTBS22DH	Differences between weather and climate and geographic factors affecting climate
Earth's processes, cycles, and history	3	SC808DE	Differences between weather and climate and evidence for climate change	BTBS22DI	Evidence for climate change
Earth's resources, their use, and conservation	1	SC808DF	Management of Earth's resources (e.g., advantages and disadvantages of different energy sources, methods of waste management)	BTBS22DJ	Use and conservation of Earth's resources, including land, water, and renewable and nonrenewable energy sources
Earth's resources, their use, and conservation	2	SC808DG	Land and water use (e.g., importance of conservation)	BTBS22DJ	Use and conservation of Earth's resources, including land, water, and renewable and nonrenewable energy sources
Earth in the Solar System and the universe	1	SC808DH	Observable phenomena on Earth resulting from the movements of Earth and the Moon (e.g., seasons, tides, eclipses)	BTBS22DK	Phenomena caused by the motion of Earth and the Moon (e.g., seasons, tides, Moon phases)
Earth in the Solar System and the universe	2	SC808DI	The role of the Sun in the Solar System (i.e., provides light/heat to planets and their moons)	BTBS22DL	The Sun as a star and physical features of the Earth, Moon, and other planets
Earth in the Solar System and the universe	2	SC808DJ	Compare characteristics of Earth to other bodies in the Solar System (e.g., presence of water, distance from Sun)	BTBS22DL	The Sun as a star and physical features of the Earth, Moon, and other planets

A dash (-) indicates no mapped questionnaire variable/item.

Light blue shading indicates multiple Curriculum Questionnaire items mapped to a single Teacher Questionnaire item.

Light green shading indicates multiple Teacher Questionnaire items mapped to a single Curriculum Questionnaire item.

Appendix C: Scatterplot Data Tables

Exhibit C.1: Underlying Data for Exhibits 2.3, 2.5, 2.7, and 2.9

Country	Number		Algebra		Geometry and Measurement		Data and Probability	
	Number of Curriculum Questionnaire Topics Taught	Average Percentage of Teacher Questionnaire Topics Taught to Students	Number of Curriculum Questionnaire Topics Taught	Average Percentage of Teacher Questionnaire Topics Taught to Students	Number of Curriculum Questionnaire Topics Taught	Average Percentage of Teacher Questionnaire Topics Taught to Students	Number of Curriculum Questionnaire Topics Taught	Average Percentage of Teacher Questionnaire Topics Taught to Students
Australia	7	97	6	58	4	81	5	90
Austria	7	98	6	68	5	93	2	64
Azerbaijan	7	100	6	90	4	91	5	94
Bahrain	7	100	6	83	5	95	5	89
Brazil	7	94	5	53	3	61	4	52
Chile	7	96	5	66	5	78	5	74
Chinese Taipei	7	99	6	88	4	80	4	64
Cote d'Ivoire	7	83	4	42	2	43	0	22
Cyprus	7	97	6	64	3	60	3	63
Czech Republic	7	100	5	33	5	84	3	27
England	7	98	5	72	5	74	5	83
Finland	7	97	6	52	5	69	3	32
France	7	91	6	28	4	80	4	59
Georgia	7	100	5	77	5	77	5	78
Hong Kong SAR	7	100	5	66	4	91	3	52
Hungary	7	100	5	77	5	95	5	85
Iran, Islamic Rep. of	7	98	5	54	5	92	4	79
Ireland	7	97	6	72	5	59	5	76
Israel	7	90	6	78	5	79	3	44
Italy	7	99	6	46	5	88	4	77
Japan	6	92	3	76	4	78	5	93
Jordan	7	99	6	87	5	97	5	86
Kazakhstan	7	100	6	96	5	72	5	79
Korea, Rep. of	7	94	5	79	5	89	4	77
Kuwait	7	100	6	66	5	94	5	95
Lithuania	7	100	5	69	5	70	3	73
Malaysia	7	100	6	85	5	79	4	60
Malta	7	96	5	64	5	58	5	72
Morocco	7	96	5	50	4	62	2	39
Oman	7	99	4	73	5	87	5	90
Palestinian Nat'l Auth.	7	100	4	60	4	90	5	86
Portugal	7	100	6	64	5	92	3	58
Qatar	7	100	6	75	5	86	5	80
Romania	7	100	6	91	5	94	5	96
Saudi Arabia	7	99	6	78	5	89	5	93
Singapore	7	100	6	90	4	90	4	90
South Africa	7	99	6	77	5	77	0	42
Sweden	6	83	6	54	4	55	5	67
Türkiye	7	100	5	78	4	78	4	96
United Arab Emirates	7	99	6	79	5	90	5	87
United States	7	99	6	87	5	87	5	84
Uzbekistan	7	100	6	87	5	74	5	77

See Exhibit 2.10 for information regarding country-level missing data for the Teacher Questionnaire topics.

