



17

Questionnaire Design and Computer-Based Questionnaire Platform

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INTRODUCTION

Questionnaires have been important components of the PISA survey from its beginning. They have gained substantially in importance by delivering information about the learning contexts in countries and providing standalone reporting indicators in addition to merely explaining the “background” for reporting cognitive test results. The format and design of the questionnaires have changed across the different PISA cycles and the transition from paper-based to computer-based assessment began slowly for the questionnaires instruments since PISA 2012. While optional online administration for the School Questionnaire was already introduced in PISA 2012, PISA 2015 provided all questionnaires on computer.

As shown in Table 17.1, a number of questionnaires, both compulsory and optional, were implemented in PISA 2015.

Table 17.1 PISA 2015 questionnaires

Questionnaire	Mode of delivery	Compulsory
Student Questionnaire	Computer and paper	Yes
School Questionnaire	Computer and paper	Yes
Educational Career Questionnaire	Computer only	No
ICT Questionnaire	Computer only	No
Teacher Questionnaire	Computer only	No
Parent Questionnaire	Paper only	No

Computer-based delivery was the standard administration format, with the exception of the parent questionnaire option for all countries that implemented it, and a minority of countries that still used paper-based delivery for all tests and questionnaires. The student questionnaires were delivered as part of the student delivery platform and presented on the schools’ computers. The School Questionnaire and the optional Teacher Questionnaires were administered online. The electronic assessment allowed for several types of innovations but the major purpose was to increase the data quality and the response rate for this study.

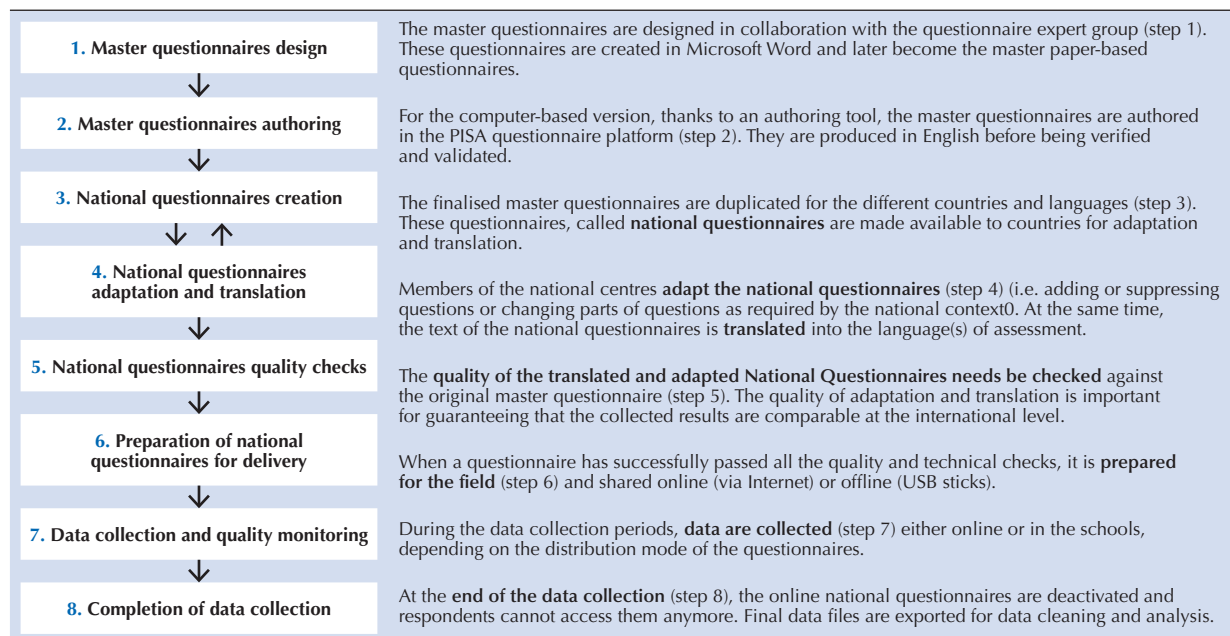
After providing a global overview of the questionnaire implementation process used for PISA 2015, this chapter explains the PISA 2015 design for both the paper-based and the computer-based questionnaires in the field trial and the main survey. The next sections describe the computer-based questionnaires, the PISA questionnaire platform and its functionalities.

GENERAL QUESTIONNAIRE PROCESS

The questionnaire life cycle in PISA follows a process that can be split in eight major steps described in Figure 17.1.

■ Figure 17.1 ■

PISA 2015 questionnaire life cycle





For each cycle of the PISA survey, this sequence of steps takes place twice: once for the field trial and once for the main survey. During the field trial, the whole platform (i.e. the tools, computer servers, network access, etc.) and the material (i.e. the questionnaires) are tested on a limited sample of respondents. Between the field trial and the main survey, the collected results and feedback are analysed. Then, for the main survey, the sequence is started for a second time and each step integrates all necessary adjustments in terms of process, questionnaires material, and tooling. This double-phase cycle provides better data quality.

In the following sections, each step of this process is explained in more detail.

STEP 1: MASTER QUESTIONNAIRES DESIGN

Starting with the first cycle in 2000, PISA has emphasised the importance of collecting context information from students and schools along with the assessment of student achievement. A Student Questionnaire (StQ – approximately 30 minutes) and a School Questionnaire (ScQ – approximately 45 minutes) cover a broad range of contextual variables. The content of these questionnaires – especially the content of the StQ – has changed considerably between cycles, but the design has remained stable: every student participating in the PISA assessment completes the StQ, and every school principal (one per school) completes the ScQ. (Please also see Chapter 3 about the context questionnaire development).

PISA has also included several international options, i.e. additional instruments that countries could administer on a voluntary basis. For PISA 2015, it included a Parent Questionnaire (PAQ) as well as optional questionnaires for the students including the Educational Career Questionnaire (ECQ) and ICT Familiarity Questionnaire (ICTQ). In addition, for the first time, PISA 2015 included a Teacher Questionnaire (TCQ) as an international option into its design. Table 17.2 summarises the participation of countries/economies in the international questionnaires.

[Part 1/2]

Table 17.2 Questionnaire participation in PISA 2015 main survey

Country	Mode	Student	School	Ed. Career	ICT	Student UH	Teacher	Parent
OECD								
Australia	CBA	Yes	Yes	Yes	Yes		Yes	
Austria	CBA	Yes	Yes		Yes	Yes		
Belgium	CBA	Yes	Yes	Yes	Yes	Yes		Yes
Bulgaria	CBA	Yes	Yes	Yes	Yes			
Canada	CBA	Yes	Yes					
Czech Republic	CBA	Yes	Yes		Yes	Yes	Yes	
Denmark	CBA	Yes	Yes		Yes	Yes		
Estonia	CBA	Yes	Yes		Yes			
Finland	CBA	Yes	Yes		Yes	Yes		
France	CBA	Yes	Yes		Yes			Yes
Germany	CBA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Greece	CBA	Yes	Yes	Yes	Yes			
Hungary	CBA	Yes	Yes	Yes	Yes			
Iceland	CBA	Yes	Yes	Yes	Yes			
Ireland	CBA	Yes	Yes		Yes			Yes
Israel	CBA	Yes	Yes		Yes			
Italy	CBA	Yes	Yes	Yes	Yes		Yes	Yes
Japan	CBA	Yes	Yes		Yes			
Korea	CBA	Yes	Yes	Yes	Yes		Yes	Yes
Luxembourg	CBA	Yes	Yes		Yes			Yes
Mexico	CBA	Yes	Yes		Yes			Yes
Netherlands	CBA	Yes	Yes		Yes	Yes		
New Zealand	CBA	Yes	Yes		Yes			
Norway	CBA	Yes	Yes					
Poland	CBA	Yes	Yes	Yes	Yes			
Portugal	CBA	Yes	Yes		Yes		Yes	Yes
Slovak Republic	CBA	Yes	Yes	Yes	Yes	Yes		
Slovenia	CBA	Yes	Yes	Yes	Yes	Yes		
Spain	CBA	Yes	Yes	Yes	Yes		Yes	Yes
Sweden	CBA	Yes	Yes		Yes			
Switzerland	CBA	Yes	Yes		Yes			
Turkey	CBA	Yes	Yes					
United Kingdom (excluding Scotland)	CBA	Yes	Yes		Yes			Yes
United Kingdom (Scotland)	CBA	Yes	Yes					Yes
United States	CBA	Yes	Yes	Yes		Yes	Yes	
United States (Puerto Rico)	PBA	Yes	Yes					

