CHAPTER 4:

TIMSS 2027 Assessment Design

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Overview

TIMSS has been conducted every four years since 1995, assessing two student populations in mathematics and science. With each assessment designed to link to the one that preceded it, TIMSS provides regular and timely trend data for educators and policymakers that can be used to inform evidence-based decisions for improving educational policy and practice. For countries that have participated since its inception, TIMSS now provides trend data covering 32 years.

In each cycle, TIMSS aims to assess student achievement in mathematics and science in a way that represents the breadth and richness of these subjects as they are taught across participating countries. It also seeks to monitor educational progress by facilitating the analysis of trends in student performance from one assessment cycle to the next. Given the diversity of curricula and student ability levels within and across participating countries, and evolving curricular expectations over time, TIMSS requires assessments that span a wide range of topics and item difficulty levels. To achieve these goals, TIMSS uses an innovative measurement approach.

The TIMSS 2027 assessment design builds on the key features of the group adaptive design introduced in TIMSS 2023 and leverages the enhanced adaptability of digital-based assessments to further reduce the mismatch between item difficulty and student ability at the group and individual levels. At the group level, the TIMSS 2027 adaptive design organizes the assessment blocks by difficulty level—difficult, medium, and easy—and combines these blocks into more and less difficult test forms. While each country administers all the test forms, the sampling proportions of more and less difficult forms can vary with the expected mathematics and science achievement levels of the students in each country.

To further improve measurement accuracy, particularly for those at the lower end of the proficiency distribution, TIMSS 2027 includes four new blocks at each grade level: two very easy mathematics blocks and two very easy science blocks. These blocks are intended for students who struggle to respond correctly to items in the initial part of their assigned test form. With this feature, the TIMSS 2027 assessment design aims to measure students' achievement more

precisely, while limiting changes to the design and ensuring that trend can be reported with the same level of confidence as in past cycles of TIMSS.

Student Population Assessed

TIMSS assesses the mathematics and science achievement of students in their fourth and eighth years of formal schooling. Participating countries may choose to assess one or both populations, according to their policy priorities and resource availability.

TIMSS defines the target populations as students in the fourth and eighth years of schooling according to the International Standard Classification of Education[1] developed by the UNESCO Institute for Statistics. The ISCED classification provides an international standard for describing levels of schooling across countries, from early childhood education (level 0) to doctoral or equivalent level study (level 8).

The target populations for TIMSS are defined as follows:

- Grade 4: the grade that represents four years of schooling, counting from the first year of ISCED Level 1.
- Grade 8: the grade that represents eight years of schooling, counting from the first year of ISCED Level 1.

ISCED Level 1 corresponds to primary education and is the first stage of formal schooling. The target grade of the fourth grade for the TIMSS assessment is typically the fourth grade in most countries. Similarly, the target grade of the eighth grade for TIMSS is the eighth grade in most countries and usually corresponds to ISCED Level 2, or lower secondary education. However, given the cognitive demands of the assessments, TIMSS aims to avoid assessing very young students. Thus, TIMSS recommends that countries assess at the fifth grade if the average age in fourth grade at the time of testing is less than 9.5 years, and at the ninth grade if the average age in eighth grade is less than 13.5 years.

Reporting Student Achievement

The TIMSS assessment is designed to provide a comprehensive picture of the mathematics and science achievement of fourth- and eighth-grade students in each participating country. It is also designed to report student achievement in each of the content and cognitive domains described in Chapters 1 and 2 of this document.

One of the major strengths of TIMSS is the ability to report trends over time in mathematics and science achievement. Careful and gradual modification to the assessment design, preserves the links between successive administrations, ensuring comparable data from each of the nine TIMSS cycles from 1995 through 2027. This enables countries to measure changes in student achievement from one cycle to another. Additionally, though the scales for each grade were established separately and are not directly comparable, countries that participate in successive cycles of TIMSS can compare their relative performance of the cohort tested at the fourth grade in one cycle with the same cohort's performance in eighth grade in the next cycle.

The mathematics and science achievement scales at each grade were established by the first TIMSS administration cycle in 1995, and subsequent assessment results have been linked through successive concurrent calibrations between adjacent assessment cycles. Each scale's

midpoint of 500 represents the average of the international achievement distribution for that cycle, with 100 points on the scale equivalent to one standard deviation of the distribution. Following data collection, student responses to the items in each assessment are analyzed, and proficiency estimates on the TIMSS mathematics and science scale metrics are generated, to provide a comprehensive picture of the distribution of student achievement for each country.

