
PISA 2021 INTEGRATED DESIGN

1. The purpose of this document is to outline the assessment and questionnaire design for PISA 2021. The PISA 2021 design will expand on the major design and methodology innovations from PISA 2015 and 2018 that included: (i) a reconceptualisation of minor domains to diminish differences in domain coverage across cycles; (ii) computer administration as the primary mode of delivery for all core domains; (iii) machine-assisted coding of human-coded responses for all domains; and, (iv) multistage adaptive testing (MST) for Reading.¹
2. This document was presented to the PGB at its 46th meeting.

Changes to the design since PISA 2018

3. Changes proposed for the PISA 2021 design of the cognitive instrument will focus on: (i) extending the use of MST to both Reading and Mathematics in 2021 (and presumably to all three core domains in 2024) and (ii) the use of minor domain-only forms (two minor domains) delivered to a small percentage of the sampled populations instead of the three-domain forms^{2,3,4}. Key changes in the context questionnaires design include revisions of the framework and instruments, the development of new scales and methodological innovations that include within-construct matrix sampling, and revisions to the approach of measuring Economic, Social, and Cultural Status (ESCS). This proposed 2021 computer-based design reflects the comments and recommendations received from the Technical Advisory Group from its meeting in August 2018.

- For Mathematics, the major domain in 2021, the item pool from which the Main Survey MST is to be assembled will include both trend and new items. The Mathematics design will be very similar to the Reading design from 2018 when the Field Trial was delivered as a traditional linear (nonadaptive) test both to provide preliminary parameters for the new items and to evaluate unit order effects while the Main Survey was delivered through an MST design.
- For Reading, now a minor domain, the 2018 MST design will be reused with a 25% reduction in its item pool. For Science, the nonadaptive 2018 forms will be reused intact. For the innovative domain of Creative Thinking, the instruments will be nonadaptive and based on new items.

¹ Additional information relating to adaptive testing for PISA 2018 can be found in the document: CY7_GEN_Main Survey Integrated Design[Final]_1.pdf which is available on the PISA Portal.

² In PISA 2018, the three-domain forms measured the major domain (two 30-minute clusters or one hour) and two minor domains (one 30-minute cluster or a half hour each) and were delivered to 12% of each national sample.

³ Re-analyses of 2015 data without the three-domain forms has shown no noticeable impact on national distributions and covariance estimates.

⁴ The implementation of the MST design for Mathematics and Reading requires 60 minutes of assessment time per domain.

- The Field Trial design, in preparation for the 2021 Main Survey, emphasizes innovation and advances in the methodologies and procedures used for each cycle. The 2021 cycle will continue to collect reliable, valid, and comparable information about a widening range of knowledge, skills, and contextual factors, which will be facilitated by the expanded use of MST for Reading and Mathematics in the Main Survey.
- Even though the majority of participants will implement PISA 2021 as a computer-based survey, a set of participants will continue to implement PISA as a paper-based survey. For these participants, the PISA 2021 paper-based design will use instruments that measure trends in Reading, Mathematics, and Science based on existing materials from both PISA 2015 and 2018 paper-based assessments (PBAs) as well as from PISA for Development: in other words, without new item development. These instruments do not cover the innovative domains nor do they include the interactive features of tasks that may apply to the computer-based design.

Overview

4. This document presents the proposed designs for the cognitive assessment as well as the questionnaires for both the Field Trial and Main Survey. However, detailed information will be presented for the Field Trial only, as the final design of the Main Survey will depend in part on the evaluation of the Field Trial data and results. The designs presented here are based on the following assumptions:

- The computer-based design includes the assessment of Reading, Mathematics, and Science as well as Creative Thinking for every participant.
 - i. Computer-based trend materials for Science will be identical to those used in 2018 that were based on the trend items (1/3) and new items developed in 2015 (2/3).
 - ii. MST for Reading will be based on the slightly reduced set of items (around 25% fewer) from the 2018 Main Survey.
 - iii. Mathematics will follow the same MST design as Reading and will be based on 12 new and 7 trend 30-minute clusters of items.⁵
- The computer-based design also incorporates an optional assessment of Financial Literacy. Per request of the OECD, Financial Literacy will be administered through an additional sample of students beyond the 6,300 students. These students will take one hour of Mathematics or Reading and one hour of Financial Literacy.
- The paper-based design options are based mostly on Reading, Mathematics, and Science trend items. PBA participants in 2021 will continue to rely on the 2015 PBA trend clusters identical to those used in 2018 or on the PISA for Development instruments.
- The cognitive assessment portion of the survey will take approximately 120 minutes to complete for both the computer and the paper modes.

⁵ Clusters are mutually exclusive item sets of 30 minutes. In the case of Mathematics, both clusters M6a and M6b will be used for all participants.

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- Participants need to implement the Field Trial in the same mode as the Main Survey. Therefore, all participants planning to implement PISA as a computer-based assessment (CBA) in the Main Survey MUST do so in the Field Trial as well.
 - The following combination of instruments focusing on cognitive assessments and context questionnaires will be presented to students and schools as well as to parents and/or teachers when applicable:
 - i. A student workflow that includes: (i) a cognitive testing session measuring the domains of Reading, Mathematics, Science, and Creative Thinking as well as the optional domain of Financial Literacy, when applicable; (ii) a core Student Questionnaire session; (iii) optional questionnaires sessions that include an Information and Communications Technology (ICT) Familiarity Questionnaire, a Well-Being Questionnaire, a Global Competence Questionnaire, and a Financial Literacy Questionnaire, as applicable.
 - ii. A core School Questionnaire administered to school principals of participating schools.
 - iii. An optional Teacher Questionnaire, (TQ) including measures of Teachers Well-Being administered to both general as well as mathematics-related teachers.
 - iv. An optional Parent Questionnaire (PQ) to be answered by parents of participating students.
5. Figure 1 shows simplified versions of the Integrated Design for PISA 2021 computer- and paper-based modes for both the student (part 1) and nonstudent (part 2) components.

Figure 1. PISA 2021 Integrated Design (Simplified) (Part 1)

