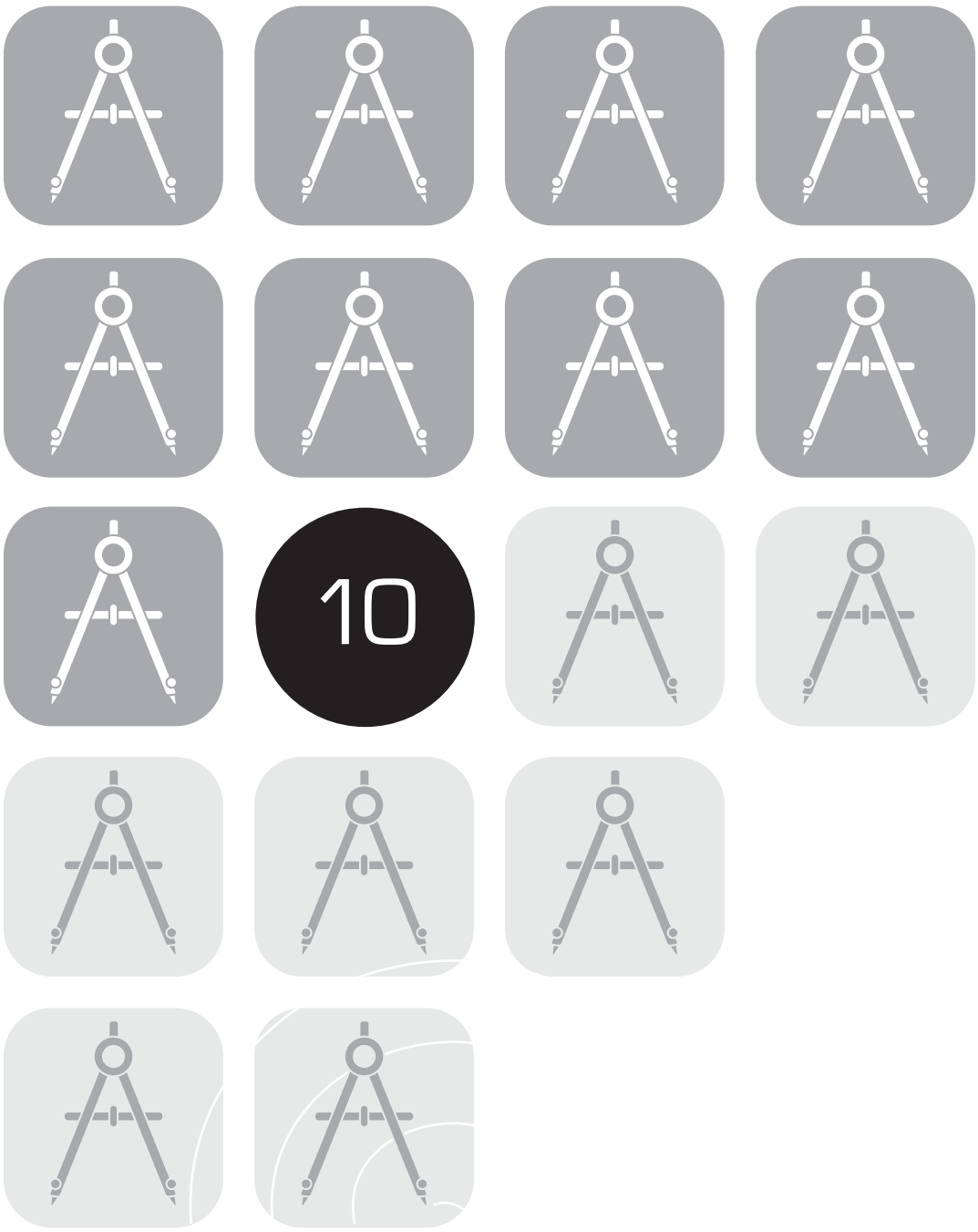

Data Management and Database Construction for TIMSS 1999 Benchmarking

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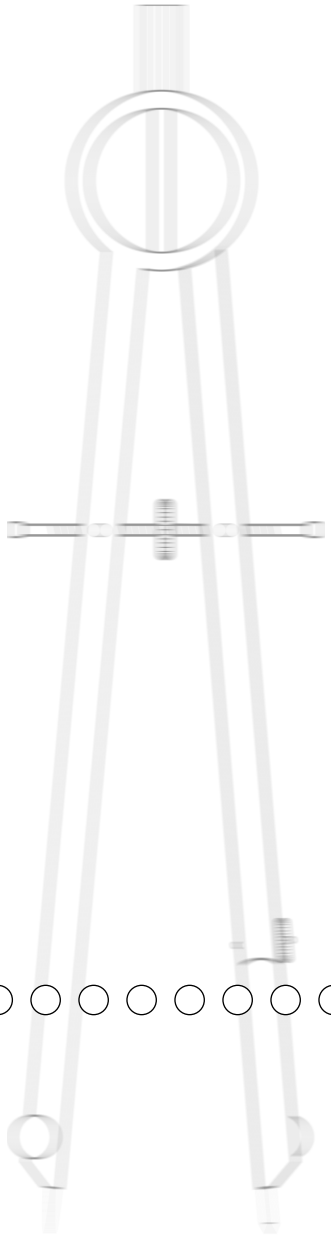

10 Data Management and Database Construction for TIMSS 1999 Benchmarking

Dirk Hastedt
Oliver Neuschmidt
Eugenio J. Gonzalez

10.1 Overview

The achievement test and questionnaire data from the countries (including the United States) that participated in TIMSS 1999 were processed through a closely cooperative process involving the TIMSS International Study Center at Boston College, the IEA Data Processing Center (DPC), the Educational Testing Service (ETS), Statistics Canada, and the national research centers of the participating countries. Under the direction of the International Study Center, each institution was responsible for specific aspects of the data processing. This process is described in Hastedt & Gonzalez (2000). The present chapter, which is based on Hastedt & Gonzalez, describes those aspects of the database construction process that were relevant to the Benchmarking database.

In general, data processing for TIMSS consisted of six basic tasks: (1) data entry, (2) creation of the international database, (3) calculation of sampling weights, (4) scaling of achievement data, (5) analysis of the background data, and (6) creation of the exhibits for the TIMSS 1999 reports. This chapter describes the data checking and database creation that was implemented by the DPC, and the steps taken to ensure the quality and accuracy of the Benchmarking database.[1] It discusses the responsibilities of each participant in creating the database; the flow of the data files among the centers involved in the data processing; the structure of the data files submitted by Westat for processing, and the resulting files that are part of the database; the rules, methods, and procedures used for data verification and manipulation; the data products created during data cleaning; and the computer software used in that process.

