

Computer based coding of constructed response items in IEA studies

First steps

Presentation prepared for the
IEA General Assembly Tallinn
October 2009



Background

- Countries participating in TIMSS and PIRLS 2011 expressed their interest to make use of the IEA Coding Expert software
- How can this be organised?
- IEA DPC tasks in the coding process
- Country tasks in the coding process



Content

1. Coding: some general remarks
2. Coding Expert - a modular software concept
3. The coding process - five steps and the transformation into computer based coding



Coding – General remarks

- Also known as scoring, marking, or rating
- Assign a code, i.e. a number to a constructed response item
 - Simple answer (word or figure; 0,1)
 - More detailed response (partial credit; more options; e.g. 0,1,2...)
 - Essay (Many dimensions)

Example: TIMSS 95 (advanced Physics)

G11. The water level in a small aquarium reaches up to a mark A. After a large ice cube is dropped into the water, the cube floats and the water level rises to a new mark B.

What will happen to the water level as the ice melts? Explain your reasoning.



Example: TIMSS 95 (advanced Physics)

Code	Response
	Correct Response
20	Same level. Response refers to the fact that the volume (or mass) of the water displaced by the ice is equal to the volume (or mass) of the water produced when the ice is melted (Archimedes' principle). <i>Example: Level is the same because the ice displaces the same volume of water as when it melts.</i>
29	Other acceptable responses.
	Partial Response
10	Same level. Incomplete or incorrect explanation. <i>Examples: a) Ice and water has the same mass. b) Ice has less density than water.</i>
11	Same level. No explanation.
19	Other partially correct responses.
	Incorrect Response
70	Rising level, with or without explanation.
71	Sinking level. The water has smaller volume/greater density/"molecules are closer together" than the ice OR the ice has greater volume/smaller density/"molecules are further apart" than the water.
72	Sinking level. Because ice contains air.
73	Sinking level. As the ice melts the mass decreases (or disappears).
74	Sinking level. With other or without explanation.
79	Other unacceptable responses.
	Nonresponse
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

Coding Expert – A Modular Software Concept

The Coding Expert software consists of three modules:

- Administrator module: Coding Expert Manager
 - Tailored for the DPC hardware and software environment (scanning software, servers...)
 - Not transferable into other systems
- User module: Coding Expert Client
 - Stand alone, thin client
 - Normal PC or Notebook required
 - Windows OS
- Training module: Coding Expert Trainer
 - Stand alone, thin client
 - Normal PC or Notebook required
 - Windows OS



Steps in the coding process

- Preparation of the coding process
- Coder recruitment
- Training of coders
- Coding of constructed response items
- Control procedures



Step 1: Coding preparation

- Identification of items (done)
- Preparation of coding instructions (done)
- Example material (done)
- Assignment of variables (done)
- Partioning of test booklets to facilitate the coding process, taking into account
 - Number/type of test booklet
 - Groups of coders
 - Reliabililty coding
 - Subject



Preparation - Coding Expert Manager

- Item definition (what to code: WinDEM codebook, where to find material)
 - Code plan definition (how to code: scoring guide)
 - Definition of area with expected answers can be found
 - “Packing” of student answers, rules and coding instruction
-
- All test booklets need to be scanned
 - All of the above done at the DPC
 - Workshop with countries envisaged



The CE-Manager

Definition of projects, items, and rules

IEADPC.CodingExpert.Manager (Server: S-SQL-CE; Database = CE_TIMSS07) --- Project Setup

Projects Packaging Administration About

Projects

- TIMSS_07
 - Coding Items
 - Rules

ID: 3

Name: TIMSS_07

Description:

Save

Coding Item	Gesamt	Offen	Paketi	Importiert
Gesamt	139146	0	46	139100
M031009	803	0	2	801
M031016	818	0	0	818
M031030	816	0	0	816
M031041	817	0	0	817
M031068	838	0	0	838
M031079B	803	0	2	801
M031079C	803	0	2	801
M031106	838	0	0	838
M031128	818	0	0	818
M031133	818	0	0	818
M031134	800	0	0	800