Student Components

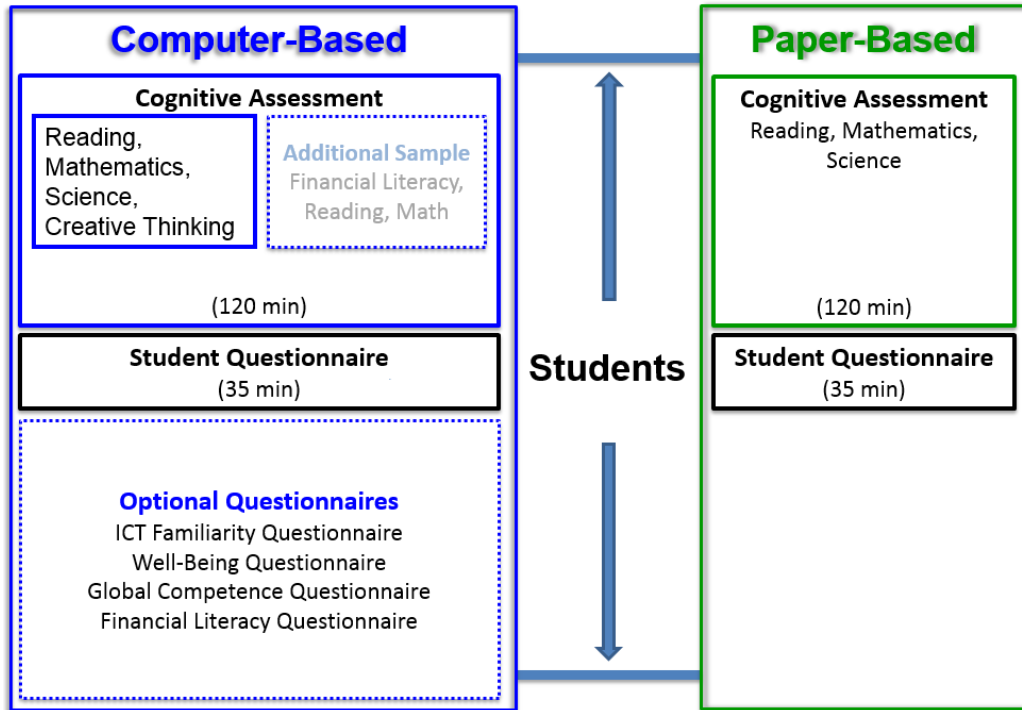
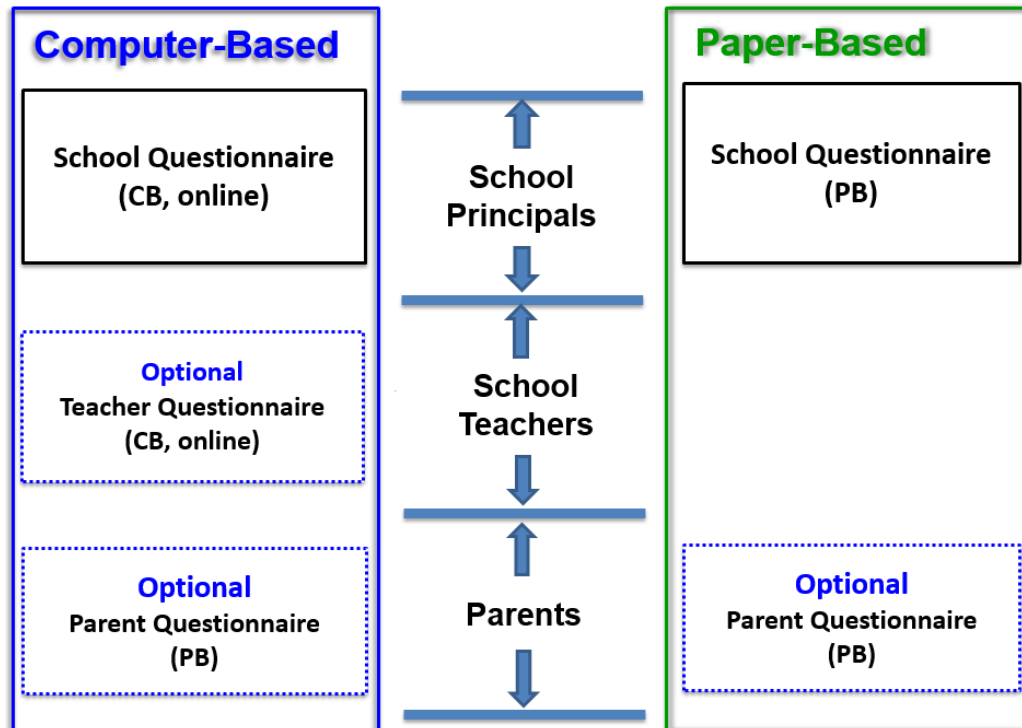


Figure 2. PISA 2021 Integrated Design (Simplified) (Part 2)

Nonstudent Components



PISA 2021 Cognitive Assessment Design

6. Under the cognitive assessment design for PISA 2021, the individual testing time for measuring the four domains of Reading, Mathematics, Science and Creative Thinking will remain at two hours (120 minutes) for each student. While computer-based delivery will remain the primary mode for 2021, paper-and-pencil instruments linking to earlier PISA cycles will be provided for participants that are not able or willing to test their students by computer. However, a return to the paper mode will not be considered for participants that already transitioned to CBA in 2015 or 2018. The PBA will be limited to existing Reading, Mathematics, and Science items administered as trend in 2015 and 2018 cycles or as part of PISA for Development.

7. The designs described in detail in the following sections cover the four skill domains that will be assessed in 2021. The design of the optional Financial Literacy domain is described in a separate section. The designs follow those from 2015 and 2018 that, as previously noted, increased construct coverage, reduced distinctions between minor and major domains, introduced machine-assisted coding, and implemented multistage adaptive testing in 2018. These characteristics improved the information that PISA can provide to policy makers concerning the distribution of skills in student populations. In addition, they rely on advanced measurement and computer technologies to deliver PISA in an efficient manner. In summary, the PISA 2021 assessment design will provide participants with the following information:

- population distributions in Mathematics as the major domain that reflect the new 2021 framework as well as links to the framework and scale developed in 2012 through trend materials;
- subscale population distributions in Mathematics and correlations between Mathematics subscales and the other domains;
- population distributions in Science linked to the 2015 framework and the Science scale;
- population distributions in Reading linked to the 2018 framework and the Reading scale;
- population distributions in Creative Thinking;
- pairwise covariance estimates among each of the four domains; and
- three-way association estimates among the four cognitive domains, including the three core PISA domains (Reading, Mathematics, and Science) and the innovative domain (Creative Thinking), based on the all possible pairwise covariances.

8. Table 1 shows the number of clusters for each domain (trend and new) and the modes that will be included in the PISA 2021 Field Trial and Main Survey.

Table 1. Domain coverage and mode of assessment for PISA 2021

Domain Coverage	CBA Field Trial	CBA Main Survey	PBA PISA	PBA PISA-D
Mathematics (New)	12 30-min clusters	MST* 60-min		
Mathematics (Trend)	7** 30-min clusters	(based on ≈15 30-min clusters of materials)	6 30-min clusters	4 30-min clusters
Reading	MST*** 60-min (based on ≈12 30-min clusters)		6 30-min clusters	4 30-min clusters
Science	6 30-min clusters		6 30-min clusters	4 30-min clusters
Creative Thinking (New)	5 30-min clusters	4 30-min clusters		
Financial Literacy	3 30-min clusters	2 30-min clusters		

* Mathematics MST design similar to nearly identical to 2018 MS Reading Design

** This includes both clusters M6a and M6b for each participant. Because in PISA 2015 and 2018 each participant only assessed one of these two clusters, there will be an extra cluster of trend materials to be prepared in PISA 2021 for all current participants.

*** Reading MST design nearly identical to 2018 but based on an item pool reduced by approximately 25%
Note: Clusters are mutually exclusive item sets of 30 minutes

9. As in the previous cycle, participants should note that the contractors will assume full responsibility for assembling all paper and computer forms of the cognitive instruments. While there are many more forms in PISA 2021 than in previous cycles, there will be no additional work on the part of the participants in assembling these forms.

Main Survey Assessment Design

10. The Main Survey assessment designs for PISA 2021 cover the same domains as in the Field Trial: Reading, Mathematics, and Science for both computer- and paper-based modes. In addition, these designs also incorporate Creative Thinking as the innovative domain and Financial Literacy as the optional domain in the computer-based mode. These designs require participants to draw a random sample of at least 150 schools representing their national population of 15-year-old students, with a sample of 42 assessed students from each school for a total of 6 300 assessed students for computer-based administration or 35 assessed students from each school for a total of 5 250 assessed students for paper-based administration. Every student receives a test form that consists of two domains for one hour of assessment time per domain.