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1. Data entry for the Benchmarking data is described in Chapter 8. The weighting, scaling, and analysis procedures are described in chapters 5, 13, and 15, respectively.

10.2 Data Flow

The data collected in the TIMSS 1999 Benchmarking survey were transferred to data files in the international format by NCS and Westat, as described in chapter 8. The files were then submitted to the DPC for cleaning and verification. The major responsibilities of the DPC were to check that the data files matched the international standard and to make modifications as necessary; to apply standard cleaning rules to the data to verify their consistency and accuracy; to interact with Westat to resolve any problems that arose; to produce summary statistics of the background and achievement data for review by the TIMSS International Study Center; and finally, upon feedback from Westat and the TIMSS International Study Center, to construct the Benchmarking database. The DPC was also responsible for returning validated data files to Westat.

Once the achievement data had been checked for format and internal consistency, they were sent to the International Study Center where basic item statistics were produced and reviewed.[2] The sampling weights, which were produced by Westat, were reviewed by Statistics Canada and the TIMSS International Study Center before being forwarded to ETS for use in scaling the student achievement data. Once the sampling weights and the scaled scores for mathematics and science achievement were verified at the International Study Center, they were sent to the DPC for inclusion in the Benchmarking database. The International Study Center prepared the exhibits for the TIMSS 1999 Benchmarking reports and published the results of the study.