Construct Coverage

A key goal of the TIMSS assessment is to broadly cover the constructs being measured. This requires far more test items than any single student can answer within a reasonable time. To address this challenge, TIMSS employs a multiple-matrix sampling approach that groups the items into blocks, then assembles the blocks into test forms; each student is presented with only one of 14 possible test forms.

At each grade level, the entire pool of items is grouped into 14 mathematics blocks and 14 science blocks. These blocks are an exhaustive and mutually exclusive organization of items, with approximately 10–14 items in each block at the fourth grade and 12–18 at the eighth grade. Each block includes items from different content and cognitive domains. Of the 14 blocks per subject, eight are trend blocks that were administered in a prior assessment, and six are new blocks that were selected from the field test. The linkage through the trend blocks enables comparison of results between successive TIMSS cycles.

TIMSS 2027 Group Adaptive Design

Since 2015, TIMSS assessment designs have offered options to tailor item difficulty to student ability with the goal of providing more precise measurement for students at the lower end of the achievement distribution in mathematics.[2,3] For TIMSS 2023, an integrated group adaptive assessment design was introduced in mathematics and science,[4,5] enabling a broader range of item difficulties and more precise targeting across all student ability levels.

The TIMSS 2027 design retains the key aspects of the TIMSS 2023 group adaptive design while maintaining the 14-block structure that was first implemented in TIMSS 2007. This design requires grouping the blocks into three difficulty levels—easy, medium, and difficult—with five easy, four medium, and five difficult blocks per subject and grade.

Block Difficulty Level

For the group adaptive design to be effective, there must be distinctive differences in the average difficulties of the blocks.[6] The difficulty goals for TIMSS in terms of average percent correct across participating countries are 40 percent for the difficult blocks, 55 percent for the medium blocks, and 70 percent for the easy blocks. New blocks developed for TIMSS 2027 will aim to achieve these difficulty levels, but the existing trend blocks, especially the trend blocks developed before TIMSS 2023, can only be assigned as-is to the closest difficulty level.

As described in the previous section, for each subject and grade, eight of the 14 blocks are trend blocks carried over from TIMSS 2023, and six are new blocks composed of items selected from the field test. Of the eight trend blocks, three are difficult, two are medium, and three are easy. For the six new blocks, two are developed to meet each of the three difficulty levels. As shown in Exhibit 1, the difficulties of the existing trend blocks align closely with the three target

difficulty levels for both subjects at the fourth grade. At the eighth grade, the existing trend blocks are generally more difficult than the long-term target difficulty goal for all three levels in both subjects. However, by combining these existing blocks with newly developed blocks designed to be closer to the target difficulties, progress is made toward achieving the long-term goals for the three distinct difficulty groups. As shown in the last column of Exhibit 1, the expected difficulties for 2027, after combining the existing blocks and new blocks, are approaching the long-term targets of each difficulty level— 40 percent, 55 percent, and 70 percent, respectively.

Exhibit 1: Average Difficulties of Existing Trend Blocks from 2023 and Expected Difficulties for 2027 (Average Percent Correct)

Subject	Block Difficulty Level	Empirical Difficulty of Trend Blocks from 2023	Expected Difficulty for 2027
Fourth Grade Mathematics	Difficult	40%	40%
	Medium	53%	54%
	Easy	71%	71%
Fourth Grade Science	Difficult	40%	40%
	Medium	53%	54%
	Easy	68%	69%
Eighth Grade Mathematics	Difficult	32%	35%
	Medium	41%	48%
	Easy	62%	65%
Eighth Grade Science	Difficult	37%	38%
	Medium	49%	52%
	Easy	62%	65%

Block Identification

To facilitate the later assignment of the blocks to test forms, each trend and new block is assigned a slot with a unique TIMSS 2027 block ID corresponding to its difficulty level. Each block label starts with M for mathematics or S for science, followed by D, M, or E to indicate the difficulty level (difficult, medium, or easy). Trend blocks from TIMSS 2023 are relabeled in TIMSS 2027 to differentiate them from the new 2027 block IDs while maintaining their original identity. The trend block labels begin with T23, followed by either A or B to indicate the grade level. The remainder of the block label follows the naming conventions used in the TIMSS 2023 assessment design. The oldest blocks (i.e., those developed in 2019) will be retired after the TIMSS 2027 administration.

Exhibits 2 and 3 show how the existing trend blocks fit into the subject-by-difficulty-level scheme at the fourth grade and eighth grade, respectively, and where the new blocks belong.