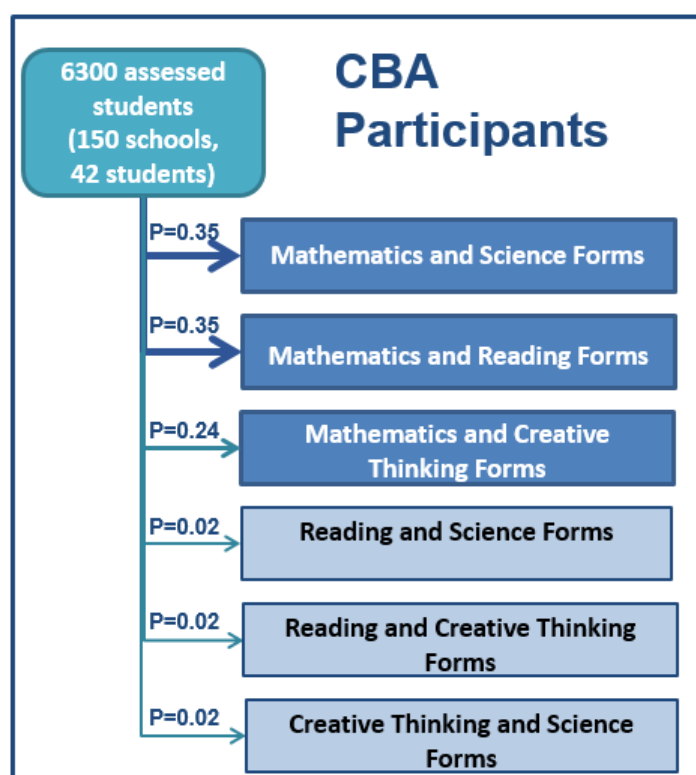
Main Survey CBA Assessment Design

11. The 2015 PISA design supported the expressed long-term goal of diminishing the differences between minor and major domain coverage. In addition, the introduction of the computer-based mode of assessment ensured that the design innovations could be implemented with the required spiraling of the set of trend clusters. The 2021 design will continue to benefit from these innovations and the greater stability of estimates achieved by the increased construct coverage for minor domains.

12. As was the case for Reading in 2018, invariance analyses will be conducted on the 2021 Mathematics Field Trial data. As the Main Survey Mathematics adaptive testing design will be very similar to the Reading design that successfully minimised any effects of test adaptation, it is expected that parameter invariance due to unit position effects will also hold for Mathematics in 2021. The Field Trial is designed to verify this assumption for Mathematics. We will nevertheless also develop a nonadaptive design for 2021 for the very unlikely event that the Field Trial indicates intolerable violations of parameter invariance due to unit position effects.

13. The proposed 2021 design is based on the materials shown in Table 1 across the four domains and will be organised into test forms as shown in Figure 3.

Figure 3. Main Survey Computer-Based Assessment Design



14. There are six different kinds of test forms representing various combinations of two of the four domains; students will receive one of these forms according to the prescribed probability (Figure 2). Ninety-four percent of students will receive test forms involving 60 minutes of Mathematics as the major domain, and 60 minutes of one of the three minor domains (Reading, Science, or Creative Thinking). These forms will provide the necessary covariance information between Mathematics and each of the three minor domains.

15. In addition, some test forms will contribute covariance information between the three minor domains. These two-minor-domain forms will be sampled at a lower rate so that only 6% of students receive one of these forms. These forms will provide equivalent amount of bivariate information as provided in previous PISA cycles by the three-domain forms. This design allows for the implementation of adaptive testing for both Reading and Mathematics while also removing potential differences in the assessment of the minor domains where every student receives the same testing time.

16. Finally, this design ensures that the presentation of materials is balanced in terms of position and that sampling is appropriate, with the random assignment of a form within a school following the specific preassigned probability distribution noted in Figure 2. The adaptive testing design proposed for the 2021 Mathematics assessment, which is consistent with the 2018 Reading design, is commonly referred to as multistage adaptive testing (MST), an approach that is particularly well suited for tests that consist of multiple item units that may require both automatic and human coding. In addition, MST utilises routing decisions that are based on performance on a set of items, and hence can be expected to be more robust against item-by-country interactions than item-level adaptive algorithms.

17. The multistage design that is being recommended for PISA 2021 was successfully used in PISA 2018 and by the OECD Programme for the International Assessment of Adult Competencies (PIAAC). The remaining nonadaptive minor domains of Science and Creative Thinking will continue to be administered using two 30-minute clusters.

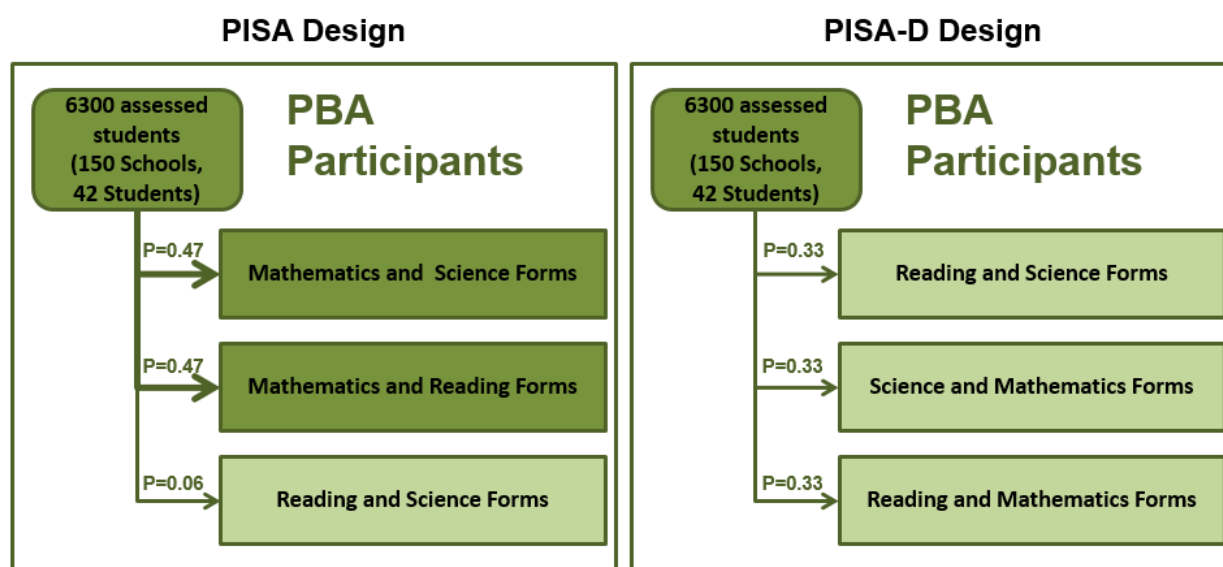
Main Survey PBA Assessment Design

18. As was the case in PISA 2015 and 2018, participants that are not able or willing to use computer-based delivery for PISA 2021 can choose to test their students using a paper design. In PISA 2021, two versions of the paper-based instruments are being considered. Both designs are similar as they consist of paper-based items for Science, Reading, and Mathematics and a sample size of 5 250 assessed students. An overview of these PBA designs is shown in Figure 4.