10.3 Data Cleaning at the IEA Data Processing Center

Once the Benchmarking data were received from Westat, they were submitted to the DPC for checking before being incorporated into the Benchmarking database. This process is generally referred to by the DPC as data cleaning. The goals of the TIMSS international data cleaning were to identify, document, and, where necessary and possible, correct deviations from the international file structure, and to correct key punch errors, systematic deviations from the international data formats, problems in linking observations across files, inconsistent tracking information across and within files, and inconsistencies within and across observations. The main objective of the process was to ensure that the data adhered to international formats and accurately and consistently reflected the information collected within

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2. The item review process is described in chapter 12.

each participating country. All of the international data-cleaning steps also were applied to the Benchmarking data to ensure that these data achieved the same quality standards as the international data.

Data cleaning involved three main steps. First, all incoming data files were checked, and reformatted as necessary, so that their structure conformed to the international format. As a second step, all problems with identification variables, linkage across files, codes used for different groups of variables, and participation status were detected and corrected. Thirdly, the distribution of each variable was examined, with particular attention to variables that presented implausible or inconsistent distributions based on the information from the country involved and on other answers in the questionnaires. In this third stage, data summary reports were generated for each country. They listed the codes used for each variable and pointed to outliers and changes in the structure of the data file. They also contained univariate statistics. The reports were sent to each participating country, and the NRC was asked to review the data and advise how best to resolve inconsistencies. In many cases the NRC was asked to go back to the original booklets from which the data had been entered. In the case of the Benchmarking participants these reports were sent to Westat, the contractor for field operations, for review.

In data cleaning, two main procedures were used to make any changes to the data that were necessary. Inconsistencies that could be resolved unambiguously were corrected automatically by a program applying standard cleaning routines. Other errors were corrected case by case by the DPC staff. All changes made to the data were recorded in an editing database, so that it was possible to reconstruct the original database received from any country. The three main steps in the data cleaning process are described in more detail below.

10.3.1 Standardization of the National File Structure

The first step in data checking at the international level was to verify the compatibility of the datasets received from countries with the international file structure as defined in the TIMSS 1999 international codebook.

Although the TIMSS 1999 codebooks distributed with the data entry software gave clear and detailed instructions about the structure and format of the files to be submitted to the DPC, some countries opted to use other formats that differed from the international standard. For the most part, these differences were due to specific national circumstances. For example, the U.S. added questions to the School, Teacher, and Student Questionnaires. These items had to be added to the codebooks to ensure that they corresponded to the data files.

After the national files were converted into the extended dBase format required by the DPC, the structure of the files was inspected and any deviations from the international file structure identified. A custom-designed program was used to scan the structure of the files for each country to identify the following deviations:

- International variables omitted
- National variables added
- Different variable length or number of decimal positions
- Different coding schemes or out-of-range values
- Specific national variables
- Gang-punched variables

At the same time, the data management and tracking forms submitted by each NRC to document such deviations were reviewed. Following these checks, the DPC made any changes necessary to make the files compatible with the international format. In most cases specific programs had to be customized to fit the file structures and particularities of each country.

As part of the standardization process, the file structure was rearranged to facilitate data analysis, since the files no longer needed to correspond directly to the data-collection instruments. At this time also, the Student Background Files and Student Achievement Files were merged into a single file. Variables created during data entry solely for the purpose of cross-checking the data were omitted from all files at this time, and new variables were added (i.e., reporting variables, derived variables, sampling weights, and achievement scores).

10.3.2 Cleaning Rules and Procedures

After the data files received from the countries were transformed into the international format, a set of standard checks and cleaning rules were applied.

The first step was to check for deviations from international standards in both data-collection instruments and data files. Instruments were checked for missing questions or items, changes in the number of answer categories, alterations in coding schemes, and other national adaptations. Data files were examined for missing variables, changes in field length and number of decimal places, modifications of coding schemes, and additional national variables.