Note: CBA = Computer-Based Assessment, PBA = Paper-Based Assessment. UH = “Une heure” shortened questionnaire version.

[Part 2/2]

Table 17.2 Questionnaire participation in PISA 2015 main survey)

Country	Mode	Student	School	Ed. Career	ICT	Student UH	Teacher	Parent
PARTNER								
Albania	PBA	Yes	Yes					
Algeria	PBA	Yes	Yes					
Argentina	PBA	Yes	Yes					
Brazil	CBA	Yes	Yes		Yes		Yes	
B-S-J-G (China)	CBA	Yes	Yes	Yes	Yes		Yes	
Chile	CBA	Yes	Yes		Yes		Yes	Yes
Colombia	CBA	Yes	Yes		Yes		Yes	
Costa Rica	CBA	Yes	Yes		Yes	Yes		
Croatia	CBA	Yes	Yes	Yes	Yes			Yes
*Cyprus	CBA	Yes	Yes					
Dominican Republic	CBA	Yes	Yes		Yes		Yes	Yes
FYROM	PBA	Yes	Yes					
Georgia	PBA	Yes	Yes					Yes
Hong Kong (China)	CBA	Yes	Yes	Yes	Yes		Yes	Yes
Indonesia	PBA	Yes	Yes					
Jordan	PBA	Yes	Yes					
Kazakhstan	PBA	Yes	Yes					
Kosovo	PBA	Yes	Yes					Yes
Latvia	CBA	Yes	Yes	Yes	Yes			
Lebanon	PBA	Yes	Yes					
Lithuania	CBA	Yes	Yes	Yes	Yes			
Macao (China)	CBA	Yes	Yes		Yes		Yes	Yes
Malaysia	CBA	Yes	Yes				Yes	
Malta	PBA	Yes	Yes					Yes
Moldova	PBA	Yes	Yes					
Montenegro	CBA	Yes	Yes					
Peru	CBA	Yes	Yes	Yes	Yes		Yes	
Qatar	CBA	Yes	Yes					
Romania	PBA	Yes	Yes					
Russia	CBA	Yes	Yes		Yes			
Singapore	CBA	Yes	Yes		Yes			
Chinese Taipei	CBA	Yes	Yes		Yes		Yes	
Thailand	CBA	Yes	Yes	Yes	Yes			
Trinidad and Tobago	PBA	Yes	Yes					
Tunisia	CBA	Yes	Yes					
United Arab Emirates	CBA	Yes	Yes				Yes	
Uruguay	CBA	Yes	Yes		Yes			
Viet Nam	PBA	Yes	Yes					

* Note by Turkey: The information in this document with reference to « Cyprus » relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Note: CBA = Computer-Based Assessment, PBA = Paper-Based Assessment. UH = "Une heure" shortened questionnaire version.

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, allowing for the collection of data that leads to reliable, precise and unbiased estimations of population parameters for each participating country. In addition, the design also has to ensure that important policy issues and research questions can be addressed in later analysis 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. This is usually done by pre-testing all questionnaire content in the field trial one year prior to the main survey assessment. Accordingly, more material is tested in the field trial than will be implemented later on in the main survey. Results are then discussed with the PISA expert groups and material for the main survey is selected.

For PISA 2015, different assessment designs were implemented depending on whether a country used paper or computer-based tests. Only countries implementing the computer-based questionnaires were assessing the newly developed science material for PISA 2015. Countries using the paper-based assessment were mainly implementing trend material (i.e., material that was already used in previous cycles).

In addition, the field trial and the main study questionnaire designs greatly differ in many respects. The goal 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 2015. Moreover, processes and implementation are tested for all countries, including those that are new to PISA.



In the following sections, the differences between the field trial and the main survey design for both paper and computer-based assessments are explained in more detail.

Field trial questionnaire design

Computer-based design

For the Student Questionnaire, four parallel booklets were implemented. For the School Questionnaire, as well as for the optional Parent and Teacher Questionnaires, more material than could be used in the main survey was administered, leading to a slightly longer time to complete the whole questionnaire in the field trial than was planned for the main survey.

Each Student Questionnaire included a set of core items (i.e., StQ-FT Core Items) and one of four rotated blocks (i.e., StQ-FT-A, StQ-FT-B, StQ-FT-C or StQ-FT-D). The set of core items included a minimal set of student background variables – around five minutes in length – that were administered to all students. The four rotated blocks consisted of 25-minutes of non-overlapping content. As shown in Figure 17.2, these four blocks were randomly assigned to students. The optional questionnaires for students, Educational Career and ICT Familiarity questionnaires (ECQ and ICTQ) were administered following the Student Questionnaire and were available only as computer-based instruments.

The computer-based School Questionnaire in the field trial included trend and new material covering approximately 60 minutes.

The optional computer-based Teacher Questionnaire covered approx. 45-minutes. It included a set of core questions (10 minutes assessment time) followed by two non-overlapping modules of 35 minutes each (TCQ-FTScience and TCQ-FTGeneral). The Teacher Questionnaire was administered to at most 10 science teachers and 15 teachers of other subjects in each school (For additional information about the sampling of teachers, please refer to Chapter 4).

Paper-based design

Countries that chose the paper-based mode of delivery administered the paper-based Student Questionnaire. Students in these countries received both the tests and the questionnaires in paper-based forms. The paper-based Student Questionnaire took up to 30 minutes of assessment time and included mostly trend items, as well as some additional newly developed items.

The paper-based School Questionnaire included mostly trend items from previous cycles and is designed to be answered in approximately 60 minutes.

The optional Parent Questionnaire (PAQ) was administered on paper only, thus countries testing on paper as well as those testing on computer were able to implement this option. The PAQ included trend items as well as newly developed content and covered an assessment time of approximately 30 minutes.

The field trial questionnaire designs for the Student Questionnaire and the Teacher Questionnaire are shown in Figure 17.2 below.

■ Figure 17.2 ■

Field trial computer-based design for Student (StQ) and Teacher Questionnaires (TCQ)

Student Questionnaire			
StQ-FT Core Items (5 min): gender, age, grade, educational program, parental occupation, parental education, immigration background			
Within-school random assignment to one out of four non-overlapping blocks (25 min each)			
StQ-FT-A	StQ-FT-B	StQ-FT-C	StQ-FT-D
(Optional) Educational Career Questionnaire (10 min)			
(Optional) ICT Familiarity Questionnaire (10 min)			
Within-school random assignment to one out of two non-overlapping blocks			
ICT-FT-A		ICT-FT-B	



Optional: Teacher Questionnaire	
TCQ-FT-Core: Teacher background, school climate (10 min)	
TCQ-FT-S (35 min) Administered to the sample of science teachers	TCQ-FT-G (35 min) Administered to the sample of non-science teachers

Main survey questionnaire design

The questionnaire designs for the field trial and the main survey were different. The main survey Student Questionnaire consisted of only one booklet and the assessment time was again limited to a maximum of 30 minutes. The School Questionnaire content was also reduced to an assessment time of approximately 45 minutes. The questionnaires in total still covered all policy modules proposed in the questionnaire framework (see Chapter 3). The two optional questionnaires for students – Educational Career and ICT Familiarity – were kept at 10 minutes in length each.