19. Existing paper-based PISA participants will continue with the PISA PBA design from 2015 and 2018 where students will be randomly assigned to three types of forms. This design provides the strongest link with CBA PISA, as 100% of the materials are PISA trend.

20. New participants joining PISA as PBA in 2021 will administer instruments that are strongly linked to PISA PBA and CBA while having more than half of the items at or below proficiency Level 2. These instruments, while including over 50% of PISA trend items, also include items from other surveys. In other words, these instruments provide more information for the low levels of the proficiency distribution, making them more appropriate for participants where a larger proportion of the population is expected to perform at these levels.

Figure 4. Main Survey Paper-Based Assessment Designs



21. As with the CBA design shown in Figure 3, the PISA PBA design shown in Figure 4 includes six intact clusters from each of the three core domains, while the PISA-D design includes four clusters from each of the three core domains (see Table 1 as well). These instruments do not include new items based on 2015 Science, 2018 Reading, or 2021 Mathematics. The position of items within each domain will be balanced and the assignment of a form within a school will follow a probability-based sampling of forms as shown in Figure 3. However, it is important to note that at this time, the number of participants potentially implementing either of these two designs remains unknown, and that the feasibility of reporting subscale scores for Mathematics for the PISA-D design remains to be evaluated. These designs therefore are tentative and may evolve during the cycle, in particular following the Field Trial.

Field Trial Assessment Design

22. This section illustrates the Field Trial design for PISA 2021, which is necessarily complex because it must provide evidence to support various goals and inferences in preparation for the Main Survey. One of the goals to be met by the Field Trial is collecting information in preparation of the planned introduction of MST for the major domain of Mathematical Literacy, the use of a reduced Reading MST, and the use of previously used nonadaptive designs for the other minor and innovative domains.

23. The 2018 Field Trial design for Reading will be replicated for 2021 Mathematics to gather information about Mathematics testing units in variable order instead of fixed order within the 30-minute (intact) clusters. A testing unit will remain as the minimum granular size of item sets at which adaptiveness can take place. Units are sets of items related to a common stimulus. Because the multistage design necessitates the sequence and position of units to change across forms as it adapts, examining and ensuring parameter invariance at the unit level is a necessary condition for PISA 2021 to move Mathematics to an adaptive testing design.

24. The goals of the Field Trial design include:

- evaluation of the invariance of item parameters compared to previous PISA cycles for the 2021 cycle (CBA and PBA);
 - evaluation of the invariance of item characteristics, in preparation for adaptive testing, when delivered in fixed unit order versus variable unit order;
 - estimation of initial item parameters to evaluate the quality of the new Mathematics and Creative Thinking items in preparation for the selection of Main Survey items and for the implementation of the adaptive design for Mathematics in the Main Survey;
 - evaluation of sampling and survey operations aspects; and,
 - assessment of how well the computer platform functions within and across participants.
25. Because the primary goal of the Field Trial is to support the goals noted above and not to estimate the proficiency distribution of national populations, the sampling requirements and level of inference differ from those of the Main Survey.

Field Trial CBA Assessment Design

26. The Field Trial in 2021 will again serve the purpose of comparing several design variants, this time with respect to adaptive testing, as done in 2018. Selecting schools having a large eligible student body and with sufficient computer facilities should be considered. The recommended sample design for participants choosing computer delivery is a sample of 1,992 assessed students from a minimum of 28 schools, with 71-72 students from each school. This approach is similar to 2015 and 2018. Although the PISA 2021 Field Trial design is adjustable in terms of number of schools, increasing the number of schools while sampling a reduced number of students per school is not recommended because it would make comparisons among the results from each group more difficult. However, for participants having difficulty in finding large schools, an alternative design with 50 students from each of 39 sampled schools will be offered.

27. Three randomly equivalent groups will be formed within a school or across multiple schools: CBA Trend, CBA Trend and New Mathematics, and CBA New Mathematics and Creative Thinking. It is important to understand that each student will be randomly assigned to one of the forms from his or her assigned group and that each test form will consist of two 60-minute blocks, one from each domain. Reading will always be administered through a one-hour MST design.

28. The forms associated with each group have specific functions that support one or more of the Field Trial goals listed earlier. It is important to note that the analyses to be carried out on the Field Trial data are typically geared toward aggregated data across participants. The Field Trial data will provide evidence on the level of reporting scale performance and item invariance rather than information at the national level. The Field Trial sample size is not large enough to evaluate national results separately.

Group 1 – CBA Trend, Fixed Unit Order (FUO), Intact Cluster

The Field Trial CBA design for Group 1 includes six intact trend Mathematics clusters from 2015 and 2018, a reduced version of the 2018 Reading MST, and six intact trend Science clusters from 2018. The total sample size per participant for this group is expected to be 618 students that will take one of 18 forms (Forms 1-18), yielding

an expected number of 137 responses per Mathematics and Science item per participant, and an average of 80 responses per Reading item per participant.

Group 2 – CBA Trend and New Mathematics, Variable Unit Order (VUO)

Group 2 includes 24 forms (Forms 19-42) and is designed to provide variations of unit orders within clusters. The order of units within a cluster will vary based on a limited number of sequences to examine the invariance of psychometric characteristics relative to the Group 1 results (Fixed Unit Order). Each of the 24 forms consists of a combination of one of six trend Mathematics clusters and three of 12 new Mathematics clusters as shown in Figure 4. Every trend cluster will be paired with each new cluster once and will appear in all four cluster positions once or twice in each position (six times altogether). The total sample size for this group is designed to be 618 to yield, per participant, an expected number of 103 responses per trend item and 154 responses per new item.