After all deviations from the international standard had been identified, a cleaning program was run on each file to make a set of standard changes. This was to facilitate the application of more specific cleaning rules at the next stage. After this step, each data file matched the international standard as specified in the international codebook. Among changes made at this time were adjustments to the hierarchical identification number system, differentiation between "not applicable", "missing", and "not administered" codes, adding omitted variables and coding them as "not administered", and recoding systematic deviations from the international coding scheme.

All problems were recorded in an error database containing one error file for each file that was checked. The cleaning program labelled each problem with an identification number, and provided a description of the problem, and the action taken. As problems were identified that could not be automatically rectified, they were reported to the responsible NRC so that data-collection instruments and tracking forms could be checked to trace the source of the errors. Wherever possible, staff at the DPC suggested a remedy and asked the NRCs to either accept it or propose an alternative. The data files were updated as solutions to problems were found. Where the NRC could not solve problems by inspecting the instruments or forms, a general cleaning program was applied.

After all automatic updates had been made, any remaining corrections to the data files were entered directly, or manually, using a specially developed editing program. These corrections took into account country-specific information that could not be used by the cleaning program.

10.3.3 National Cleaning Documentation

NRCs received a detailed report of all problems identified in their data, and of the steps taken to correct them. These included:

- A record of all deviations from the international data-collection instruments and the international file structure
- Documentation of the data problems uncovered by the cleaning program and the steps taken to resolve them
- A list of all manual corrections made in each data file.

In addition to documenting data errors and updates, the DPC provided each NRC with new data files that incorporated all agreed updates. In the case of the Benchmarking data, these reports were sent to Westat. The data files were transformed from the standard layout designed to facilitate data entry to a new format oriented more toward data analysis. The updated files included a range of new variables that could be used for analytic purposes. For example, the student files included nationally standardized scores in mathematics and science that could be used in national analyses to be conducted before the international database became available.

10.4 Data Products

Data products sent by the DPC to NRCs included both data almanacs and data files.

10.4.1 Data Almanacs

Each country received a set of data almanacs, or summaries, produced by the TIMSS International Study Center. These contained weighted summary statistics for each participating country on each variable included in the survey instruments. There were two types of display. The display for categorical variables included an estimate of the size of the student population, the sample size, the weighted percentage of students who were not administered the question, the percentage of students choosing each of the options on the question, and the percentage of students who chose none of the options. The percentage of students to whom the question did not apply was also presented. For continuous

variables the display included an estimate of the size of the student population, the sample size, the weighted percentage of students who were not administered the question, the percentage who did not respond, the percentage to whom the question did not apply, the mean, mode, minimum, maximum, and the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles. These almanacs were also produced for participating states and districts. Example of such data displays are presented in Exhibits 10.1 and 10.2. These data almanacs were sent to the participating countries for review. When necessary, they were accompanied by specific questions about the data presented in them. They were also used by the TIMSS International Study Center during the data review and in the production of the reporting exhibits.

Exhibit 10.1 Example Data Almanac Display for a Categorical Student Background Variable

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Student Background Data Almanac by Mathematics Achievement - 8th Grade

Question : Are you a girl or a boy?
Location : SQ2-02 / SQ2S-02 (BSBGSEX)