Exhibit 2: Subject and Difficulty Level for TIMSS 2027 Fourth-Grade Blocks

Subject	Difficulty Level	TIMSS 2027 Block ID	TIMSS 2023 Trend Block Label*
Mathematics	Difficult	MD1	T23A_MD3 (23)
		MD2	T23A_MD1 (19)
		MD3	New block for 2027
		MD4	T23A_MD5 (23)
		MD5	New block for 2027
	Medium	MM1	New block for 2027
		MM2	T23A_MM1 (23)
		MM3	New block for 2027
		MM4	T23A_MM3 (19)
	Easy	ME1	T23A_ME1 (23)
		ME2	New block for 2027
		ME3	T23A_ME3 (23)
		ME4	T23A_ME5 (23)
		ME5	New block for 2027
Science	Difficult	SD1	T23A_SD3 (23)
		SD2	T23A_SD1 (19)
		SD3	New block for 2027
		SD4	T23A_SD5 (23)
		SD5	New block for 2027
	Medium	SM1	New block for 2027
		SM2	T23A_SM1 (23)
		SM3	New block for 2027
		SM4	T23A_SM3 (19)
	Easy	SE1	T23A_SE1 (23)
		SE2	New block for 2027
		SE3	T23A_SE3 (23)
		SE4	T23A_SE5 (23)
		SE5	New block for 2027

* The number in parentheses is the assessment year in which the block was first introduced.

Exhibit 3: Subject and Difficulty Level for TIMSS 2027 Eighth-Grade Blocks

Subject	Difficulty Level	TIMSS 2027 Block ID	TIMSS 2023 Trend Block Label*
Mathematics	Difficult	MD1	T23B_MD3 (23)
		MD2	T23B_MD1 (19)
		MD3	New block for 2027
		MD4	T23B_MD5 (23)
		MD5	New block for 2027
	Medium	MM1	New block for 2027
		MM2	T23B_MM1 (23)
		MM3	New block for 2027
		MM4	T23B_MM3 (19)
	Easy	ME1	T23B_ME1 (23)
		ME2	New block for 2027
		ME3	T23B_ME3 (23)
		ME4	T23B_ME5 (23)
		ME5	New block for 2027
Science	Difficult	SD1	T23B_SD3 (23)
		SD2	T23B_SD1 (19)
		SD3	New block for 2027
		SD4	T23B_SD5 (23)
		SD5	New block for 2027
	Medium	SM1	New block for 2027
		SM2	T23B_SM1 (23)
		SM3	New block for 2027
		SM4	T23B_SM3 (19)
	Easy	SE1	T23B_SE1 (23)
		SE2	New block for 2027
		SE3	T23B_SE3 (23)
		SE4	T23B_SE5 (23)
		SE5	New block for 2027

* The number in parentheses is the assessment year in which the block was first introduced.

Test Form Design

In TIMSS 2027, the 14 mathematics and 14 science blocks at each grade are arranged into 14 test forms. Each form contains two mathematics blocks and two science blocks. To provide a mechanism for comparing student responses across different forms, each item block appears in two of the 14 test forms. Exhibit 4 illustrates the block pairings and sequence that make up each test form. The pairing pattern is identical at both grades. When blocks of different difficulties are paired in the same form, the easier block always comes first. Because each form consists of two mathematics and two science blocks, the same matching pairs of mathematics and science blocks appear in the same form. For example, blocks ME1 and MM1 appear in the same form as their science counterparts SE1 and SM1.

Exhibit 4: Block Pairings for Each Test Form

Subject	Difficult Blocks	Medium Blocks	Easy Blocks
Mathematics	MD1	MM1	ME1
	MD2	MM2	ME2
	MD3	MM3	ME3
	MD4	MM4	ME4
	MD5	—	ME5
Science	SD1	SM1	SE1
	SD2	SM2	SE2
	SD3	SM3	SE3
	SD4	SM4	SE4
	SD5	—	SE5

The 14 test forms at each grade are classified into two levels of difficulty:

- More difficult forms (7) composed of either two difficult blocks, or one medium and one difficult block, for each subject;
- Less difficult forms (7) composed of either two easy blocks, or one easy and one medium block, for each subject.

Exhibit 5 displays the block assignments for the 14 test forms, with forms 1–7 being the more difficult and forms 8–14 the less difficult ones. Half of the 14 test forms contain two mathematics blocks in Part 1, while the other half contain two mathematics blocks in Part 2. The same distribution applies to the science blocks. The block assignments are identical for both grades.