The mode of assessment did not change from the field trial to the main survey, i.e. countries that implemented the assessment on computer also administered the computer-based questionnaire, while paper-based testing countries administered a limited set of mainly trend questions for students and schools. The Parent Questionnaire again was administered on paper only, while the Teacher Questionnaire and the optional ICT and Educational Career Questionnaires were available only on computer.

The main survey questionnaire designs for the computer-based instruments are shown in Figure 17.3 below.

■ Figure 17.3 ■

Main survey computer-based design for Student (StQ) and Teacher Questionnaires (TCQ)

Student Questionnaire (n = 6300 in CBA Design per country) (approximately 30 minutes)	
Optional: Educational Career Questionnaire (ECQ) (10 min)	
Optional: ICT Familiarity Questionnaire (ICTQ) (10 min)	
School Questionnaire (ScQ) (n = 150 per country) (45 min)	
Optional: Teacher Questionnaire (TCQ) (up to 10 science teachers and 15 non-science teachers per school) (30 min)	
TCQ-MS-Core: Teacher background and education (5 min.)	
TCQ-MS-S (25 min) Administered to the sample of science teachers No overlap with TCQ-MS-G	TCQ-MS-G (25 min) Administered to the sample of non-science teachers No overlap with TCQ-MS-S

As the majority of countries decided to implement the computer-based assessment for this cycle, the next paragraphs describe the computer-based questionnaires in more detail. The description of steps 2 to 8 of the questionnaire life cycle focuses on the questionnaire platform and the associated functionalities.

STEP 2: MASTER QUESTIONNAIRES AUTHORIZING

The implementation of the cycle described in the previous section is supported by a set of tools, integrated in two major subsystems, in the PISA platform.

The first subsystem is the PISA portal, step 1 (master questionnaires design) and related activities (e.g. general information sharing, files sharing and global tracking of issues using the PISA platform).

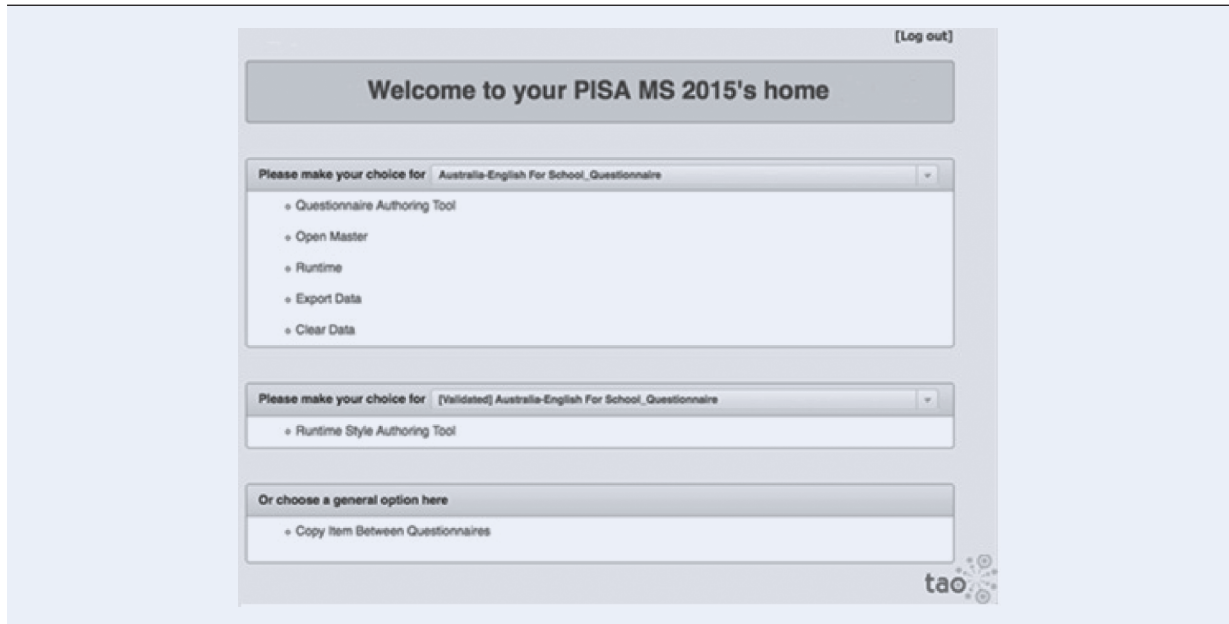


The second subsystem is the PISA questionnaire platform, a comprehensive toolbox that focuses on: production (i.e. their definition, authoring, testing, adaptation, and validation) of questionnaires (master and national questionnaires), delivery of these questionnaires to respondents, and the management of all administrative aspects related to them.

Consequently, the questionnaire platform is designed to reflect these goals. When users log in to the platform, they are taken to a home page as shown in Figure 17.4, providing them access to the platform's features.

■ Figure 17.4 ■

Questionnaire platform home page



Questionnaire authoring tool

Main view for questionnaire editing

Users working on questionnaires first see the questionnaire authoring tool (QAT) editor when connecting to the questionnaire platform. The tool is used to author the computer-based questionnaires of PISA 2015. It is an online editor that allows a user to add, suppress or edit a question. When users open the QAT editor, they are presented with a view on the structure of an entire questionnaire, which is not a *what you see is what you get* (WYSIWYG) view of what participants eventually see. Figures 17.5 and 17.6 show the main view of this editor for a National Project Manager (NPM).



■ Figure 17.5 ■

QAT main view (with a specific question SC002 as an example)

English (Australia) For School_ Questionnaire > Production

Check variables Export PDF Cancel last changes Save Home Log out

Navigation Screen 1 of 37 ID: SC0info

Items Errors

SC0info

SC1info

SC001

SC002

SC003

SC004

SC053

SC059

SC052

SC2info

SC009

SC010

SC012

SC013

SC013R01

SC014

SC016

SC016E01

SC017

SC3info

SC018

SC019

SC025

SC027

SC4info

SC032

SC035

SC036

SC037

SC037R01

SC040

SC040R01

Screen 2 of 37 ID: SC1info

Screen 3 of 37 ID: SC001

Screen 4 of 37 ID: SC002 Template: List of text inputs (+ pie chart)

Screen Hidden: Invert Columns and Rows: Pie Chart: Not included in List of Items:

Options:

Question: As of 1 April, 2015, what was the total school enrollment (number of students)?

Description:

Help:

Instruction: (Please enter a number for each response. Enter "0" (zero) if there are none.)