Exhibit C.2: Underlying Data for Exhibits 3.3, 3.5, 3.7, and 3.9

Australia	10	64	7	67	9	54	7	62
Austria	13	79	11	81	12	85	7	85
Azerbaijan	9	82	11	98	12	90	10	95
Bahrain	14	87	11	76	12	83	10	88
Brazil	11	85	5	24	6	35	8	86
Chile	10	75	8	66	10	61	10	83
Chinese Taipei	15	73	10	93	7	48	5	11
Cote d'Ivoire	2	26	2	28	2	25	0	20
Cyprus	6	64	3	53	3	47	6	82
Czech Republic	11	87	11	85	11	87	10	93
England	9	71	11	74	11	75	4	56
Finland	11	73	11	91	11	75	7	85
France	9	69	8	49	7	41	7	71
Georgia	8	75	9	81	7	71	10	96
Hong Kong SAR	11	65	5	39	10	61	10	36
Hungary	13	92	11	96	12	96	10	93
Iran, Islamic Rep. of	11	62	10	84	10	70	7	72
Ireland	11	57	10	80	10	58	7	46
Israel	8	57	7	77	10	48	10	36
Italy	15	83	9	73	8	55	10	71
Japan	6	48	9	61	11	51	0	62
Jordan	15	88	11	89	12	85	10	82
Kazakhstan	15	96	11	96	12	93	10	99
Korea, Rep. of	9	68	4	58	9	66	6	72
Kuwait	8	78	9	88	11	83	4	74
Lithuania	15	86	9	75	12	84	10	94
Malaysia	13	93	11	72	9	60	9	65
Malta	13	43	8	52	12	47	7	39
Morocco	6	73	4	54	3	47	10	76
Oman	14	86	9	78	12	80	10	78
Palestinian Nat'l Auth.	11	81	10	90	10	78	10	86
Portugal	15	66	11	75	9	39	10	82
Qatar	9	81	9	76	10	75	5	73
Romania	15	96	11	94	12	96	10	58
Saudi Arabia	15	89	9	77	12	82	10	90
Singapore	12	73	9	79	10	68	3	20
South Africa	8	76	10	80	7	62	4	41
Sweden	14	79	11	72	12	79	10	61
Türkiye	14	91	10	89	11	81	10	86
United Arab Emirates	15	88	11	85	12	87	10	88
United States	15	89	6	77	11	82	9	90
Uzbekistan	10	85	7	98	2	97	0	98

See Exhibit 3.10 for information regarding country-level missing data for the Teacher Questionnaire topics.