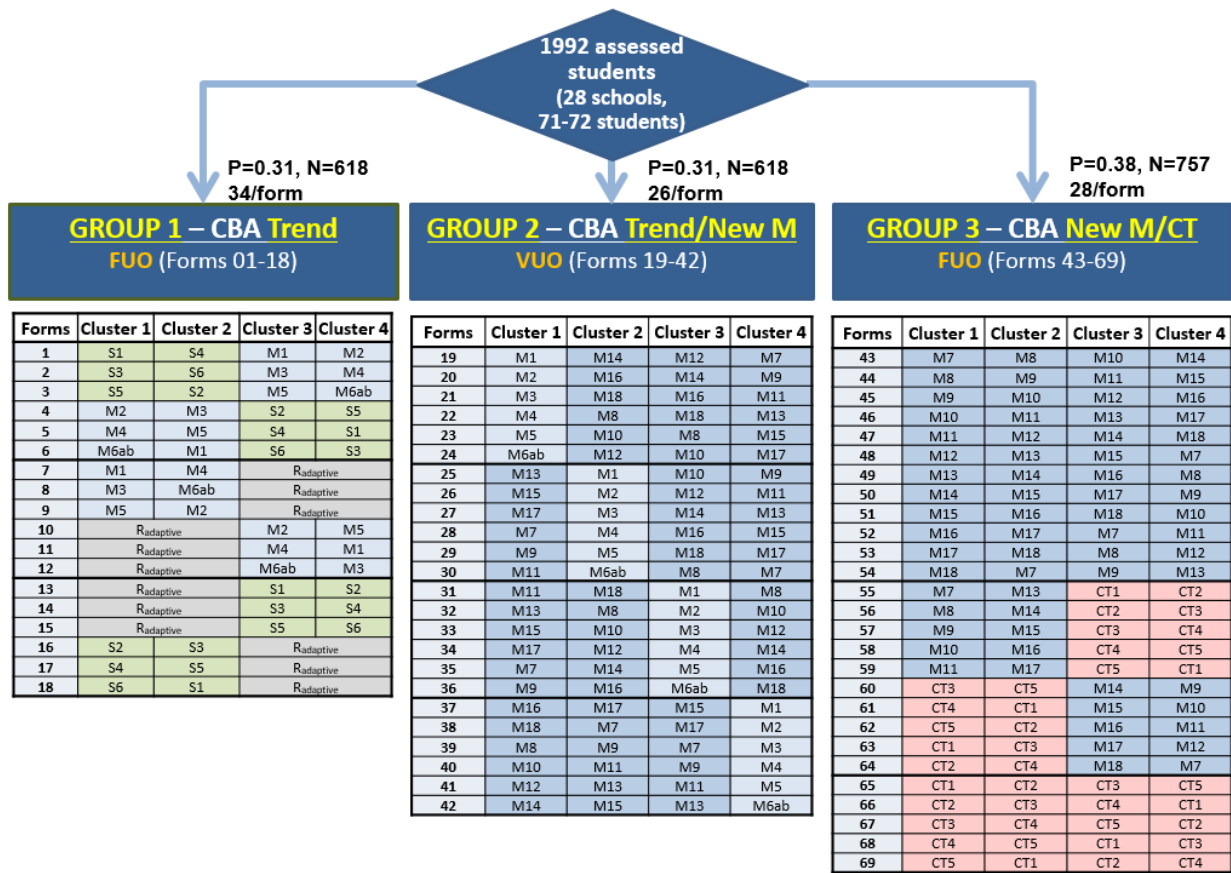
Group 3 – CBA New Mathematics and Creative Thinking, Fixed Unit Order (FUO)

Clusters in Group 3 are based on a fixed order of units to provide a basis for comparisons with variable unit order forms administered in Group 2. There are two sets of forms in this group. The first set of 12 forms (Forms 43-54) is assembled from new Mathematics clusters and each cluster is presented once in every position and paired with other clusters at least once. The second set of 10 forms (Forms 55-64) includes two new Mathematics clusters and two new Creative Thinking clusters. Cluster positions are balanced for both domains. The third set of 5 forms (Forms 65-69) includes four new Creative Thinking clusters. Every form will be administered to 28 students; thus these two sets will be administered to a total of 757 students. This will yield an average of 159 responses per new Mathematics item and 224 responses per new Creative Thinking item.

29. The approach from 2015 and 2018 to reduce the distinction between major and minor domains has been supported by analytic approaches that utilise data from multiple cycles. Data collected during the major domain cycle provides a basis for the analyses of two subsequent minor domain cycles. In terms of the Field Trial data analysis, Group 1 forms can be directly linked to the existing data from prior cycles. The variability in the psychometric characteristics of the 2021 Field Trial data collected relative to the 2018 analysis results gives a baseline for the magnitude of error we must expect across data collections when moving to Mathematics adaptive testing. The variability in Group 1, given fixed unit order within a cluster with full construct coverage, is the lower bound that can be used to evaluate the variability of psychometric characteristics observed for Group 2 (variable unit order) and Group 3 (fixed unit order) of the new Mathematics clusters. Also the same variability will be referred to for comparisons of Mathematics trend clusters of Group 1 (fixed unit order) and Group 2 (variable unit order).

30. As shown in Figure 5, the Field Trial CBA Design with Creative Thinking is based on sampling 71-72 students per school. Students will be randomly assigned to one of these three groups, with 31% assigned to one of the forms in Group 1-CBA Trend; 31% to one of the test forms in Group 2-CBA Trend and New Mathematics; and 38% to one of the test forms in Group 3-CBA New Mathematics and Creative Thinking. It is important to remember that each test form results in a total testing time of two hours per student.

Figure 5. Field Trial Computer-Based Assessment Design, with Creative Thinking



Where:

- M1-M6ab represent trend Mathematics clusters (light blue)
- M7-M18 represent new Mathematics clusters (dark blue)
- Radaptive represents Reading MST (gray)
- S1-S6 represent trend Science clusters from 2018 CBA (green)
- CT1-CT5 represent new Creative Thinking clusters (pink)
- Note: FUO = fixed unit order; VUO = variable unit order

31. Participants that choose not to assess Creative Thinking would follow a similar design except that Group 3 will include only forms 43 to 54 using the same sample size and distribution of students across the three groups.

32. It should be emphasised again that the Field Trial design supports the examination of Field Trial data at the scale level and inferences of invariance of item characteristics with respect to unit order within a cluster on the aggregated data across all participants. The Field Trial, because of its sample size, does not support inferences at the national level.

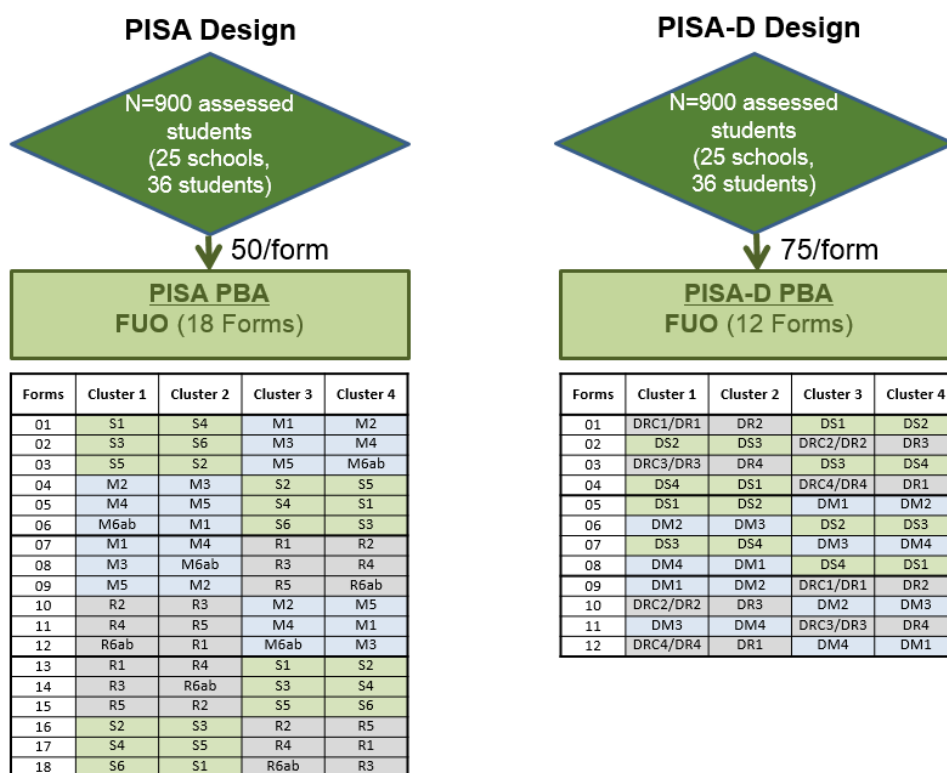
Field Trial PBA Assessment Designs

33. Participants that choose to implement PISA in the paper-based mode in the Main Survey will do so in the Field Trial as well. The paper-based Field Trial designs require reduced sample sizes compared to the CBA Field Trial because participants will be using trend materials that have been used in previous cycles. These participants will sample 25

schools and select 36 students from each school for a total Field Trial sample size of 900 assessed students.