Code	Response	Input size
Q01TA01	Number of boys	Medium
Q02TA01	Number of girls	Medium

Format: Integer

Min value: 0

Max value: 10000

Footer:

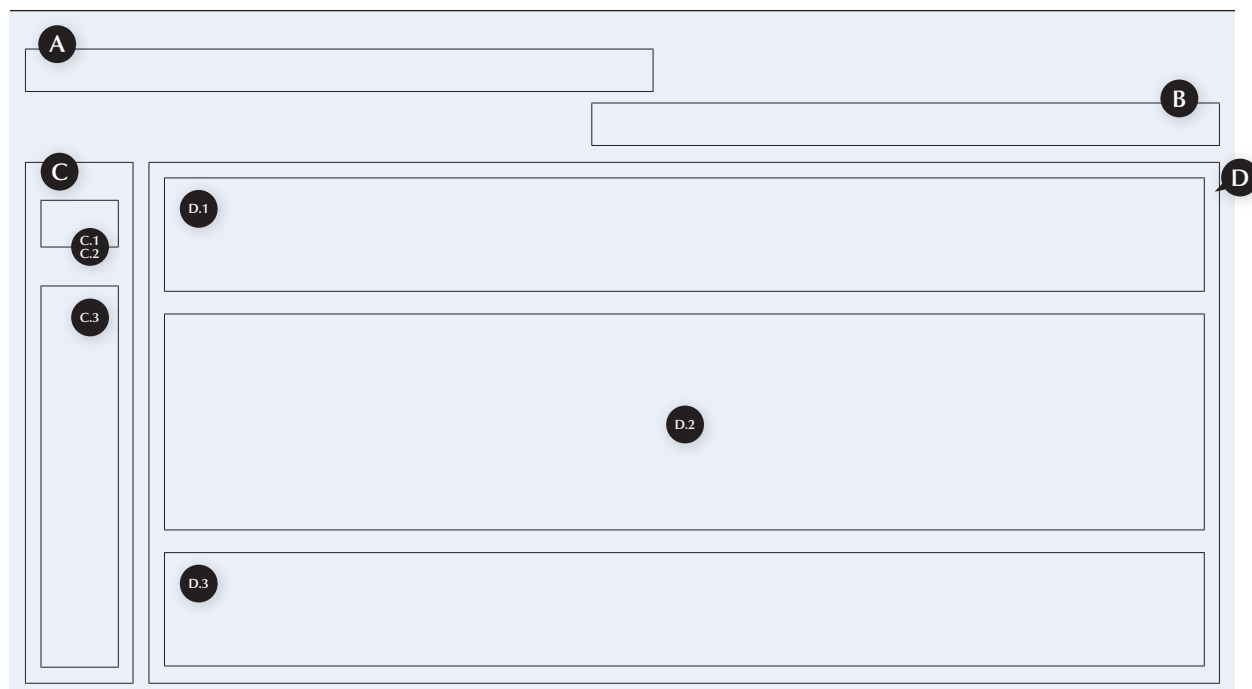
Screen 5 of 37 ID: SC003

Screen 6 of 37 ID: SC004

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■ Figure 17.6 ■

Organisation of the main view of the QAT editor





The organisation of the main view presented in Figure 17.6 is the following:

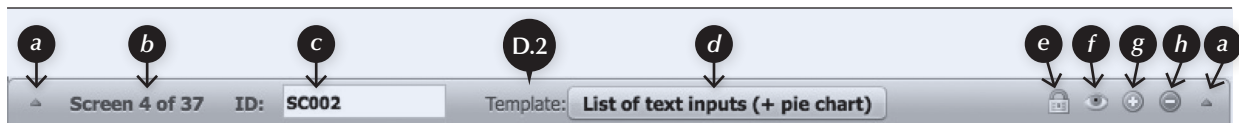
- A. The questionnaire title** concatenates the questionnaire label (country, language and type of questionnaire) and the questionnaire mode (i.e. the modes of the QAT are critical as they define the rights of a current user. According to the mode, the access for modifying questionnaires in the QAT editor is locked or unlocked, allowing each user to work independently).
- B. The questionnaire toolbar** provides the following action buttons:
- *Check variables* checks throughout the questionnaire if an identifier is used by more than one variable (this check is also automatically performed when the *Save* action is triggered).
 - *Export PDF* generates a PDF version of the questionnaire.
 - *Cancel last changes* reloads the previously saved version of the questionnaire.
 - *Save* saves the questionnaire to the database. When used, this action triggers two kinds of checks: one to check if all rules are correctly formatted (no missing variables, no syntax error) and the other one to check if each variable has a unique identifier. If one test fails, the questionnaire is saved but the user will be unable to execute it.
 - *Home* redirects to the questionnaire platform home page.
 - *Log out* disconnects the user from the platform.
- C. The navigation menu** is a panel offering two viewing options:
- a list of the question items [C.1] or
 - a list of the unresolved errors (e.g. problematic rules) [C.2]
 - and quick access to the related question [C.3].
- D. The QAT editor** displays the list of all questions (called “screens”) and rules (called “rules headers”) available for a questionnaire. When clicked, each part toggles between an expanded (D.2) or a collapsed view (D.1 and D.3).

Questions expanded view and questions preview

Figure 17.7 shows the features available at the top of the expanded view.

■ Figure 17.7 ■

The expended view information



- a. *Show/hide screen* button toggles between a collapsed or expanded view of the question (screen or rules header).
- b. Screen NUM of TOTAL (where NUM is the rank of the screen in the sequence of screens of the loaded questionnaire in the QAT editor and TOTAL is the total number of screens existing for the edited questionnaire) or *rules header*.
- c. The *ID* field displays the technical identifier of the screen or rules header.
- d. The *template selector* displays the name of the template used for editing the question (see part below about the question templates).
- e. The *lock* button, not made available to National Project Managers (NPMs), gives them the right to edit or not.
- f. The *preview* icon opens a preview of the item.
- g. The *add screen* icon inserts a new question or rule in the edited questionnaire.
- h. The *delete screen* button removes (after confirmation) the question or rule from the edited questionnaire.

The questionnaire platform offers two preview options for reviewing and checking the quality of the masters encoded in English (Figure 17.8).

■ Figure 17.8 ■

Preview of a question with the QAT editor

The first option is a question preview panel triggered within the QAT editor, via the preview icon available in the expanded view of each question. In this preview mode, the identifiers of response fields are visible to facilitate the questionnaire authoring.

The second option is a full questionnaire preview accessible via the *runtime* menu entry of the questionnaire platform home page. This option lets users navigate through a questionnaire in a test environment and offers the same conditions as those met by the “real respondents” when the questionnaire goes to the field.

Question templates

Inside the expanded view, the user can edit the different parts of a question using the QAT editor: the question text, the description, the instruction, the help and the different answer categories.

The QAT editor is a template-based questionnaire authoring system that supports, amongst other features, the creation of multilingual contents (including left-to-right and right-to-left written texts, extended character sets for Arabic, Chinese, Hebrew, Japanese, Korean, Russian, Thai, etc.), the design of the rules-based routings driving the questionnaire flow, and the enforcement of the quality of the answers via validation rules and constraints.