Appendix D: Relative Achievement in Mathematics and Science Content Domains

Exhibit D.1: Relative Achievement in Mathematics Content Domains

Country	Overall Mathematics Average Scale Score	Number (63 Items)		Algebra (58 Items)		Geometry and Measurement (42 Items)		Data and Probability (37 Items)	
		Average Scale Score	Difference from Overall Score	Average Scale Score	Difference from Overall Score	Average Scale Score	Difference from Overall Score	Average Scale Score	Difference from Overall Score
³ Singapore	605 (6.1)	606 (5.7)	1 (1.6)	604 (6.8)	-1 (1.8)	605 (6.0)	-1 (1.3)	615 (6.8)	10 (1.7) ▲
Chinese Taipei	602 (3.1)	611 (3.4)	9 (1.7) ▲	612 (3.2)	10 (1.4) ▲	600 (3.0)	-2 (1.6)	585 (2.9)	-17 (1.1) ▼
Korea, Rep. of	596 (3.0)	602 (3.1)	6 (1.5) ▲	595 (3.1)	-1 (1.4)	603 (3.6)	7 (1.6) ▲	584 (3.8)	-12 (2.9) ▼
† Japan	595 (3.0)	590 (3.7)	-5 (1.2) ▼	593 (3.5)	-2 (1.3)	600 (3.2)	5 (1.6) ▲	609 (3.2)	15 (2.0) ▲
† Hong Kong SAR	575 (5.0)	576 (5.3)	1 (1.2)	577 (5.5)	3 (1.3)	579 (5.6)	4 (1.3) ▲	562 (5.4)	-13 (1.7) ▼
² England	525 (4.5)	532 (4.8)	8 (1.5) ▲	513 (4.8)	-12 (1.6) ▼	519 (4.6)	-6 (1.1) ▼	537 (5.4)	12 (2.2) ▲
Ireland	522 (2.7)	528 (2.9)	6 (1.3) ▲	503 (2.9)	-19 (1.2) ▼	513 (3.3)	-8 (2.4) ▼	546 (3.3)	24 (1.3) ▲
² Czech Republic	518 (2.3)	525 (2.4)	7 (0.8) ▲	513 (2.6)	-5 (1.5) ▼	520 (2.5)	2 (1.0)	504 (2.3)	-14 (0.9) ▼
² Sweden	517 (2.4)	514 (2.4)	-4 (1.2) ▼	511 (2.8)	-6 (1.7) ▼	516 (3.1)	-1 (2.0)	532 (3.0)	15 (1.2) ▲
² Lithuania	514 (3.1)	509 (3.2)	-5 (1.1) ▼	512 (3.3)	-1 (0.8)	526 (3.3)	12 (0.9) ▲	506 (3.5)	-7 (1.6) ▼
² Austria	512 (2.3)	511 (2.3)	-1 (1.2)	517 (2.7)	5 (2.1)	519 (2.8)	7 (1.7) ▲	495 (2.5)	-17 (0.8) ▼
Australia	509 (3.5)	505 (3.6)	-4 (1.2) ▼	498 (3.4)	-10 (0.9) ▼	506 (3.5)	-3 (1.6)	532 (3.8)	24 (1.0) ▲
³ † Türkiye	509 (4.3)	511 (4.6)	2 (1.6)	498 (4.9)	-11 (1.5) ▼	496 (4.4)	-13 (2.1) ▼	529 (4.4)	20 (1.0) ▲
Hungary	506 (3.7)	510 (3.9)	4 (1.0) ▲	504 (3.9)	-2 (1.6)	506 (3.8)	0 (1.6)	498 (3.5)	-8 (0.9) ▼
Finland	504 (2.6)	504 (2.6)	0 (1.3)	490 (2.7)	-13 (0.8) ▼	513 (2.7)	9 (0.9) ▲	508 (2.9)	4 (1.2) ▲
² Norway (9)	501 (2.3)	495 (2.4)	-5 (1.2) ▼	485 (2.6)	-15 (1.0) ▼	506 (2.8)	6 (1.4) ▲	521 (3.3)	21 (2.2) ▲
Italy	501 (3.0)	502 (2.8)	2 (1.1)	492 (3.3)	-9 (1.9) ▼	509 (3.8)	8 (1.6) ▲	496 (3.2)	-5 (0.8) ▼
Malta	499 (1.2)	500 (1.3)	0 (0.8)	496 (1.6)	-3 (1.3)	496 (1.5)	-3 (1.3)	505 (1.6)	6 (1.3) ▲
≡ Romania	496 (4.9)	503 (4.7)	7 (1.2) ▲	502 (5.1)	6 (1.7) ▲	492 (5.1)	-4 (1.8)	467 (6.1)	-29 (2.8) ▼
Cyprus	494 (2.7)	487 (2.9)	-7 (1.3) ▼	507 (3.0)	14 (1.4) ▲	492 (3.0)	-2 (1.4)	486 (3.2)	-8 (1.7) ▼
United Arab Emirates	489 (1.7)	493 (1.7)	4 (0.4) ▲	496 (1.8)	8 (0.4) ▲	479 (2.0)	-10 (0.7) ▼	475 (1.9)	-13 (0.7) ▼
≡ United States	488 (4.2)	486 (4.4)	-2 (1.1)	492 (4.6)	4 (0.9) ▲	480 (4.0)	-8 (1.0) ▼	492 (4.1)	4 (1.1) ▲
³ Israel	487 (3.9)	485 (3.9)	-2 (1.0)	494 (4.1)	7 (1.9) ▲	484 (4.1)	-4 (1.7)	481 (4.4)	-6 (1.9) ▼
France	479 (3.1)	475 (3.2)	-3 (1.2) ▼	466 (3.6)	-13 (1.4) ▼	482 (3.6)	3 (1.8)	491 (3.5)	12 (1.4) ▲
Azerbaijan	479 (3.7)	494 (4.0)	15 (1.8) ▲	489 (4.2)	11 (1.9) ▲	458 (4.1)	-20 (1.9) ▼	442 (4.6)	-37 (2.5) ▼
Portugal	475 (2.7)	468 (2.6)	-8 (1.1) ▼	474 (3.3)	-1 (2.3)	485 (3.0)	10 (1.7) ▲	474 (2.5)	-1 (1.4)
¹ Georgia	467 (3.2)	477 (3.4)	10 (2.0) ▲	476 (3.5)	10 (1.6) ▲	452 (3.2)	-15 (1.7) ▼	433 (3.2)	-33 (2.1) ▼
Kazakhstan	454 (3.5)	454 (3.3)	0 (1.3)	466 (4.1)	12 (1.7) ▲	445 (3.4)	-9 (1.4) ▼	432 (3.4)	-22 (2.4) ▼
Qatar	451 (4.2)	448 (4.5)	-3 (1.7)	459 (4.4)	8 (1.4) ▲	441 (4.5)	-10 (1.2) ▼	443 (4.5)	-9 (1.4) ▼
Bahrain	426 (2.4)	423 (2.4)	-3 (1.7)	434 (2.8)	7 (1.4) ▲	416 (2.7)	-11 (1.7) ▼	421 (2.6)	-5 (1.7) ▼
ψ Iran, Islamic Rep. of	423 (3.6)	416 (3.7)	-7 (2.1) ▼	424 (3.8)	1 (1.0)	406 (3.7)	-17 (1.3) ▼	423 (3.4)	-1 (1.5)
Uzbekistan	421 (4.3)	433 (4.6)	12 (1.2) ▲	427 (5.1)	6 (2.0) ▲	415 (4.3)	-6 (1.8) ▼	371 (4.8)	-50 (2.5) ▼
† Chile	416 (3.2)	411 (3.0)	-5 (1.6) ▼	414 (3.7)	-2 (2.9)	410 (3.0)	-6 (2.3)	420 (3.9)	4 (1.4) ▲
Oman	411 (2.7)	408 (2.8)	-3 (1.6)	419 (2.8)	8 (0.7) ▲	403 (2.7)	-8 (1.6) ▼	403 (2.7)	-8 (1.6) ▼
Malaysia	411 (3.5)	409 (3.6)	-2 (0.8)	406 (3.7)	-4 (1.1) ▼	417 (3.4)	6 (1.0) ▲	403 (3.5)	-8 (1.4) ▼
ψ Kuwait	399 (5.2)	399 (5.4)	0 (2.1)	382 (6.1)	-17 (1.6) ▼	386 (6.3)	-13 (2.8) ▼	402 (4.5)	4 (2.2)
² Saudi Arabia	397 (3.3)	393 (3.7)	-4 (1.6) ▼	401 (3.5)	5 (1.0) ▲	385 (3.4)	-12 (2.1) ▼	397 (3.4)	0 (1.8)
ψ South Africa (9)	397 (3.1)	410 (3.2)	13 (1.4) ▲	411 (3.6)	14 (1.8) ▲	358 (3.8)	-39 (1.3) ▼	341 (3.6)	-55 (1.8) ▼
Jordan	388 (3.2)	392 (3.1)	4 (1.4) ▲	405 (3.4)	17 (1.4) ▲	373 (3.6)	-15 (1.6) ▼	359 (4.0)	-29 (2.9) ▼
Morocco	378 (3.0)	382 (3.2)	5 (1.7) ▲	375 (3.8)	-3 (1.5)	380 (3.6)	2 (1.6)	354 (2.8)	-24 (1.3) ▼
ψ Palestinian Nat'l Auth.	382 (3.0)	--	--	--	--	--	--	--	--
ψ Brazil	378 (2.8)	--	--	--	--	--	--	--	--
≡ New Zealand	485 (4.1)	484 (4.2)	-1 (1.5)	472 (4.5)	-13 (1.9) ▼	483 (4.5)	-3 (2.8)	503 (4.0)	18 (1.5) ▲
* Cote d'Ivoire	263 (4.9)	--	--	--	--	--	--	--	--