34. Based on the applicable PBA design, students will be randomly assigned to one of the 18 forms in the PISA PBA Design or one of the 12 forms in the PISA-D Design containing trend items from two of the three PISA core domains—Reading, Mathematics, and Science. These designs are shown in Figure 6. As noted earlier, it is important to note that for the reasons indicated above, these designs are tentative and may evolve before actual 2021 implementation.

Figure 6. Field Trial Paper-Based Assessment Designs



Where:

- R1-R6ab represent trend Reading clusters from PISA; DR1-DR4 represent Reading clusters from PISA-D (gray)
- M1-M6ab represent trend Math clusters from PISA; DM1-DM4 represent Math clusters from PISA-D (blue)
- S1-S6 represent trend Science clusters from PISA; DS1-DS4 represent Science clusters from PISA-D (green)
- DRC1-DRC4 represent Reading Component clusters from PISA-D (also gray)
- Note: FOU = fixed unit order

Financial Literacy Design

35. The assessment of Financial Literacy will be offered again in PISA 2021 as an optional computer-based component. It will be based on a revised Financial Literacy framework based on the PISA 2021 updated framework. The cognitive instruments will include trend items plus a set of new interactive items that were developed specifically for PISA 2021.

36. As requested from the OECD Secretariat, Financial Literacy will be administered to a separate sample of PISA-eligible students who will take a combination of Reading, Mathematics, and Financial Literacy tasks.

Main Survey Design for Financial Literacy

37. Under the computer-based assessment design for PISA 2021, the total testing time for measuring the three domains of Reading, Mathematics, and Financial Literacy will remain at two hours (120 minutes) for each student.

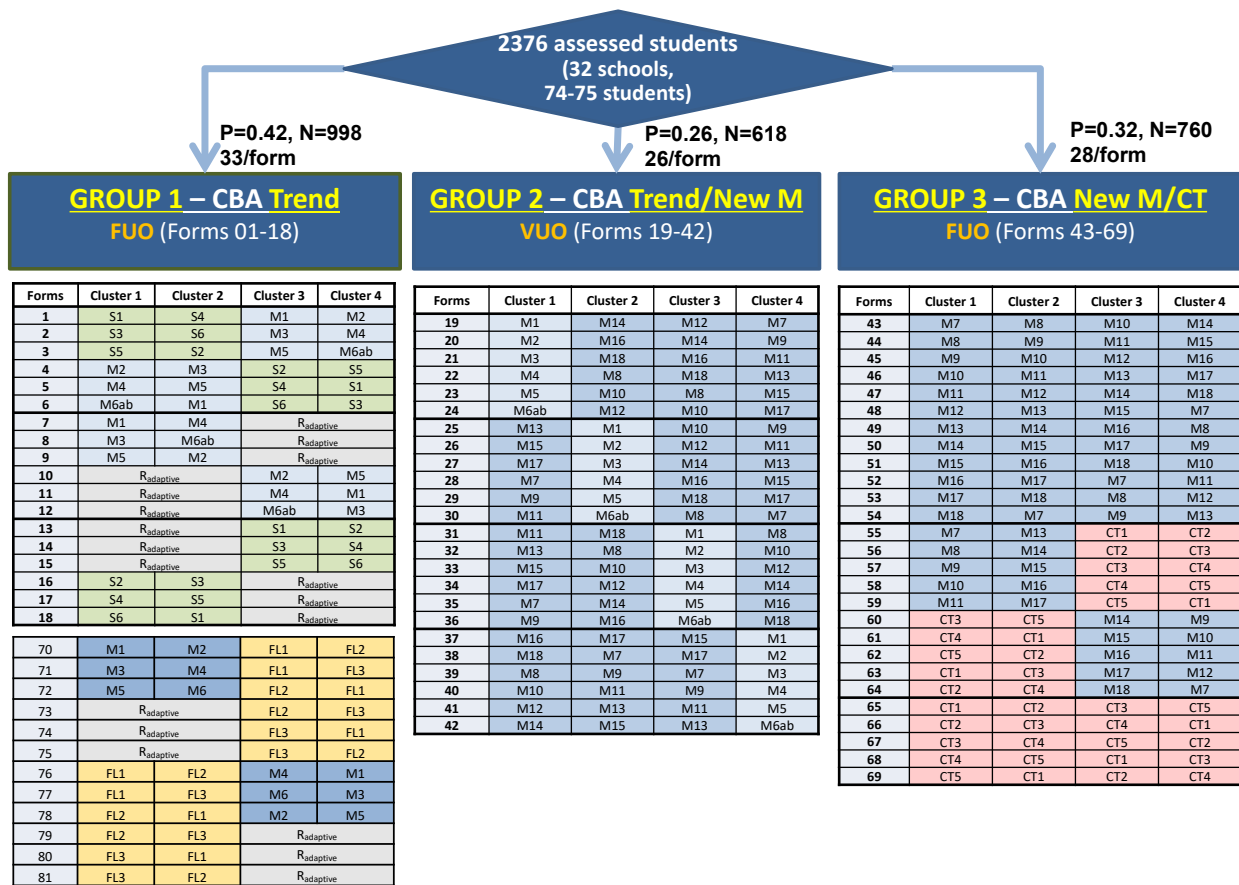
38. For the Main Survey, the Financial Literacy sample will be 1,650 students, with each student taking 60 minutes of Financial Literacy tasks and 60 minutes of either MST Mathematics or 60 minutes of MST Reading. Data for the Financial Literacy sample will be analysed separately from the regular PISA data, and a set of plausible values will be produced that can be used to study relationships among these three domains.

Field Trial Design for Financial Literacy

39. For the Field Trial design, the Financial Literacy sample will be 384 students who will each be assigned one of the 12 Financial Literacy testing forms. These forms include 60 minutes of Financial Literacy tasks and an hour of Reading Literacy tasks or an hour of Mathematical Literacy tasks. They are based on three clusters of Financial Literacy (FL1 to FL3) assembled from both trend items from 2015 and 2018 as well as new items in addition to the Reading Literacy MST items and Mathematical Literacy items from cluster M1 to M6ab. The 12 Financial Literacy forms—referred to as Forms 70-81—will be administered to Group 1 (Fixed Unit Order), and each form will be taken by approximately 33 students.

40. The Field Trial integrated design with Financial Literacy is shown in Figure 7 with a total sample size of 2,376 students (1,992 students from the original design + 384 students from the Field Trial design).

Figure 7. Field Trial CBA Design, with Creative Thinking and Financial Literacy



Where:

- M1-M6ab represent trend Mathematics clusters from 2018 (light blue)
- M7-M18 represent new Mathematics clusters (dark blue)
- R_{adaptive} represents Reading MST (gray)
- S1-S6 represent trend Science clusters from 2018 (green)
- CT1-CT5 represent new Creative Thinking clusters (pink)
- FL1-FL3 represent trend and new Financial Literacy clusters (yellow)

Note: FOU = fixed unit order; VUO = variable unit order

PISA 2021 Questionnaire Design

41. PISA has always emphasized the importance of collecting background information from students and schools along with the assessment of student achievement. This has been done through student and school questionnaires that covered a broad range of contextual variables. The content of these questionnaires has changed considerably over cycles, but the design has remained stable: Every student completes the Student Questionnaire, and every school administrator completes the School Questionnaire.