The question types – or the templates – available in the QAT editor are:

- *exclusive choice*
- *multiple choice*
- *list of text inputs (+ pie chart)*
- *list of exclusive choice (table)*
- *list of multiple choice (table)*
- *multiple list of text inputs (table)*
- *simple list of text inputs with check-in option*



- *scale question type (also called slider)*
- *free text input*
- *forced choice*
- *drop down list*
- *drop down (table)*
- *information.*

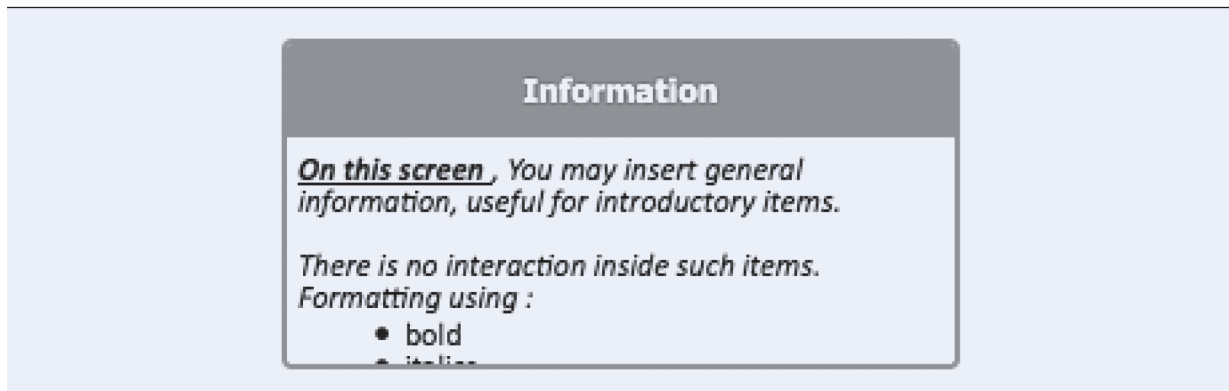
Additionally, there are two templates for defining rules that are used within the questionnaire:

- *consistency check rule*
- *routing rule.*

A short description of each template is given below, with examples in Figures 17.9 through 17.20.

■ Figure 17.9 ■

Information template



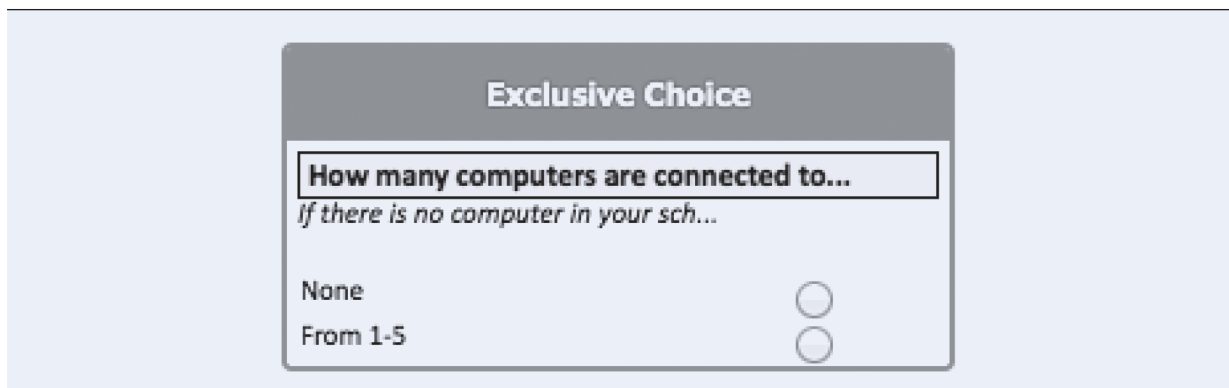
The *information* template is used to insert an introduction, a transition or a closing page into the questionnaire.

The author can use this template to present the questionnaire (e.g. its goals, structure, general recommendations and other instructions...), to introduce a new section of questions and to thank the respondent at the end of the questionnaire.

■ Figure 17.10 ■

Exclusive choice template

(technical name *simpleMultipleChoiceRadioButton*)



The *exclusive choice* template presents a question to the respondent as well as a set of mutually exclusive responses.

Each response option receives an identifier. The data saved for this template includes a value of either 0 or 1, for each response option. At most, only one of these values will be 1.

The presentation of this item type to the respondents uses a single set of standard radio buttons. Choosing one of the options will remove any previous choices.

■ Figure 17.11 ■

Multiple choice template

(technical name *simpleMultipleChoiceCheckbox*)

Multiple Choice

What is the use made from computers...

Course purpose

Communication with teachers

Homework

The *multiple choice* template presents a question to the respondent as well as a set of non-exclusive responses.

Each response option receives an identifier. The data saved for this template includes a value, either 0 or 1, for each response option.

The presentation of this template uses standard checkboxes. The checkboxes are selected (with a checkmark or X) when a user clicks on them, and unselected if clicked a second time.

■ Figure 17.12 ■

List of exclusive choice (table layout) template

(technical name *complexMultipleChoiceRadioButton*)

List of exclusive choice (table)

Forms of criminality in the school

Please select the frequency

	never	Once a year	Once a month	Everyday
Verbal aggression	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

This template presents the user with a set of exclusive choice questions on a single screen in a tabular format. In the default format, each row of the table is a separate response, and the columns are a set of choices for each response. In addition, the QAT editor allows the author to invert the table, so that responses are in the columns and the choices are in the rows.

Typically, this template presents a single question text (e.g. To what extent do you agree with the following statements?). The choices in the columns indicate a range for the responses (e.g., from strongly agree to strongly disagree), and the responses gathered in each row indicate one specific aspect (e.g. a statement) that should be evaluated by the respondent.



In the default case, where responses are in rows, each row will be a set of radio buttons. Clicking on one of the radio buttons will clear any previous choices in that row. A data value is collected for each radio button on the screen. So, if there are 4 rows and five columns, a total of 20 data values will be collected.

■ Figure 17.13 ■

List of multiple choice (table layout) template

(technical name *complexMultipleChoiceCheckbox*)

This template presents the respondent with one or more non-exclusive choice questions on a single screen in a tabular format. It is similar to the previous template; however, it uses checkboxes so that more than one choice can be selected for each row (or column if the presentation is inverted).

■ Figure 17.14 ■

List of text inputs (+ pie chart) template

(technical name *simpleFieldsList*)

This template is used for collecting short, open ended response data. The template presents the respondent with one or more areas to type a response, each with a label indicating the information to be entered.

The responses can be unfiltered text, or they can be limited to numeric values. Constraints can be placed on the values entered in each case. If unfiltered text is allowed, the response can be limited to a minimum and/or maximum length of text. If the response is numeric, a minimum and/or maximum numeric value can be specified. If respondents give a response outside the permitted ranges, an error message is displayed.

An optional feature of this template is the ability to include a pie chart as part of the presentation. This pie chart is constructed dynamically as the respondent enters values into the response areas. Each response area corresponds to a section of the pie chart. The responses must be numeric, and if the sum is greater than 100, an error is shown.



■ Figure 17.15 ■

Multiple list of text inputs (table layout)

(technical name *complexFieldsList*)

	Classic	Science
Cycle 1 students	<input type="text"/>	<input type="text"/>

This template, like the previous one, is used for collecting short, open ended response data. However, in this case more than one response can be collected for each area of interest. The response areas are presented as a table. Similar to the previous template, the response values can be either text or numeric, and can be limited in their range.

■ Figure 17.16 ■

Scale question type template

(technical name *slider*)

How would you qualify ICT skills of...
Students

Low High

The *slider* is one of the innovative interaction models used in the PISA2015 platform. It facilitates the work of the questionnaire author who needs to collect a relative value within a given range. The respondent moves an indicator along a scale line to indicate where in the range their answer should be.

The template allows the author to include one or more slider responses on a screen. Each slider has upper and lower limits which are integer numbers. The author can include labels for the left and right ends of the scale. Also, the step value for the slider can be set. By default, the step is 1, so each integer value in the range can be selected. But this step can be changed to, for instance, 10, which would only allow answers that are incremented by 10.



■ Figure 17.17 ■

Free Text Input Template
(technical name *textfield*)

This template supports an open ended text response. The respondent is presented with a large box in which he can enter a long text and is able to include line breaks to provide multiple paragraphs in the response.