Entity	Sample	Valid N	1.GIRL %	2.BOY %	NOT ADMINISTERED %	OMIT %	1.GIRL Mean	2.BOY Mean	NOT ADMINISTERED Mean	OMIT Mean
Connecticut	2023	2012	52.7	47.3	0.2	0.3	505.6	520.6	464.2	441.7
Idaho	1847	1832	49.6	50.4	0.5	0.3	494.2	495.7	523.7	415.0
Illinois	4781	4762	50.7	49.3	0.3	0.2	504.6	515.1	474.8	412.8
Indiana	2035	2021	50.4	49.6	0.6	0.1	509.9	519.9	483.7	419.0
Maryland	3317	3297	53.2	46.8	0.3	0.2	490.9	499.3	428.7	491.7
Massachusetts	2353	2335	50.2	49.8	0.4	0.2	509.8	517.0	534.1	513.7
Michigan	2623	2596	51.2	48.8	0.5	0.3	512.3	522.4	406.6	489.6
Missouri	1979	1963	51.2	48.8	0.5	0.3	488.2	492.3	437.8	434.2
North Carolina	3089	3079	53.5	46.5	0.1	0.2	493.6	497.5	428.6	438.5
Oregon	1889	1864	50.6	49.4	0.8	0.4	514.1	515.2	463.4	471.7
Pennsylvania	3236	3207	50.1	49.9	0.6	0.2	503.1	512.0	500.0	489.1
South Carolina	2011	1996	52.2	47.8	0.5	0.1	500.8	502.9	474.9	457.6
Texas	1996	1844	50.6	49.4	3.5	0.3	516.2	522.3	441.0	529.0
Academy School Dist. #20,	1233	1207	48.6	51.4	1.5	0.7	526.0	532.5	510.7	434.9
Chicago Public Schools, I	1132	1121	52.9	47.1	0.2	0.8	460.7	465.8	263.5	424.3
Delaware Science Coalitio	1268	1247	52.7	47.3	1.0	0.8	474.6	486.5	438.1	443.5
First in the World Consor	750	749	50.1	49.9	0.1	0.0	556.1	563.1	600.2	.
Fremont/Lincoln/WestSide	1093	1079	49.1	50.9	1.4	0.3	484.0	492.0	514.0	370.7
Guilford County, NC	1018	1014	53.5	46.5	0.1	0.2	506.6	522.0	493.1	424.6
Jersey City Public School	1004	994	52.9	47.1	0.9	0.2	472.6	479.8	362.3	395.4
Miami-Dade County PS, FL	1229	1207	49.2	50.8	0.9	0.8	420.5	424.5	391.8	300.9
Michigan Invitational Gro	903	895	50.3	49.7	0.5	0.5	535.0	529.5	483.0	472.4
Montgomery County, MD	1155	1145	51.8	48.2	0.2	0.7	533.8	542.2	473.0	483.1
Naperville Sch. Dist. #20	1212	1210	51.0	49.0	0.1	0.1	566.2	572.9	318.3	495.9
Project SMART Consortium,	1096	1096	50.7	49.3	0.0	0.0	518.6	522.7	.	.
Rochester City Sch. Dist.	966	938	52.6	47.4	2.4	0.9	439.8	452.7	414.0	365.7
SW Math/Sci. Collaborativ	1538	1518	51.2	48.8	1.3	0.0	509.2	524.3	527.5	.
Belgium (Flemish)	5259	5218	49.7	50.3	0.9	0.0	560.8	556.1	504.6	594.3
Canada	8770	7558	50.4	49.6	0.9	12.6	531.4	535.2	513.6	514.8
Chinese Taipei	5772	5765	50.2	49.8	0.0	0.1	583.6	587.1	567.9	401.9
Czech Republic	3453	3448	51.5	48.5	0.2	0.0	511.8	528.5	499.2	.
England	2960	2841	49.0	51.0	4.1	0.1	487.2	507.1	474.9	358.4
Hong Kong, SAR	5179	5098	49.4	50.6	0.4	1.1	583.7	582.3	492.1	536.3
Italy	3328	3328	51.1	48.9	0.0	0.0	474.9	484.2	.	.
Japan	4745	4686	49.5	50.5	1.3	0.1	574.8	582.5	574.0	523.3
Korea, Rep. of	6114	6113	49.2	50.8	0.0	0.0	584.4	589.9	604.0	.
Netherlands	2962	2883	52.3	47.7	2.5	0.2	538.3	544.2	506.7	377.5
Russian Federation	4332	4329	52.1	47.9	0.1	0.0	525.7	526.4	509.9	.
Singapore	4966	4964	48.5	51.5	0.0	0.0	603.3	605.5	551.9	.
United States	9072	8797	50.2	49.8	2.2	0.3	499.2	507.1	436.9	489.7
International Avg.	4755	4678	50.0	50.0	0.8	0.6	485.2	490.0	451.8	421.1