42. PISA has also included several international options that participants could choose to administer. PISA 2021 offers the following optional questionnaires for students: ICT Familiarity Questionnaire, Well-Being Questionnaire, Global Competence Questionnaire and Financial Literacy Questionnaire (for participants implementing this optional domain). In addition, PISA 2021 also offers a Teacher Questionnaire and a Parent Questionnaire.

43. The context questionnaires contribute to integral aspects of the analytical power of PISA as well as to its capacity for innovation. Therefore, the questionnaire design must meet high methodological standards, such as allowing for reliable and unbiased estimation of population parameters for each participant. In addition, the design also has to ensure that important policy issues and research questions can be addressed in subsequent analyses and reporting based on PISA data. Both the psychometric quality of the variables and indicators and the analytical power of the study have to be taken into account when proposing and evaluating a questionnaire design.

44. The Field Trial and Main Survey questionnaire designs differ in many respects. The main purpose of the Field Trial is to test more material than will be implemented to determine which items will be used in the Main Survey, and to provide the information necessary to determine which scales and/or which versions of different measures for a given construct compared in the Field Trial should be retained for the Main Survey. The proposed designs described below reflect these goals.

45. PISA 2021 Questionnaires will rely on questionnaire design principles that focus on question types, question wording, response options and scaled indices of previous surveys and expand on some principles (e.g., with regard to routing, to matrix sampling, and to the use of log-file data). This will further enhance construct validity of the questionnaire measures and efficiency of data collection in the PISA 2021 and strengthen the basis for cross-national and cross-cycle comparisons. All PISA 2021 questionnaire design principles are explained in detail in the PISA 2021 Questionnaire Framework. [Enhanced questionnaire design principles relevant to the overall PISA design](#) are briefly outlined in more detail below.

- **Routing:** The digital delivery platform has opened new possibilities for using routing (where students receive different questions based on their responses to previous survey questions) to increase the efficiency of the instrument and broaden the range of questions that can be asked in the context questionnaires. PISA 2021 will explore the possibility of using routing to update the ESCS measure and provide more targeted questions to students. Additional questions will be added to the ESCS measure for the Field Trial, but routing will be used to ask the most relevant questions on each construct to each student (for more details see routing decision tree included in PISA 2021 Questionnaire Framework) In the ESCS measure used in previous cycles, many of the questions are relevant only for

a subset of student respondents. This update is particularly important as the number of participants increases and their homogeneity in terms of characteristics decreases. If routing is not used, the number of questions needed to cover the entire ESCS range of all participants may exceed the number of questions that an individual student can answer in time available for measuring ESCS, and not all questions are applicable to all participants and all students within participants.

- **Matrix Sampling:** For PISA 2021 we will explore using matrix-sampling, where different respondents receive different sets of items, to reduce student burden while maintaining content coverage across relevant areas. This approach is viable for PISA 2021 due to the limited time available for the questionnaire and the large sample size in large-scale assessments. Two approaches to matrix sampling for PISA 2021 are summarised below and illustrated in Table 2.
 - i. The approach being proposed for PISA 2021 will utilise an alternative matrix sampling design that rotates questions within constructs instead of across constructs.⁶ In the PISA 2021 proposed within-construct matrix sampling design, every student would receive questions on all constructs but only answer a subset of all questions for each construct, thus resulting in a complete database in terms of construct-level indices. This approach will be implemented for a select number of scales in the Field Trial. Using within-construct matrix sampling is an innovation to the questionnaire design in PISA 2021 that has not been used in previous PISA cycles. A decision on the use of this design for the Main Survey will be made based on an empirical evaluation of the PISA 2021 Field Trial data and in consultation with the QEG, TAG, PGB, and the OECD Secretariat.
 - ii. The Field Trial design also will utilise a construct-level rotation approach to gather data on a larger number of new and revised questions with the goal of eliminating entire constructs and/or questions within constructs that do not function as well after the Field Trial. This approach also will allow for methodological Field Test experiments, such as comparing different response options, which can guide Main Survey questionnaire assembly. Using construct-level rotation during the Field Trial has been standard practice in PISA.

Table 2. Proposed Matrix Sampling Approaches for FT and MS

	PISA 2021 FT	PISA 2021 MS
Within-construct matrix sampling	Implemented	Considered
Construct-level rotation	Recommended	Not considered

⁶ PISA 2012 implemented an approach where entire constructs were rotated which resulted in an incomplete database and resulted in methodological concerns about possible attrition in sample size when conducting multivariate regression models and biases in the estimation of plausible values under the construct-level 2012 rotation design have also been raised rather than rotating individual items within constructs.

Main Survey Questionnaire Design

Core Questionnaires

46. During the Main Survey, PISA 2021 will implement two compulsory core questionnaires for each participant, a Student Questionnaire and a School Questionnaire. The Student Questionnaire will be administered as follows:

- Paper-based participants: A core Student Questionnaire consisting of a single form that will be administered to all students taking the PISA test, with an administration time of approximately 35 minutes.
- Computer-based participants: A core Student Questionnaire consisting of multiple partly overlapping forms to accommodate the proposed within-construct matrix sampling design for some constructs. The student questionnaire timing will remain at approximately 35 minutes for each student.

47. For both modes of administration, the questionnaires will cover all or a subset of the modules and constructs described in the questionnaire framework. Decisions about modules and constructs in the Main Survey will be made after the Field Trial with input from the QEG, TAG, PGB, and the OECD Secretariat. Depending on whether within-construct matrix sampling will be used for the Main Survey or not, the reduction in the number of modules and constructs after the Field Trial may differ, with greater reduction expected in case of a single form Main Survey questionnaire.

48. In addition to the Student Questionnaire, administrators in each of the participating schools will respond to a core School Questionnaire of approximately 45 minutes.

49. Both the Student Questionnaire and the School Questionnaire will be available as paper- as well computer-based instruments, with the mode of the questionnaires matching the participant's selected mode of administration of PISA 2021.

Optional Questionnaires

50. The following optional student questionnaires have been confirmed and will be available for computer-based participants. These questionnaires will be administered to students after the core Student Questionnaire:

- i. A computer-based ICT Familiarity Questionnaire (approximately 10 minutes);
- ii. A computer-based Well-Being Questionnaire (approximately 10 minutes); and
- iii. A computer-based Global Competence Questionnaire (approximately 10 minutes).

51. For participants in the optional assessment of Financial Literacy, all students (regardless of whether they received the Financial Literacy cognitive form) will also take a short student questionnaire focusing on Financial Literacy education and money matters (approximately 10 minutes).

52. In addition to the students' components, participants may also choose to implement one or both of the following optional questionnaires: (i) a 40-minute computer-based Teacher Questionnaire, including the teachers' well-being module, and (ii) a 30-minute paper-based Parent Questionnaire.

53. All optional questionnaires will consist of a single questionnaire form. The Teacher Questionnaire will use routing to administer mathematics-specific questions to teachers of mathematics.