This template was not used in any of the PISA 2015 master questionnaires, but it was used by some countries for their national extensions.

■ Figure 17.18 ■

Forced choice template
(technical name *multipleItems*)

This template is similar to the *exclusive choice* template. It presents the user with one or more questions with multiple answer options. Each question can have one and only one option selected. The primary difference between the two templates is in how they are formatted on the screen. In the case of *forced choice*, a descriptive text is presented at the top of the screen, then for each question the choices are displayed in a row horizontally. This template was mainly used for trend questions of previous cycles.

■ Figure 17.19 ■

Drop down(technical name *simpleDropDown*)

This template presents the respondent with one or more drop down menus from which to select their response. Each menu can have a textual label to present a question or to label the contents of the menu.

The contents of the menu are defined using some lists. The menus can share the same list of response values, or each can have a unique list. For instance, a question could ask for the date of birth, with three different drop down menus for the day, month and year parts of the date.

■ Figure 17.20 ■

Drop down (table layout) template(technical name *complexDropDown*)

Like the *drop down* template, this template presents the respondent with one or more drop down menus for providing a response. In this template, the menus are organised into a table presentation.

Like the previous template, the drop down menu contents are defined in one or more lists. In the standard layout, each menu in a row will contain the same list of response values. However, like the other table based templates, it is possible for the author to invert the rows and columns so that columns contain the same menu values.

Consistency check rule

The consistency check rule template supports a rule-based approach for validating the response provided by a user. The author provides a Boolean condition (i.e. “true” or “false”, intended to represent the truth values of logic) that checks the values of some response variables from different questions the respondent has answered. If the condition evaluates to TRUE, a message is displayed to the user.



The template for defining the consistency check rule appears as follows:

■ Figure 17.21 ■

Consistency check rule template

The rule is evaluated when the respondent navigates away from the current question (e.g. by clicking *next* or *log out*). When the condition is true, a message is shown like the one below:

■ Figure 17.22 ■

Consistency check message

The respondent can click on “Ok” and go back to the current question to change his or her response. If the respondent clicks the “Skip the check” button, the navigation proceeds as normal.

Routing rule

The routing rule allows the author to use branching within a questionnaire. Routing rules appear in between questions in the questionnaire. They are executed after the completion of the question before the rule.

The routing rules are based on Boolean conditions, similar to the consistency checks. The rules are defined using an IF-THEN-ELSE logic. If the condition evaluates to TRUE, the THEN part is executed, otherwise the ELSE part is executed. The THEN and ELSE parts can be either another IF-THEN-ELSE rule (allowing nested logic to be defined) or GOTO commands, directing the questionnaire runtime to branch to a specific question in the questionnaire.

The routing rules are typically used for skipping questions that do not make sense given a specific initial response from the respondent. A simple case is an exclusive choice question, where the last response option is “other”. If the respondents select this option, they should be shown a question asking for more information about their answer, e.g., an open ended response where they can type in their answer. Such a rule could be defined as follows:

■ Figure 17.23 ■

Routing rule template



In this case, ST019 would be the initial question where a respondent has the choice to select “other”. ST021 would be the follow-up question asking for more information, and ST022 would be assigned if ST019 has not been answered with “other”.

Concept of Questions and Answers Identifier within the QAT

An identifier (or ID) is a tag attached to an object. The ID allows the object to be referenced and to be retrieved and used in a precise perimeter of action, or scope. A relation between a tag and the object that it references must be unequivocal. Consequently, the label given to an identifier must be unambiguous and unique within the perimeter where the referenced object can be used.

In the QAT editor, the types of objects receiving an ID are the various questions, including the rules, and all elements designed to receive and store the data provided by the respondents (i.e. answers).

The IDs are one of the key parts for the computer-based questionnaires and are the basis for the data analysis. A question (or part of question) with an unexpected or inappropriate ID is unusable and can eventually not be analysed. Checking the consistency of IDs is one of the main important tasks done by contractors when reviewing a computer-based questionnaire.

STEP 3: CREATION OF NATIONAL QUESTIONNAIRES

As soon as the master questionnaires are authored and checked, they are duplicated for each country and national language version, so everybody starts with the same basis. These questionnaires become the first version of the national questionnaires. The copy operation is performed by the technical team of the PISA questionnaire platform using several system scripts. These national questionnaires are then put into a mode that allows the national centre to adapt and translate the content, as described in the step 4 of the questionnaire life cycle.

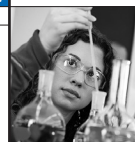
For each national questionnaire, the users continue to have access to the corresponding version of the master questionnaire in a “read-only” mode via the “Open Master” menu entry of the questionnaire software home page. To facilitate the work (i.e. reference, comparison, etc.) of the user, this “read-only” master questionnaire is displayed in a new tab-page or a new instance of the web browser.

STEP 4: NATIONAL QUESTIONNAIRE ADAPTATION AND TRANSLATION

The main work performed at this step is done by the national centre within a country. Once the national questionnaires are ready, the national centre has edit access to it in order to integrate their agreed adaptations and reconciled translations. Contrary to the cognitive assessments, the use of professional text translation formats (e.g. XLIFF formats) is not used for the questionnaires as the very last version of the translated questionnaires is directly integrated in the QAT editor. Like for authoring the master questionnaires, the national centre has access to the same functionalities in the QAT editor, such as adding new national questions and adapting existing questions, as well as the functionalities for previewing the questions. A functionality called “Copy Item between Questionnaires” can also be used in order to copy some questions from one questionnaire to another one. Thus, the same translated question only needs to be integrated once in the QAT editor.

When opening the questionnaire, the national centre can see the master questionnaire texts in English as well as some of the national questions (or parts of questions) already translated and locked. These locked questions are called “trend questions” and represent the questions used in previous PISA cycles. Maintaining the quality and integrity of the trend questions over time is important to be able to analyse the data across cycles. Thus, the verifiers take the paper version of the questions from the previous cycle and manually transfer it in the QAT editor before the national centre gets access to their national questionnaires. Then, using the lock buttons, the verifier locks the questions. These questions will appear in orange and indicate that they cannot be edited anymore. If the national centre wants to modify such an item, they must negotiate the adaptations or requested changes with the questionnaire content experts for these trend questions. If these changes are accepted, the verifier will make the changes for the national centre and again lock these questions afterwards. This translation and verification process is described in more detail in Chapter 5 of this report.

By default, the questionnaire software proposes a set of automatic formatting adapted for the PISA questionnaires such as questions displayed in bold, instructions in italic, etc. However, some of this automatic formatting might need to be adapted by the national centre according to their cultural specificities. For example, a standard font size fit to Latin-based character sets may be too small to display the intricacies of Chinese Kanji characters. Therefore, the questionnaire



software includes a function that allows the national centre to customise settings in their language. With this functionality, the user can specify the text reading direction, the font family, the font size, the text styles (bold, italic, underline, etc.), the line height and the text alignment. This configuration tool is accessible via the “Runtime Style Authoring Tool” menu entry of the questionnaire software home page.

For the table templates, the users are also able to adjust the column widths to optimise the display of each question. This feature can be useful for languages that have long words such as the German language. These adjustments are available when previewing the individual questions in the QAT editor, in a WYSIWYG mode. It is the only screen layout changes that are allowed for the computer-based questionnaires.

When all the translations have been inserted, the fonts are validated and the layout is checked, the national centre can test their questionnaires and validate their work. This part is completed via the “Runtime” menu entry of the questionnaire software home page.