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Student Background Data Almanac by Mathematics Achievement - 8th Grade

Question : Student age at the time of testing
Location : Derived (BSDAGE)

Entity	Sample	Valid N	N.A. %	Omit %	Mean	Mode	Min	P5	P10	Q1	Median	Q3	P90	P95	Max
Connecticut	2023	2018	0.2	0.0	14.0	14.0	9.5	13.3	13.5	13.7	14.0	14.3	14.6	14.8	17.9
Idaho	1847	1838	0.5	0.0	14.2	13.9	9.3	13.7	13.8	13.9	14.2	14.4	14.7	14.9	17.3
Illinois	4781	4773	0.3	0.0	14.2	13.9	9.3	13.7	13.8	13.9	14.2	14.5	14.8	15.0	18.3
Indiana	2035	2023	0.6	0.0	14.4	14.6	9.3	13.8	13.8	14.1	14.3	14.7	15.0	15.3	17.3
Maryland	3317	3308	0.3	0.0	13.9	13.8	9.6	13.3	13.4	13.7	13.9	14.2	14.4	14.8	17.4
Massachusetts	2353	2342	0.4	0.0	14.1	14.0	9.7	13.4	13.6	13.8	14.1	14.4	14.7	14.9	18.2
Michigan	2623	2606	0.5	0.0	14.1	14.1	9.6	13.5	13.7	13.8	14.1	14.4	14.7	14.9	17.8
Missouri	1979	1969	0.5	0.0	14.3	13.9	9.3	13.7	13.8	14.0	14.3	14.6	14.9	15.2	17.9
North Carolina	3089	3084	0.1	0.0	14.2	13.9	9.4	13.5	13.6	13.8	14.1	14.4	14.8	15.2	18.3
Oregon	1889	1871	0.8	0.0	14.2	14.2	9.3	13.7	13.8	13.9	14.2	14.5	14.7	14.9	18.0
Pennsylvania	3236	3209	0.6	0.0	14.2	14.0	9.4	13.6	13.7	13.9	14.2	14.5	14.8	15.1	17.4
South Carolina	2011	2000	0.5	0.0	14.2	14.3	9.5	13.6	13.7	13.8	14.2	14.4	14.9	15.3	17.6
Texas	1996	1850	3.5	0.0	14.3	14.3	12.9	13.7	13.8	14.0	14.3	14.6	15.0	15.3	18.0
Academy School Dist. #20,	1233	1215	1.5	0.0	14.2	14.0	9.6	13.6	13.7	13.9	14.2	14.5	14.7	14.9	16.3
Chicago Public Schools, I	1132	1130	0.2	0.0	14.2	13.9	9.3	13.6	13.7	13.8	14.2	14.5	14.8	15.1	16.1
Delaware Science Coalitio	1268	1256	1.0	0.0	14.1	13.9	9.6	13.4	13.6	13.8	14.1	14.4	14.8	15.2	17.3
First in the World Consor	750	749	0.1	0.0	14.2	14.5	12.4	13.7	13.8	13.9	14.2	14.5	14.6	14.8	15.4
Fremont/Lincoln/WestSide	1093	1082	1.4	0.0	14.2	14.1	9.3	13.6	13.7	13.8	14.1	14.4	14.7	14.9	16.8
Guilford County, NC	1018	1016	0.1	0.0	14.2	13.8	13.1	13.6	13.7	13.8	14.2	14.5	14.8	15.3	16.4