Numbers of items are based on the TIMSS 2023 eighth-grade mathematics items included in scaling.

() Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

See Appendix B.7 in the *TIMSS 2023 International Results* for population coverage notes 1, 2, and 3. See Appendix B.10 in the *TIMSS 2023 International Results* for sampling guidelines and sampling participation notes †, ‡, and ≡.

ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.

* Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

A dash (-) indicates comparable data not available because average achievement could not be accurately estimated.

New Zealand did not satisfy guidelines for minimum school participation rates. Achievement could not be reliably estimated for Cote d'Ivoire.

Exhibit D.2: Relative Achievement in Science Content Domains

Country	Overall Science Average Scale Score	Biology (76 Items)		Chemistry (43 Items)		Physics (48 Items)		Earth Science (45 Items)	
		Average Scale Score	Difference from Overall Score	Average Scale Score	Difference from Overall Score	Average Scale Score	Difference from Overall Score	Average Scale Score	Difference from Overall Score
³ Singapore	606 (5.7)	622 (6.1)	16 (1.7) ▲	618 (6.5)	11 (2.1) ▲	614 (6.4)	8 (1.9) ▲	572 (5.2)	-34 (1.7) ▼
Chinese Taipei	572 (2.4)	558 (2.3)	-14 (1.7) ▼	593 (3.0)	21 (1.1) ▲	565 (2.7)	-6 (1.1) ▼	581 (2.7)	9 (1.2) ▲
[†] Japan	557 (3.1)	549 (3.1)	-8 (2.5) ▼	555 (4.2)	-2 (2.4)	563 (3.3)	6 (1.0) ▲	566 (3.5)	9 (1.8) ▲
Korea, Rep. of	545 (2.2)	547 (2.5)	1 (1.5)	522 (2.4)	-23 (1.4) ▼	557 (2.9)	12 (1.4) ▲	555 (2.7)	10 (1.5) ▲
² England	531 (4.3)	531 (4.2)	-1 (1.6)	533 (4.7)	2 (3.0)	532 (4.6)	1 (1.2)	531 (4.7)	0 (2.3)
Finland	531 (3.2)	524 (3.0)	-7 (2.5) ▼	529 (3.3)	-1 (2.3)	536 (3.4)	5 (1.7) ▲	537 (3.5)	6 (1.8) ▲
^{3†} Türkiye	530 (3.6)	517 (3.7)	-12 (2.2) ▼	550 (4.7)	20 (2.3) ▲	534 (3.9)	4 (1.7) ▲	525 (3.8)	-4 (1.1) ▼
[†] Hong Kong SAR	528 (4.7)	527 (5.2)	-1 (1.8)	523 (5.3)	-5 (2.0)	529 (5.1)	1 (2.3)	532 (5.2)	5 (2.4)
² Czech Republic	527 (2.0)	526 (2.2)	-1 (1.1)	517 (3.3)	-10 (3.0) ▼	533 (3.1)	6 (2.3)	530 (2.3)	3 (1.1) ▲
Ireland	525 (3.5)	519 (4.1)	-6 (1.6) ▼	528 (3.6)	3 (1.8)	521 (3.7)	-4 (1.9)	536 (3.7)	11 (1.1) ▲
Hungary	522 (3.3)	521 (3.6)	0 (2.1)	513 (3.8)	-9 (1.5) ▼	524 (3.5)	2 (1.7)	525 (3.8)	4 (2.6)
² Sweden	521 (2.9)	519 (3.3)	-2 (2.1)	520 (3.6)	-1 (2.0)	520 (2.9)	-1 (1.5)	526 (3.3)	5 (1.6) ▲
Australia	520 (3.2)	513 (3.1)	-7 (1.1) ▼	515 (3.2)	-5 (1.1) ▼	530 (3.6)	10 (1.9) ▲	527 (3.7)	7 (2.0) ▲
² Lithuania	519 (3.0)	519 (3.2)	0 (0.8)	524 (3.7)	4 (2.0)	516 (3.2)	-3 (1.5)	517 (3.2)	-3 (1.6)
[≡] United States	513 (3.9)	516 (3.9)	3 (1.0) ▲	505 (4.1)	-9 (1.5) ▼	517 (4.2)	3 (1.5)	511 (4.3)	-3 (1.1)
² Austria	512 (2.4)	504 (3.0)	-8 (1.7) ▼	507 (3.0)	-4 (1.7)	523 (2.8)	11 (1.6) ▲	521 (3.5)	10 (2.4) ▲