STEP 5: NATIONAL QUESTIONNAIRES QUALITY CHECK

The quality of the national questionnaires must be checked according to different views: the quality of the translations, the accuracy of the translation compared to the English master version, the respect of the agreed adaptations and the technical validity of the questionnaires.

At this step, most of the checks are done manually and each contractor gets access to the questionnaire platform in a read access mode.

The translation and adaptation discrepancies are documented in an Excel file which is delivered to the national centre for their review. The national centre is therefore able to accept or refuse these comments and can update their questionnaires accordingly. (See Chapter 5 for a more detailed description of the translation validation).

The technical team of the questionnaire platform is also involved in this step to manually check all the questionnaires according to several criteria: making sure a user is able to go through the questionnaire from the beginning until the end without a software error due to, for instance, errors in routing rules, check if the number of questions match the number of agreed questions, check if all questions and messages are translated, check if all the parts of the interface are translated and well integrated and check all IDs to make sure they are in agreement with the master. As explained in step 2 of the PISA questionnaire cycle, IDs are the key identification point for the data analysis and an error in this part might result in loss of data.

National centres are provided with testing scenarios for each questionnaire to validate the accuracy of their work. These scenarios describe different ways in which a respondent could answer a questionnaire following every possible routing. National centres are asked to test the questionnaires several times based on these scenarios. When national centres are done with their testing, they need to send their results to the technical team who will analyse all the files and make sure that no technical problems are detected as it is the last step before going to the field.

As all activities performed by the national centre are carefully saved, the technical team is able at any time to monitor the different activities and help in case of technical issues. The technical support provided required 24/7 availability due to the different time zones covered in PISA.

STEP 6: PREPARATION OF NATIONAL QUESTIONNAIRES FOR DELIVERY

After the different checks and controls are performed, the translation and verification of the questionnaires are completed; all is ready to be delivered to the respondents. At this step, the QAT administrators and technical team make a number of checks and system setups using the questionnaire platform’s administrative interface shown in Figure 17.24.

■ Figure 17.24 ■

Questionnaire platform – administrative view

There are two modes of delivery used for the questionnaires. For student questionnaires, including the optional ICT and EC questionnaires, the questionnaires run in an offline, standalone mode as part of the PISA student delivery system (SDS). The School and Teacher Questionnaires are delivered online over the web to respondents around the world. Both modes share a common code base and database structure, but the preparation for delivery follows different procedures.

For the student questionnaires, the preparation step primarily involves exporting the completed national questionnaires for each country, as well as the questionnaire software and user interface translations, in a form that can be used on USB drives for delivery. Unnecessary components, such as the QAT editor, are removed from the questionnaire platform, and a database image with the national questionnaires is created. These exported files are directly integrated into the PISA SDS software for a country, and then tested and validated. See Chapter 18 for more information about the student delivery system (SDS).

The online School and Teacher Questionnaires require more steps to prepare for the field. A key step is to import the sampling information into the questionnaire platform so that the selected schools and teachers will be known to the

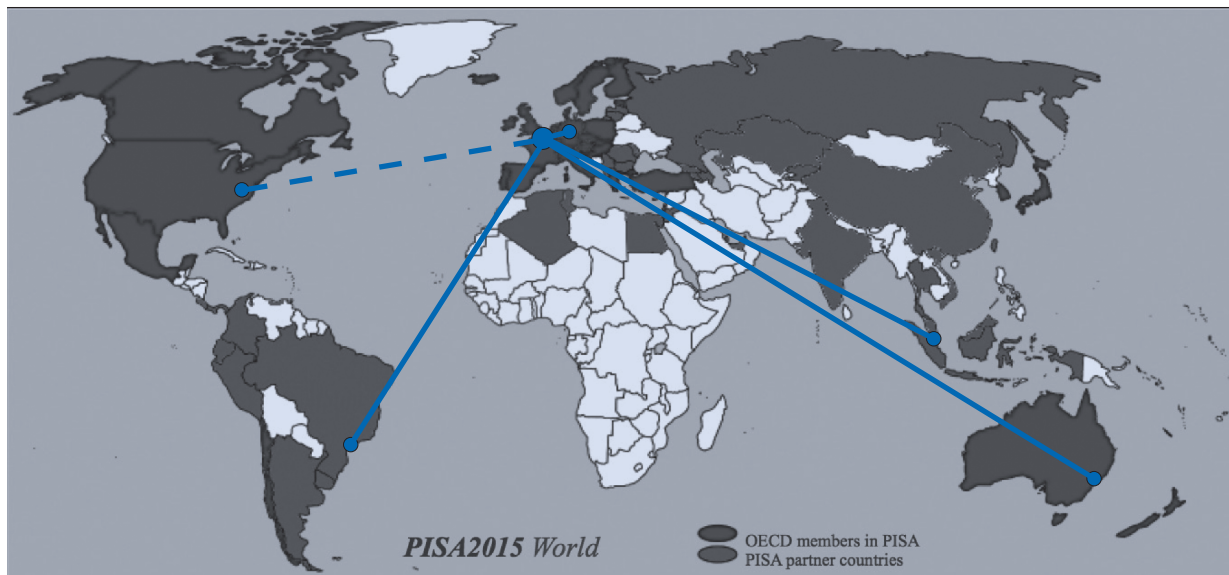


system and can be identified when they connect to complete the questionnaires. To do this, the “Sampling Task 5” (for the field trial) or “Sampling Task 11” (for the main study) output files are taken from KeyQuest, the system used for sampling within countries (see Chapter 4 for details about the sampling). These files contain the list of schools selected from the sampling process, using anonymised ID codes. They also contain information that describes the range of IDs that will be assigned to teachers if the country participates in the optional Teacher Questionnaire. The files are imported into the questionnaire platform, which creates logins and passwords for each sampled school and teacher. These logins and passwords are then sent to the national centre, which distributes them to the selected schools and teachers.

The countries participating in the online questionnaires in PISA 2015 were spread around the world. For the field trial, a single server, located in Luxembourg, was used for data collection. For the main study, in an effort to improve the performance for the end users, the questionnaire platform was distributed to servers around the world (shown in Figure 17.25). This helped to reduce the network latency that users experienced, and improved perceived performance. In addition to the primary server in Luxembourg, two server installations were added in Frankfurt, Germany, and one server was added in each of the following locations: Singapore, Sydney, Australia and Sao Paulo, Brazil.

■ Figure 17.25 ■

Distribution of the PISA 2015 servers



Countries were assigned (in a transparent way) to one of these server locations. Respondents were given a URL which connected them to the primary server in Luxembourg. Based on the ID used to login to this server, the system could determine which country the user came from, and which server they should be assigned to. The respondent was then automatically redirected to this server, where they would take the questionnaire.

In addition, one country, the United States, delivered the online questionnaires from their own national server. This server was completely standalone, so respondents connected to it directly, not through the central PISA server in Luxembourg.

Each location in this network of servers was composed of a tandem of servers mounted in a Master-Slave mode with a failover database mechanics guaranteeing the security of the data in case of a Denial of Service attack or because of a system or software failure. The slave server was also used for generation of results files (see step 8) for performance reasons.

STEP 7: DATA COLLECTION AND QUALITY MONITORING

In step 7 of the questionnaire life cycle, results are collected from students, school principals and teachers. The respondents proceed through the questionnaire, seeing the same rendering and behaviours as the QAT authors have when previewing the questionnaires in the questionnaire platform. For the students, this is done as part of the PISA student delivery system, typically running from USB drives on school computers. The questionnaire software runs offline, in a standalone mode on the school computer, and all results are saved back to the USB drive. The students do not need



to login to start the questionnaires. Identification and authorisation of the students is performed by the student delivery system.