Jersey City Public School	1004	995	1.1	0.0	14.3	13.8	9.6	13.4	13.4	13.7	14.2	14.8	15.3	15.8	18.0
Miami-Dade County PS, FL	1229	1216	0.9	0.0	14.3	14.3	9.4	13.5	13.7	13.8	14.3	14.6	15.0	15.3	18.3
Michigan Invitational Gro	903	899	0.5	0.0	14.1	14.2	9.3	13.6	13.7	13.8	14.1	14.4	14.7	14.9	17.0
Montgomery County, MD	1155	1153	0.2	0.0	14.0	13.8	9.8	13.4	13.5	13.7	13.9	14.3	14.5	14.8	17.4
Naperville Sch. Dist. #20	1212	1211	0.1	0.0	14.1	14.1	9.8	13.7	13.7	13.9	14.2	14.4	14.6	14.8	15.8
Project SMART Consortium,	1096	1096	0.0	0.0	14.2	14.1	9.5	13.6	13.8	13.9	14.2	14.5	14.8	15.1	16.3
Rochester City Sch. Dist.	966	947	2.4	0.0	14.2	13.8	9.3	13.4	13.5	13.8	14.1	14.7	15.1	15.3	17.0
SW Math/Sci. Collaborativ	1538	1518	1.3	0.0	14.2	14.0	9.8	13.5	13.7	13.9	14.2	14.5	14.8	15.0	16.8
Belgium (Flemish)	5259	5221	0.9	0.0	14.1	14.0	11.6	13.4	13.5	13.8	14.0	14.3	14.9	15.3	17.1
Canada	8770	8711	0.8	0.0	14.0	13.8	11.2	13.4	13.5	13.7	14.0	14.3	14.5	14.9	17.3
Chinese Taipei	5772	5772	0.0	0.0	14.2	14.4	10.3	13.7	13.8	13.9	14.3	14.5	14.6	14.7	17.0
Czech Republic	3453	3448	0.2	0.0	14.4	14.6	13.6	13.8	13.8	14.1	14.3	14.7	15.0	15.3	16.3
England	2960	2842	4.2	0.0	14.2	14.0	9.5	13.8	13.8	13.9	14.2	14.5	14.6	14.7	15.8
Hong Kong, SAR	5179	5156	0.4	0.0	14.2	13.6	9.7	13.4	13.5	13.7	14.0	14.4	15.3	16.2	19.2
Italy	3328	3328	0.0	0.0	14.0	14.0	12.5	13.4	13.4	13.7	13.9	14.2	14.3	14.9	18.3
Japan	4745	4684	1.4	0.0	14.4	14.5	13.2	13.9	14.0	14.2	14.4	14.6	14.8	14.8	16.0
Korea, Rep. of	6114	6113	0.0	0.0	14.4	14.1	11.3	14.0	14.0	14.2	14.4	14.7	14.8	14.9	17.3
Netherlands	2962	2890	2.4	0.0	14.2	14.0	12.6	13.5	13.6	13.8	14.2	14.5	15.0	15.3	17.8
Russian Federation	4332	4328	0.1	0.0	14.1	13.9	12.3	13.4	13.6	13.8	14.0	14.3	14.7	15.1	18.0
Singapore	4966	4966	0.0	0.0	14.4	14.0	13.0	13.8	13.9	14.0	14.3	14.6	14.8	15.1	18.8
United States	9072	8776	3.1	0.0	14.2	14.0	9.3	13.5	13.7	13.8	14.2	14.4	14.8	15.1	18.3
International Avg.	4755	4692	1.3	0.0	14.4	14.2	11.6	13.6	13.7	13.9	14.3	14.7	15.1	15.5	18.6