Exhibit 5: Test Forms with Block Assignments

Student Assessment Forms		Part 1		Part 2	
More Difficult Forms	Form 1	SM1	SD1	MM1	MD1
	Form 2	MD2	MD3	SD2	SD3
	Form 3	SM2	SD2	MM2	MD2
	Form 4	MD5	MD1	SD5	SD1
	Form 5	SM3	SD3	MM3	MD3
	Form 6	MM4	MD4	SM4	SD4
	Form 7	SD4	SD5	MD4	MD5
Less Difficult Forms	Form 8	ME1	MM1	SE1	SM1
	Form 9	SE1	SE2	ME1	ME2
	Form 10	ME2	MM2	SE2	SM2
	Form 11	SE3	SE5	ME3	ME5
	Form 12	ME3	MM3	SE3	SM3
	Form 13	SE4	SM4	ME4	MM4
	Form 14	ME5	ME4	SE5	SE4

The assignment of forms to students is carried out following a systematic random assignment process where forms are assigned sequentially, using different probabilities of selection for the more difficult forms and the less difficult forms.

Test Form Assignment within Countries

To ensure that the same set of assessment items is administered in every country, all 14 forms in the TIMSS 2027 are distributed in every country, but with varying proportions. The proportion of the more and less difficult forms varies depending on the expected average mathematics and science achievement of the student population. This expectation is based on performance in prior TIMSS assessments, or performance in the field test for countries participating for the first time. Higher performing countries administer proportionally more of the more difficult forms, while lower performing countries administer proportionally more of the less difficult forms. This assignment is to improve the match between assessment difficulty and student ability in each country and maximize the information obtained from the assessment.

Exhibit 6 illustrates the differential test form assignment plan for higher, middle, and lower performing countries. As a general objective, countries with expected higher average achievement scores, above 550 on the TIMSS mathematics and science achievement scales, would assign proportionally more of the more difficult forms (e.g., 70%) and fewer of the less difficult forms (30%). Countries with expected achievement scores between 450 and 550 would assign equal proportions of the more and less difficult forms. Countries with expected lower average achievement scores, below 450 on the TIMSS mathematics and science achievement scales, would assign proportionally fewer of the more difficult forms (30%) and more of the less difficult forms (70%).

Exhibit 6: Test Form Assignment Plan for Higher, Middle, and Lower Performing Countries

While the target difficulties for the blocks and forms have not been fully met, particularly at the eighth-grade level, the objective for the 2027 design is to come closer to these targets. Typically, countries participating in TIMSS 2027 will assign similar proportions of the more and less difficult forms as they did in TIMSS 2023. However, countries with average achievement above 600 could assign even higher proportions of the more difficult forms (e.g., 90%), and countries with average achievement below 350 could assign higher proportions of the less difficult forms.

Although the TIMSS 2027 group adaptive design was developed to provide a better match between test difficulty and student ability at the overall country level, it was also possible to apply the group adaptive approach for subgroups within a country, provided the country has clearly defined and identifiable subpopulations that differ from the rest of the country in terms of average student achievement. The implementation of such an adaptive design within a country needs to be coordinated with the sampling team to ensure proper selection and representation of the different types of schools.