Portugal	506 (2.4)	511 (2.6)	6 (1.4) ▲	502 (2.8)	-4 (1.3) ▼	495 (2.2)	-11 (1.2) ▼	507 (3.2)	2 (2.3)
Malta	501 (1.6)	493 (1.7)	-9 (0.9) ▼	508 (1.8)	7 (0.9) ▲	505 (1.6)	4 (1.3) ▲	506 (1.8)	4 (1.1) ▲
Italy	501 (3.2)	505 (3.6)	5 (1.2) ▲	490 (3.3)	-11 (1.2) ▼	486 (3.6)	-15 (1.6) ▼	513 (4.1)	12 (2.3) ▲
² Norway (9)	488 (2.6)	483 (2.9)	-5 (1.3) ▼	478 (3.4)	-10 (1.8) ▼	492 (2.8)	4 (1.2) ▲	503 (2.6)	15 (1.2) ▲
United Arab Emirates	486 (2.0)	488 (2.3)	1 (0.7)	498 (2.4)	11 (1.0) ▲	483 (2.1)	-3 (0.6) ▼	475 (2.4)	-11 (1.0) ▼
France	486 (3.2)	477 (3.3)	-9 (1.5) ▼	481 (3.4)	-5 (3.2)	496 (3.3)	9 (1.2) ▲	493 (3.3)	7 (1.7) ▲
Qatar	481 (4.3)	484 (4.3)	3 (1.6)	481 (5.0)	-1 (1.9)	478 (4.4)	-3 (1.1)	473 (4.7)	-8 (2.1) ▼
³ Israel	481 (3.6)	477 (3.9)	-3 (2.1)	489 (4.3)	8 (2.0) ▲	489 (3.9)	8 (1.5) ▲	465 (4.3)	-15 (2.1) ▼
[≡] Romania	466 (4.1)	475 (4.3)	9 (2.3) ▲	465 (4.1)	-1 (2.1)	457 (4.6)	-9 (2.6) ▼	460 (4.4)	-6 (2.5)
Cyprus	464 (3.0)	468 (3.2)	4 (2.3)	464 (3.7)	0 (2.3)	457 (3.3)	-8 (2.4) ▼	463 (4.5)	-1 (2.5)
Oman	456 (2.6)	464 (2.3)	8 (1.6) ▲	455 (2.7)	-1 (1.3)	455 (2.3)	-1 (1.2)	435 (2.6)	-21 (0.9) ▼
[†] Chile	455 (2.7)	463 (3.4)	8 (2.2) ▲	446 (2.8)	-9 (1.6) ▼	445 (2.9)	-10 (1.6) ▼	455 (2.6)	0 (1.7)
Bahrain	452 (2.6)	453 (2.5)	1 (1.4)	457 (2.9)	5 (1.6) ▲	450 (2.3)	-2 (1.9)	436 (3.0)	-16 (2.6) ▼
¹ Georgia	448 (2.9)	459 (3.3)	11 (3.3) ▲	448 (3.3)	0 (1.6)	440 (3.2)	-8 (2.7) ▼	427 (3.2)	-21 (2.3) ▼
Kazakhstan	443 (3.0)	439 (3.4)	-4 (0.9) ▼	453 (3.0)	10 (1.0) ▲	448 (2.7)	6 (1.1) ▲	426 (3.2)	-16 (1.4) ▼
Malaysia	426 (3.7)	425 (4.0)	-1 (0.9)	428 (3.7)	1 (0.9)	426 (3.5)	0 (1.4)	421 (3.8)	-5 (0.8) ▼
Brazil	420 (2.5)	428 (2.9)	8 (1.1) ▲	414 (2.4)	-5 (0.7) ▼	405 (2.9)	-15 (1.4) ▼	421 (3.0)	1 (1.3)
Kuwait	420 (5.8)	414 (5.7)	-6 (2.5)	417 (6.5)	-3 (2.7)	423 (5.4)	3 (2.5)	420 (5.8)	0 (2.8)
² Saudi Arabia	419 (3.4)	416 (3.8)	-3 (0.9) ▼	423 (3.4)	4 (1.3) ▲	415 (3.2)	-4 (1.8)	419 (3.0)	0 (1.9)
Iran, Islamic Rep. of	419 (3.6)	421 (3.4)	2 (1.5)	418 (3.9)	-1 (1.8)	408 (3.2)	-11 (1.6) ▼	411 (4.2)	-8 (2.7) ▼
Jordan	413 (3.6)	411 (3.4)	-2 (1.5)	414 (4.1)	1 (1.5)	415 (3.1)	2 (1.5)	406 (3.4)	-7 (2.1) ▼
Azerbaijan	411 (3.0)	419 (2.8)	8 (1.7) ▲	413 (3.2)	2 (1.5)	400 (3.7)	-11 (1.9) ▼	398 (3.1)	-14 (1.4) ▼
Uzbekistan	396 (3.7)	396 (4.3)	0 (1.7)	401 (3.2)	6 (2.0) ▲	388 (3.7)	-8 (1.8) ▼	389 (3.4)	-7 (1.9) ▼
Palestinian Nat'l Auth.	393 (2.9)	388 (2.9)	-5 (0.9) ▼	409 (3.1)	16 (1.8) ▲	402 (2.8)	9 (1.2) ▲	368 (3.4)	-25 (1.5) ▼
^ψ South Africa (9)	362 (4.0)	346 (4.2)	-16 (0.8) ▼	368 (4.4)	6 (1.7) ▲	374 (3.8)	12 (0.8) ▲	361 (3.7)	-2 (1.6)
^ψ Morocco	327 (3.4)	318 (3.8)	-9 (2.1) ▼	333 (3.4)	6 (2.1) ▲	324 (3.9)	-3 (1.6)	327 (3.4)	0 (1.8)
[≡] New Zealand	502 (4.0)	497 (4.2)	-5 (1.6) ▼	501 (4.2)	-1 (1.9)	508 (4.4)	6 (2.7)	508 (3.8)	6 (2.0) ▲
[✳] Cote d'Ivoire	183 (8.2)	--	--	--	--	--	--	--	--