10.4.2 Versions of the National Data Files

Building the international database was an iterative process. The DPC provided NRCs with a new version of their country's data files whenever a major step in data processing was completed. This also guaranteed that the NRCs had a chance to review their data and run their own checks to validate the data files.

Three versions of the data files were sent out to the countries before the TIMSS international database was made available. Each country received its own data only. The first version was sent to the NRC as soon as that country's data had been cleaned. These files contained nationally standardized achievement scores calculated by the DPC using a Rasch-based scaling method. Documentation, with a list of the cleaning checks and all corrections made in the data, was included to enable the NRC to review the cleaning process. Univariate statistics for the background data and item statistics for the achievement data were also provided for statistical review. A second version of the data files was sent to the NRCs when the weights and the international achievement scores were available and had been merged with the files. A third version was sent together with the data almanacs after final updates had been made, to enable the NRCs to validate the results presented in the first international reports.

10.4.3 Reports

Several reports were produced during data processing at the DPC to inform and assist the NRCs, the TIMSS International Study Center, and other institutions involved in TIMSS 1999. The NRCs were provided with diagnostic reports and univariate statistics to help them check their data. The TIMSS International Study Center and ETS were provided with international item statistics. The International Study Center also received international coding reliability statistics and international univariate statistics. A report was made to the International Study Center and the TIMSS 1999 Project Management Committee about the status of each country's data, any problems encountered in the data cleaning, and general statistics about the number of observations per file and preliminary student response rates.

10.5 Computer Software

The standard database program for handling the incoming data was dBase. Tools for precleaning and programs such as LINKCHCK (described earlier) and MANCORR and CLEAN (described below) were developed for manipulating the data.

Statistical analyses (e.g., univariate statistics) for data cleaning and review were carried out with SAS. The final data sets were also created using SAS. For item statistics, the DPC used the QUEST software (Adams and Khoo, 1993).

The main programs that were developed by the DPC and used for TIMSS 1999 are described below. Most of the programs that were written for country-specific cleaning needs are not listed. The programming resources in the main cleaning process were spent largely in developing this set of programs.

10.5.1 MANCORR

The most time-consuming and error-prone part of data cleaning is the direct or "manual" editing of errors uncovered by the review process. Based on the DPC's experience in the IEA Reading Literacy Study, TIMSS 1995, and the pilot phases of TIMSS 1999, the data-editing program MANCORR was developed. It is easy to use and generates automatic reports of all data manipulation. Its main advantage compared with other editors is that all changes in the data are documented in a log database, from which reports can be generated. As updated data were received from countries, the time-intensive manual changes could be automatically repeated. An "Undo" function allowed the restoration of original values that had been modified with the MANCORR program. The report on which changes were made in the data, by whom, and when was important for internal quality control and review. The MANCORR program was developed using CLIPPER in order to manipulate DataEntryManager files.

10.5.2 CLEAN

The main software instrument for data cleaning in TIMSS 1999 was the diagnostic program CLEAN. This program was derived from earlier versions used in the IEA Reading Literacy Study and TIMSS 1995. It was used to check all the TIMSS 1999 files individually, the linkages across files, and all between-file comparisons. An important feature of the program is that it could be used on a data file as often as necessary. It could first be used to make automatic corrections, and subsequently for creating a report only, without making corrections. Thus it was possible to run a check on the files at all stages of work until the end, when the file format was changed to the SAS format. This meant that the program was used not only for initial checks but also to check the work done at the DPC.

A feature of the TIMSS 1999 data cleaning tools is that all deviations are reported to a database, so that reports can be generated by type of problem or by record. Reports previously generated by the program could be compared automatically with newer reports to see which problems had been solved, and even more important, whether additional errors were introduced during manual correction. The databases were used to generate the final reports to be sent to the countries. These reports showed which deviations were initially in the data, which were solved automatically, which were solved manually, and which remained unchanged.

10.5.3 Programs Creating Meta Databases

Using SAS, several programs were developed by the DPC for reviewing and analyzing both the background data and the test items. For the background data, a meta database containing information provided by the initial analysis and by the international codebook was created. Another meta database containing the relevant item parameters was created for the achievement test items. Later, all statistical checks and reports used these databases instead of running the statistics over all data sets again and again. If the data for one country were changed, then statistics had to be recalculated for that country only. This reduced the computing time for certain procedures from hours to a few minutes. Both databases are the base sources of several reports produced at both the national and international levels (e.g., for the univariate and item analysis reports).

10.5.4 Export Programs

As mentioned above, SAS was the main program for analyzing the data. Using SAS, export programs were developed and tested to create output data sets for data distribution that are readable by either SAS or SPSS.

10.6 Summary

The structures and procedures designed for processing the TIMSS 1999 data were applied to the Benchmarking data files to ensure that the Benchmarking data conformed to the same format and quality standards as the TIMSS international data.

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