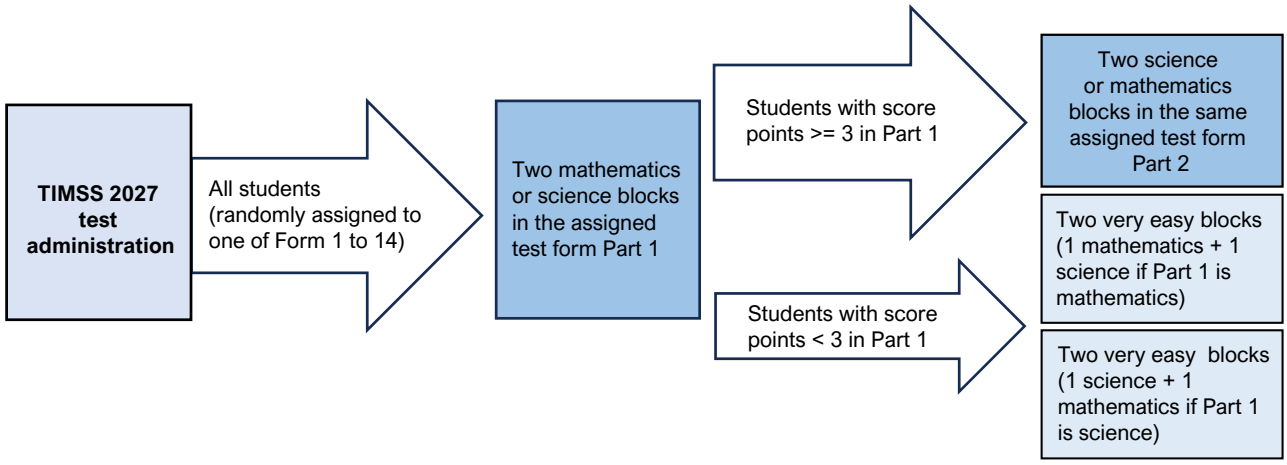
Individual-Level Adaptive Routing

In TIMSS 2027, an individual-level adaptive routing will be implemented for very-low-performing students. Students who demonstrate very low performance on Part 1 of their test form will be routed to two very easy blocks in the second part, instead of receiving the two blocks in Part 2 of their originally assigned form shown in Exhibit 5.

According to this design, students who score fewer than 3 points in Part 1 will be administered one very easy mathematics block and one very easy science block in Part 2. The 3-point threshold is based on responses to the automatically scored items (e.g., multiple-choice, drag-and-drop, number pad items, etc.), regardless of the difficulty of the individual items, or the estimated difficulty of the block. In such cases, the subject sequence in Part 2 depends on which subject was presented first in Part 1. If Part 1 contains mathematics items, then Part 2 begins with a very easy mathematics block, followed by a very easy science block. Conversely, if Part 1 contains science items, then Part 2 starts with a very easy science block, followed by a very easy mathematics block.

The diagram of TIMSS 2027 achievement test form administration is presented in Exhibit 7.

Exhibit 7: TIMSS 2027 Achievement Test Form Administration Diagram



Two very easy mathematics blocks (MVEB1 and MVEB2) and two very easy science blocks (SVEB1 and SVEB2) were constructed for each grade level. These blocks are made up of the easiest items from the existing easy blocks and, like other TIMSS blocks, consist of items drawn from different content and cognitive domains. MVEB1 contains selected items from ME1 and ME2, and MVEB2 contains selected items from ME3, ME4, and ME5; the same pattern is followed for the science blocks. As shown in Exhibit 8, this facilitates matching very easy blocks to Part 1 blocks without overlapping content, ensuring that no student sees the same item twice.

Introducing the individual-level adaptive routing for the students effectively results in an additional 14 forms, shown in Exhibit 8.

Exhibit 8: TIMSS 2027 Forms Assembled with Very Easy Blocks for Individual-Level Adaptive Routing

Assessment Forms	Forms Originally Assigned	Part 1		Part 2	
Form 15	Form 1	SM1	SD1	SVEB2	MVEB2
Form 16	Form 2	MD2	MD3	MVEB2	SVEB2
Form 17	Form 3	SM2	SD2	SVEB2	MVEB2
Form 18	Form 4	MD5	MD1	MVEB2	SVEB2
Form 19	Form 5	SM3	SD3	SVEB1	MVEB1
Form 20	Form 6	MM4	MD4	MVEB1	SVEB1
Form 21	Form 7	SD4	SD5	SVEB1	MVEB1
Form 22	Form 8	ME1	MM1	MVEB2	SVEB2
Form 23	Form 9	SE1	SE2	SVEB2	MVEB2
Form 24	Form 10	ME2	MM2	MVEB2	SVEB2
Form 25	Form 11	SE3	SE5	SVEB1	MVEB1
Form 26	Form 12	ME3	MM3	MVEB1	SVEB1
Form 27	Form 13	SE4	SM4	SVEB1	MVEB1
Form 28	Form 14	ME5	ME4	MVEB1	SVEB1

Student Testing Time

As summarized in Exhibit 9, each student completes one student achievement test form consisting of two parts, followed by a student questionnaire. The individual student response time for the TIMSS 2027 assessment is the same as it has been since TIMSS 2007, including for students who are routed to the two very easy blocks in Part 2.

At the fourth grade, the TIMSS administration consists of two 36-minute sessions, one for each part, and then followed by a 30-minute session for the student questionnaire. At the eighth grade, the administration consists of two 45-minute sessions, followed by a 30-minute session for the student questionnaire. Students are given a short break between sessions.

Exhibit 9: TIMSS 2027 Student Testing Time – Fourth and Eighth Grades

Activity	Fourth Grade	Eighth Grade
Student Achievement Test Form – Part 1	36 minutes	45 minutes
Break		
Student Achievement Test Form – Part 2	36 minutes	45 minutes
Break		
Student Questionnaire	30 minutes	30 minutes

References

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