Numbers of items are based on the TIMSS 2023 eighth-grade science items included in scaling.

() Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

See Appendix B.7 in the TIMSS 2023 International Results for population coverage notes 1, 2, and 3. See Appendix B.10 in the TIMSS 2023 International Results for sampling guidelines and sampling participation notes †, ‡, and ≡.

ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.

✳ Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

A dash (-) indicates comparable data not available because average achievement could not be accurately estimated.

New Zealand did not satisfy guidelines for minimum school participation rates. Achievement could not be reliably estimated for Cote d'Ivoire.

Appendix E: Technical Details

Data and Sample

The datasets used in this study are publicly available from the [TIMSS 2023 International Database](#). Primary data sources were the eighth-grade Curriculum Questionnaire, the eighth-grade Mathematics and Science Teacher Questionnaires, and eighth-grade student achievement data.

In general, data from all countries were included in the analyses. However, there are some exceptions to this principle, and some countries are excluded from specific sets of results:

- Norway did not have comparable data available for teachers' reports of topics taught to students and is excluded from any analyses using these reports.
- New Zealand did not satisfy minimum school participation requirements and is reported at the bottom of exhibits that report student-level data.
- Some countries do not have mathematics or science content domain subscores in TIMSS 2023 due to low reliability, so they were excluded from correlation analyses. This included Brazil, Côte d'Ivoire, and Palestinian National Authority in mathematics and Côte d'Ivoire in science.
- The TIMSS 2023 eighth-grade benchmarking participants from the United Arab Emirates were not included in this report.

Merging and Data Processing

[Appendix B: Curriculum and Teacher Questionnaire Framework Mapping](#) provides important information about the preparatory work of checking correspondence between the Curriculum Questionnaire and Teacher Questionnaire items related to curriculum topics. This section focuses on the data preparation and analysis following this process.

Descriptive analyses for the Curriculum Questionnaire data reported at the country level were completed using IBM SPSS Statistics (Version 26). Curriculum Questionnaire responses were recoded to determine mathematics and science content domain coverage at the national level. The response categories "All or almost all students" and "Only the more advanced students" were recoded as "Taught," and "Not included in the curriculum through Grade 8" was recoded as "Not Taught." This recoding process generated dichotomous variables (Taught = 1; Not Taught = 0) for each Curriculum Questionnaire item. For each mathematics and science content domain, the number of items coded as Taught was summed to produce an overall measure of intended curriculum coverage and produce the bar charts shown in this report.

Teacher responses to the Teacher Questionnaires were recoded using a similar procedure as was applied to the Curriculum Questionnaire data. The categories “Mostly taught before this year” and “Mostly taught this year” were recoded as “Taught,” while “Not included in the curriculum through Grade 8” was recoded as “Not Taught.”