For the online questionnaires for school principals and teachers, delivery is performed over the Internet. This requires the principals and teachers to identify themselves prior to beginning the questionnaire. Respondents are assigned login IDs and passwords as part of the sampling process in step 6. When they first connect to the questionnaire platform, they must enter this ID and password. The questionnaire software will select the appropriate questionnaire based on this ID. In some countries, users must select which language they would like to use when completing the questionnaire.

As respondents complete the questionnaires, data is collected by the questionnaire platform. The original data saved is the response to each question. This data depends on the template used for each question. For questions that use radio buttons or checkboxes, a data value is saved for each of these controls on the screen. The value will be zero or one depending on whether the control has been selected. For sliders, dropdown menus and textual responses, the value selected or entered is saved. If no response is selected or entered, a value of “null” is saved.

Along with the response data, additional data is saved for each respondent. The final valid path taken by the respondent in the questionnaire is saved. This allows one to determine which questions are valid and were presented to the respondent based on the routings that were taken. Also, a log of actions by the respondent and the questionnaire system is saved. This log includes events such as those shown in Figure 17.26.

■ Figure 17.26 ■

Logged events

SESSION_START	The user starts or resumes a questionnaire
ITEM_START	The user starts an item
HELP	The user clicks the Help button
RESET	The user clicks the Reset button to clear previously entered answers
LIST_OF_ITEMS	The user clicks the List of Items button to see the questions that have already been visited in the questionnaire
SELECTED_JUMP	The user clicks on one of the questions in the List of Items to jump to that item
SELECTED_FORWARD	The user clicks the Next button to move forward in the questionnaire
SELECTED_BACK	The user clicks the Back button
SELECTED_LOG_OUT	The user clicks the Logout button to leave the questionnaire
MOVE_FORWARD	The system moves forward to the next question
MOVE_BACK	The system moves back to the previous question
MOVE_JUMP	The system jumps to a new question
LOG_OUT	The system logs off the user
ANSWER_SELECTION	An answer is selected or entered
RANGE_CHECK	The answer entered triggered a range check
CONSISTENCY	A consistency error message is displayed
CONSISTENCY_CANCEL	The move action is cancelled due to the consistency error
CONSISTENCY_SKIP	The consistency error is skipped and the move action proceeds

During this phase, for online questionnaires, the National Project Managers and administrators of the questionnaire platform can monitor the activity of the questionnaire respondents. The monitoring shows which respondents have connected to the questionnaire platform and how far they have progressed through the questionnaire. The platform also supports generating a PDF file for a respondent, showing the questionnaire including all the responses that have been saved. The overall status information can be exported to a spreadsheet for further sorting and filtering.

In the main study, the sampling process selects schools that are chosen to participate in the PISA survey, along with replacement schools if the originally sampled schools refuse or are unable to participate. Through the monitoring tools available in the questionnaire platform, the NPMs are able to activate and disable these schools to control access based on their status. Additionally, some countries used this feature to disable schools after they have completed their questionnaires.

The administrators of the questionnaire platform have additional tools available for monitoring the progress of the respondents. These include a view of all currently connected users, as well as a history of the logins, both successful and unsuccessful. These reports are important in supporting users who report problems and also for monitoring performance issues on the servers. Additionally, the questionnaire platform saves many different logs, which the administrators use for detecting problems and troubleshooting them. All these servers are monitored and must be up 24/7.



STEP 8: COMPLETION OF DATA COLLECTION

Following a negotiated agenda depending on a country's testing date, the access to the online questionnaires is closed. The production phase of the national questionnaires is then ended. This fixed end date allows the final export of results data for inclusion in the PISA analysis. After the access is closed, respondents who attempt to login receive a message indicating that the questionnaires are currently not available and asking them to contact their national centre for further information.

Each country's result data is exported on a weekly basis. Due to the large volume of data, the data generation is performed only once a week to reduce the load on the system. The national centres can download the latest results in a single compressed file, which is imported directly into the Data Management Expert system.

The access to the servers and the questionnaire software is available several weeks after the end of the data collection to allow some time for the NPMs to retrieve the data but also ask questions in case of problems with the data collected.

DEVELOPMENT PROCESS OVERVIEW AND TECHNICAL INFRASTRUCTURE

This section describes the technical aspects of the software and hardware used to support the computer-based PISA 2015 Questionnaires. The PISA Questionnaire platform is a complex and relatively large software system. The development followed standard software development processes. A modified agile process (see https://en.wikipedia.org/wiki/Agile_software_development) was used, implementing multiple releases in the course of developing the platform. An open source project management platform (Redmine, <http://www.redmine.org>) was used to track and document the work.

The PISA questionnaire software was written primarily in PHP on the server side and JavaScript within the web browser. The Apache web server was used for delivery of web content, and data was saved using the MySQL database system. The questionnaire content was structured using custom XML markup.

The online questionnaire servers were Linux based, using Ubuntu 12.04 LTS. The student questionnaires were delivered as part of the PISA student delivery system, which was based on XAMPP. For the main study, multiple servers were deployed using the Amazon Web Services EC2 system.

The methods for software testing evolved as the project progressed. Aspects of unit testing (using the Jenkins system, <https://wiki.jenkins-ci.org>) were implemented, but the fundamental testing was functional and integration testing performed by developers and project managers. A system of automated functional testing using a farm of more than 40 computers running various web browsers and OS's was also deployed. Finally, load testing of the online questionnaires was implemented using the JMeter system (<http://jmeter.apache.org/>).

CONCLUSION

As we saw with the description of the steps of the PISA 2015 questionnaire life cycle, having computer-based questionnaires provided several advantages: flexibility to accommodate language constraints, easy monitoring and check of the work done by the users, a more efficient and reliable data collection process, and collected data available quickly and cleaner for the final analysis. While the advantages of switching to the computer-based questionnaires are important and are a significant motivator to make the PISA cycles more innovative, it is important to also recognise the challenges that countries faced with online delivery of questionnaires. Having access to the Internet and a web browser, which is a basic part of a modern society in 2015, is a necessary but not sufficient requirement to be a part of a computer-based study. The major challenge with delivering online questionnaires taken by thousands of people around the world who can be anywhere (at home, at work, in a cyber cafe...) is that the environment is not controlled at all and all problems cannot be anticipated. For example, what kind of definition should we give for "reliable Internet connection"? Just having a look on Wikipedia for the average connection speed in different countries shows the huge range of Internet infrastructure in the PISA countries.¹

For PISA 2015, several national centres had to deal with "technical issues" such as users who were unable to have access to a computer with the minimum web browser version supported by the study, or users who refused to continue to answer the questionnaire due to a very slow Internet connection. Other technical challenges encountered by users included network filters in schools that interfered with access to the questionnaires and web browser extensions that interfered with the web pages that implement the questionnaires. Finally, some users could not meet the relatively modest requirements for browser versions. In general, these problems are common to any large scale web application.



The consequences of these problems are a reduction in response rates and lost data as users are reluctant to take part in a questionnaire which is seen as difficult to answer. Some national centres had to send paper versions of the questionnaires to principals and teachers to increase response rates. This increased the workload of the national centre and reduced the value of an online survey.

While most countries already realise the benefits of transitioning from paper-based to computer-based questionnaires, paper-based questionnaires still have their place in PISA, and will for the foreseeable future as some countries still need further development of the infrastructure required to support online questionnaires.

Note

1. https://en.wikipedia.org/wiki/List_of_countries_by_Internet_connection_speeds