Field Trial Questionnaire Design

54. As previously mentioned, one of the major goals of the Field Trial is to evaluate the quality of the context questionnaires used in previous cycles as well as the quality of new items developed for PISA 2021. Thus, more content will be tested in the Field Trial since some of the new content will be dropped for the Main Survey.

Core Questionnaires

55. Consistent with the Main Survey, the PISA 2021 Field Trial will implement two compulsory core questionnaires for each participant: the Student Questionnaire and the School Questionnaire.

56. The Student Questionnaire will be administered to all participating students, with assessment completion time of approximately 35 minutes per student. It will be administered on computer or paper, matching the participant's selected mode of administration for PISA 2021.

57. Two different Field Trial Designs will be implemented for the paper- and computer-based administrations.

- Paper-based participants: Two forms of the Student Questionnaire will be developed for the Field Trial to allow for the inclusion of more content without extending the time needed by each student to complete the questionnaire. Each paper-based Field Trial questionnaire form will include a set of common items (approximately 5 minutes in length) followed by one of two non-overlapping rotated blocks (both approximately 30 minutes in length). The two rotated blocks will serve the purpose of testing a larger number of constructs with the goal of reducing content after the Field Trial. One of the two forms will be randomly assigned to each student.
- Computer-based participants: Multiple partly-overlapping versions of the Student Questionnaire will be developed to allow for the inclusion of more content in the Field Trial and the combination of the construct-level and the within-construct matrix sampling designs outlined in the draft framework.⁷ These forms will be randomly assigned to students. Each Field Trial questionnaire form will include a set of common items (approximately 5 minutes in length) and multiple rotated blocks (totalling approximately 30 minutes in length). The multiple rotated blocks will serve the same purposes as the paper-based Field Trial of reducing testing time and allowing the administration of more content, and in addition they will serve the following purposes:

⁷ Preliminary plans indicate a maximum of 8 forms. However, this needs to be confirmed once the materials are finalised.

- i. first, the implementation of a number of methodological comparisons in terms of question types, question wording, and response options, some of which will be evaluated for the same constructs; and,
- ii. second, a large-scale feasibility test of within-construct matrix sampling for select constructs.

58. The School Questionnaire in the Field Trial will be available in two modes: computer and paper, both of which will be approximately 60 minutes in length. The mode used by a participant will match its delivery mode for the student assessment in PISA 2021. The slightly longer duration in the Field Trial is because new questions for the School Questionnaire need to be administered and evaluated before final questions can be chosen for the Main Survey.

Optional Questionnaires

59. The confirmed optional questionnaires for students—ICT Familiarity, Well-Being, and Global Competence—will be administered following the Student Questionnaire. The Well-Being and Global Competence Questionnaires will be based on previously administered questions in PISA 2018. The ICT Familiarity Questionnaire will draw on previously administered questions as well as new item development. Each optional questionnaire will be administered in a single form during the Field Trial of approximately 10 minutes for Well-Being and Global Competence and approximately 15 minutes for the new ICT Questionnaire. The extended time for the ICT Questionnaire will serve the purpose of testing additional content during the Field Trial and making item selections prior to the Main Survey. Only participants using the computer-based assessments will be able to choose to implement these optional questionnaires. Additionally, participants may choose to implement one or both of the following optional questionnaires: (i) a 60 minute computer-based Teacher Questionnaire, including a 20-min Teacher Well-Being module and (ii) a 35 min paper-based Parent Questionnaire. For PISA 2021, the Teacher Questionnaire will consist of one form that uses routing to administer some questions specifically to mathematics teachers and other questions only to teachers of other subjects.

60. Finally, similar to the Main Survey, for participants in the optional assessment of Financial Literacy, all students (regardless of whether they received the Financial Literacy cognitive form) will also take a short student questionnaire (approximately 15 minutes) focusing on Financial Literacy education and money matters.

61. Annexes A and B, show the Field Trial integrated designs, with detailed information about the questionnaires for both the computer- and paper-based modes respectively.

Une Heure (UH) Option

62. The existing Une-Heure (UH) option for special needs students that was available in 2015 and 2018 will continue to be available in PISA 2021. This option involves the administration of a shorter test and questionnaire to students with special educational needs. Its primary purpose is to assist some participants to achieve the PISA coverage standard. The UH option is offered as a separate session with logistical and cost implications for the national centre.

63. The cognitive assessment includes a 60-minute single testing form comprised of 20 minutes of trend material from each of the three core domains of Reading, Mathematics and Science. This form is currently available only for computer-based but will be extended to paper-based participants if needed.

64. Students taking the UH instrument will take an approximately 20-minute UH version of the Student Questionnaire. This form includes a subset of items from the regular 35-minute Student Questionnaire that will be administered in the same mode as the UH instrument. Also, students taking the UH Form-UH Student Questionnaire will not be administered any of the international options.

65. Annex C shows the Field Trial CBA integrated design for the UH Option.

Annex A. Field Trial Computer-Based Integrated Design

<p>Test Session (120 minutes) <i>Computer-Based, Cognitive Test</i></p>
<p>Student Questionnaires <i>Computer-Based Questionnaires</i></p>
<p>Student Questionnaire (StQ) (~35 minutes) Common Items (~5 minutes), including <i>gender, age, grade, educational program, immigration background</i> (Final list of constructs for the core will be determined after the QEG review) Multiple partly overlapping blocks (~30 minutes each) that will be randomly assigned to students</p>
<p>Optional: ICT Familiarity Questionnaire (ICTQ) (~15 minutes)</p>
<p>Optional: Global Competence Questionnaire (GCQ) (~10 minutes)</p>
<p>Optional: Well-Being Questionnaire (WBQ) (~10 minutes)</p>
<p>Optional: Financial Literacy Questionnaire (FLQ) (~15 minutes)</p>
<p>School Questionnaire (~60 minutes) <i>Computer-Based, Online Questionnaire</i></p>
<p>One form (~45 minutes)</p>
<p>Optional : Teacher Questionnaires (TQ) (~60 minutes) <i>Computer-Based, Online Questionnaire</i> To be administered to all teachers with routing to target questions to general vs. mathematics teachers only</p>
<p>Core Teacher Questionnaire (~40 minutes)</p>
<p>All teachers will also receive the teachers' well-being module (~20 minutes)</p>
<p>Optional : Parent Questionnaire (PQ) (~35 minutes) <i>Paper-Based Questionnaire</i></p>

Annex B. Field Trial Paper-Based Integrated Design

<p>Test Session (120 minutes) <i>Paper-Based, Cognitive Test</i></p>
<p>Student Questionnaire (≈35 minutes) <i>Paper-Based Questionnaire</i></p>
<p>Common Items (≈5 minutes): gender, age, grade, educational program, immigration background (<i>Final list of constructs for the core will be determined after the QEG review</i>)</p>
<p>Within-school random assignment to one of two non-overlapping blocks (≈30 minutes each)</p>
<p>School Questionnaire (≈60 minutes) <i>Paper-Based Questionnaire</i></p>
<p>Optional : Parent Questionnaire (PQ) (≈35 minutes) <i>Paper-Based Questionnaire</i></p>

Annex C. Field Trial Computer-Based UH Integrated Design

UH Test Session (60 minutes)
Computer-Based, Cognitive Test

UH Student Questionnaire (≈20 minutes)
Computer-Based Questionnaires