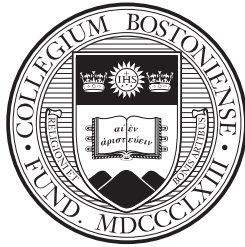
To calculate the average percentage of topics taught to students, as well as the correlation between the percentage of topics taught and achievement in the content domains, teacher questionnaire data was merged with student achievement data. A student was considered to have been taught a topic if at least one of their teachers reported that it had been taught, and data were aggregated such that each student was represented by a single row (sometimes including data from multiple teachers) in the final dataset. This allowed for calculation of percentages of mathematics and science content domain topics taught at the student level. If students were missing data for more than one third of items in a particular content domain, the percentage of topics taught for that student was treated as missing within the content domain. Using these student-level percentages, country-level average percentages and associated jackknife standard errors were subsequently computed with the [IEA IDB Analyzer](#) together with SPSS, applying the student-level TOTWGT. Then, country-level mathematics and science content domain averages were merged with the curriculum data to generate the scatterplots presented in this report.

The Pearson correlation coefficients between the average percentage of topics taught to students and student achievement were estimated using the IDB Analyzer and SPSS. Student achievement was represented by plausible values (PVs) provided for each content domain (Number, Algebra, Geometry and Measurement, Data and Probability, Biology, Chemistry, Physics, and Earth Science). These PVs are imputed proficiency estimates based on the subset of items assessing topics within each content domain.³⁶ All analyses incorporated the student-level sampling weight (TOTWGT), and jackknife repeated replication was used to estimate standard errors.³⁷

References

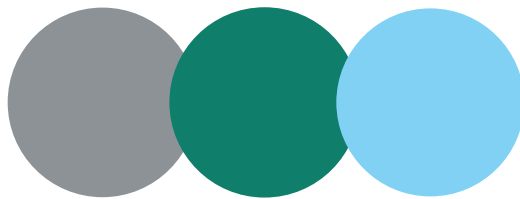
- 1 Aldrich, C. E. A., Bookbinder, A., & Khorramdel, L. (2024). Developing the TIMSS mathematics and science achievement instruments. In M. von Davier, B. Fishbein, & A. Kennedy (Eds.), *TIMSS 2023 technical report (methods and procedures)* (pp. 1.1–1.23). Boston College, TIMSS & PIRLS International Study Center. <https://doi.org/10.6017/lse.tpisc.timss.rs3063>
- 2 Mullis, I. V. S., Martin, M. O., & von Davier, M. (Eds.). (2021). *TIMSS 2023 assessment frameworks*. Boston College, TIMSS & PIRLS International Study Center. <https://timssandpirls.bc.edu/timss2023>
- 3 Johansson, S., & Hansen, K. Y. (2019). Are mathematics curricula harmonizing globally over time? Evidence from TIMSS National Research Coordinator data. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(2), em1656. <https://doi.org/10.29333/ejmste/99516>
- 4 Shimizu, Y., & Vithal, R. (2023). Mathematics curriculum reforms around the world: The 24th ICMI study (p. 584). Springer Nature. <https://doi.org/10.1007/978-3-031-13548-4>
- 5 Stacey, O., De Lazzari, G., Grayson, H., Griffin, H., Jones, E., Taylor, A., & Thomas, D. (2018). *The globalization of science curricula*. Springer Nature. <https://doi.org/10.1007/978-3-319-71532-2>
- 6 Clark-Wilson, A., & Hoyles, C. (2019). From curriculum design to enactment in technology enhanced mathematics instruction—Mind the gap! *International Journal of Educational Research*, 94, 66–76. <https://doi.org/10.1016/j.ijer.2018.11.015>
- 7 Nevenglosky, E. A. (2018). *Barriers to effective curriculum implementation* (Publication No.10823221) [Doctoral dissertation, Walden University]. ProQuest Dissertations & Theses Global.
- 8 Au, W. (2007). High-stakes testing and curricular control: A qualitative metasynthesis. *Educational Researcher*, 36(5), 258–267. <https://doi.org/10.3102/0013189X07306523>
- 9 Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research*, 75(2), 211–246. <https://doi.org/10.3102/003465430750022>
- 10 Stein, M. K., Remillard, J., & Smith, M. S. (2007). How curriculum influences student learning. In F. K. Lester, Jr. (Ed.), *Second handbook of research on mathematics teaching and learning* (Vol. 1, pp. 319–370). Emerald Publishing Limited. <https://doi.org/10.1108/978-1-28141-200-320251012>
- 11 Mullis, I. V. S., & Martin, M. O. (Eds.). (2017). *TIMSS 2019 assessment frameworks*. Boston College, TIMSS & PIRLS International Study Center. <http://timssandpirls.bc.edu/timss2019/frameworks/>
- 12 Tyler, R. W. (1957). The curriculum—then and now. *The Elementary School Journal*, 57(7), 364–374.
- 13 Livingstone, I. D. (1986). *Second International Mathematics Study. Perceptions of the intended and implemented mathematics curriculum. Contractor's report 1986*. <https://eric.ed.gov/?id=ED274525>
- 14 Kurz, A., Elliott, S. N., Wehby, J. H., & Smithson, J. L. (2010). Alignment of the intended, planned, and enacted curriculum in general and special education and its relation to student achievement. *The Journal of Special Education*, 44(3), 131–145. <https://doi.org/10.1177/0022466909341196>
- 15 Bokhove, C., Miyazaki, M., Komatsu, K., Chino, K., Leung, A., & Mok, I. A. C. (2019). The role of “opportunity to learn” in the geometry curriculum: A multilevel comparison of six countries. *Frontiers in Education*, 4(63). Frontiers Media SA. <https://doi.org/10.3389/educ.2019.00063>
- 16 Floden, R. E. (2002). The measurement of opportunity to learn. In A. C. Porter & A. Gamoran (Eds.), *Methodological advances in cross-national surveys of educational achievement* (pp. 231–266). Board on International Comparative Studies in Education, National Academy Press. <https://www.nationalacademies.org/read/10322/chapter/9>
- 17 Scheerens, J. (2016). Recapitalization, implications for educational policy and practice and future research. In *Opportunity to Learn, Curriculum Alignment and Test Preparation: A Research Review* (pp. 121–135). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-43110-9_6
- 18 Martone, A., & Sireci, S. G. (2009). Evaluating alignment between curriculum, assessment, and instruction. *Review of Educational Research*, 79(4), 1332–1361. <https://doi.org/10.3102/0034654309341375>

- 19 Bhaw, N., & Kriek, J. (2023). The curriculum–TIMSS alignment for grade 8 science from 2007 to 2019: A case of South Africa and Singapore. *African Journal of Research in Mathematics, Science and Technology Education*, 27, 71–84. <https://doi.org/10.1080/18117295.2023.2192903>
- 20 Roach, A. T., Niebling, B. C., & Kurz, A. (2008). Evaluating the alignment among curriculum, instruction, and assessments: Implications and applications for research and practice. *Psychology in the Schools*, 45(2), 158–176. <https://doi.org/10.1002/pits.20282>
- 21 Traynor, A. (2017). Does test item performance increase with test-to-standards alignment? *Educational Assessment*, 22(3), 171–188. <https://doi.org/10.1080/10627197.2017.1344092>
- 22 Pelgrum, W. J. (1989). *Educational assessment: Monitoring, evaluation and the curriculum*. Enschede: Febo Printers.
- 23 Scheerens, Recapitalization.
- 24 Martone & Sireci, Evaluating alignment.
- 25 Polikoff, M. S., & Porter, A. C. (2014). Instructional alignment as a measure of teaching quality. *Educational Evaluation and Policy Analysis*, 36(4), 399–416. <https://doi.org/10.3102/0162373714531851>
- 26 Bhaw & Kriek, Curriculum–TIMSS alignment for grade 8 science.
- 27 Livingstone, Second International Mathematics Study.
- 28 Daus, S., & Braeken, J. (2018). The sensitivity of TIMSS country rankings in science achievement to differences in opportunity to learn at classroom level. *Large-scale Assessments in Education*, 6(1), 1. <https://doi.org/10.1186/s40536-018-0054-1>
- 29 Karakus, G. (2021). A literary review on curriculum implementation problems. *Shanlax International Journal of Education*, 9(3), 201–220. <https://doi.org/10.34293/education.v9i3.3983>
- 30 Mullis, *TIMSS 2023 assessment frameworks*.
- 31 Centurino, V. A. S. & Kelly, D. L. (2021). TIMSS 2023 science framework. In I. V. S. Mullis, M. O. Martin, & M. von Davier (Eds.), *TIMSS 2023 assessment frameworks*. <https://timssandpirls.bc.edu/timss2023/frameworks/chapter-2.html>.
- 32 Philpot, R., Lindquist, M., Mullis, I. V. S., & Aldrich, C. E. A. (2021). TIMSS 2023 mathematics framework. In I. V. S. Mullis, M. O. Martin, & M. von Davier (Eds.), *TIMSS 2023 assessment frameworks*. <https://timssandpirls.bc.edu/timss2023/frameworks/chapter-1.html>
- 33 Alia, A., Japelj Pavešić, B., & Rožman, M. (2022). Opportunity to learn mathematics and science. In B. Japelj Pavešić, P. Koršňáková, & S. Meinck (Eds.), *Dinaric perspectives on TIMSS 2019: Teaching and learning in mathematics and science in South-Eastern Europe* (IEA Research for Education, Vol. 13, pp. 39–64). Springer, Cham. https://doi.org/10.1007/978-3-030-85802-5_3
- 34 Daus, The sensitivity of TIMSS country rankings.
- 35 Bokhove et al., Opportunity to learn in the geometry curriculum.
- 36 Fishbein, B., Yin, L., & Bezirhan, U. (2024). TIMSS 2023 achievement scaling implementation. In M. von Davier, B. Fishbein, & A. Kennedy (Eds.), *TIMSS 2023 technical report (methods and procedures)* (pp. 12.1–12.23). Boston College, TIMSS & PIRLS International Study Center. <https://doi.org/10.6017/lse.tpisc.timss.rs4586>
- 37 Fishbein, B., Siegel, P., Atasever, U., Cooney, D., & Gonzalez, E. (2024). Standard error estimation in TIMSS. In M. von Davier, B. Fishbein, & A. Kennedy (Eds.), *TIMSS 2023 technical report (methods and procedures)* (pp 13.1–13.10). Boston College, TIMSS & PIRLS International Study Center. <https://doi.org/10.6017/lse.tpisc.timss.rs6950>



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