Gesamt

Importiert Others

99.97%

0.03%

Refresh

The CE-Manager

Item Definitions

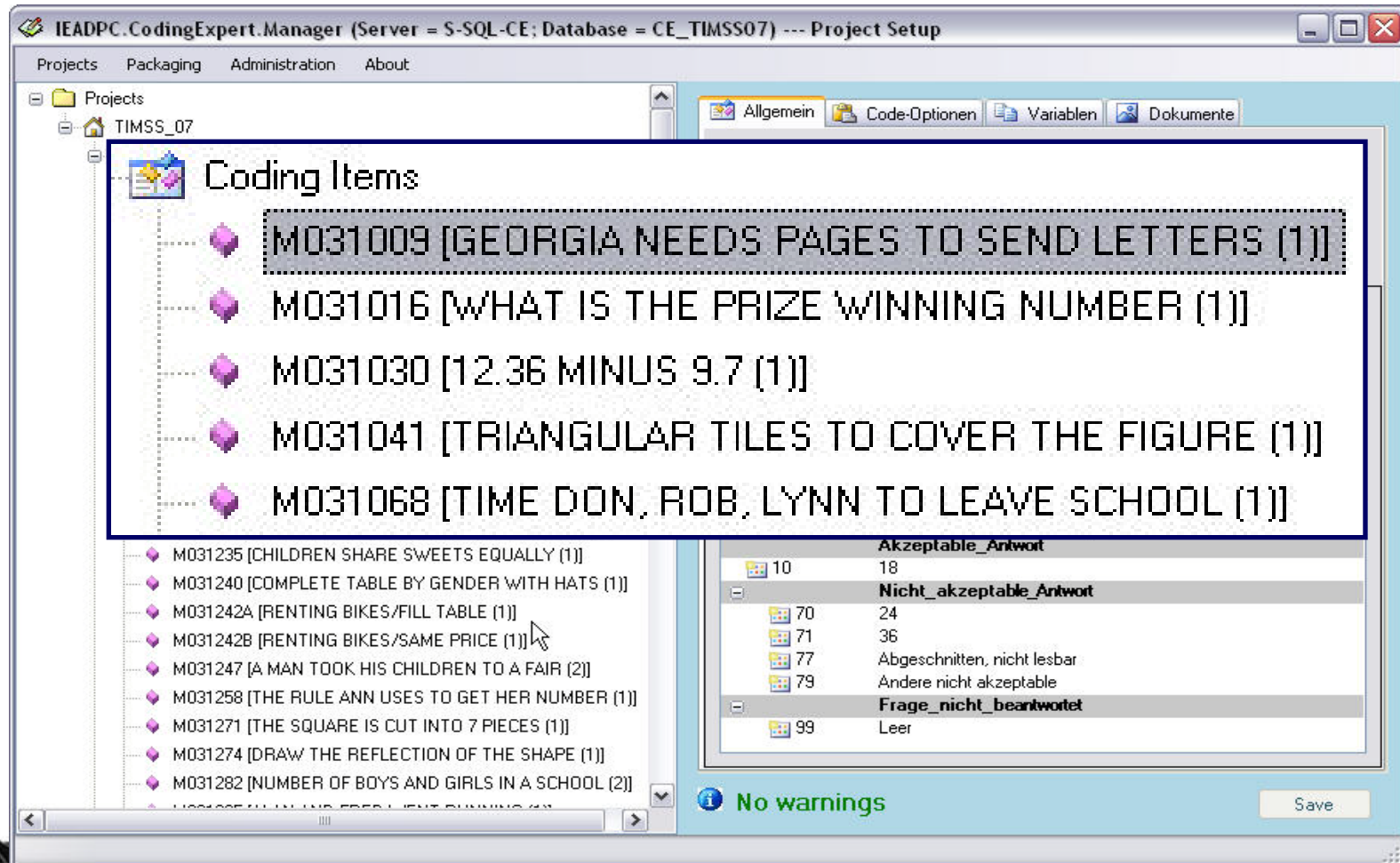
The screenshot displays the IEADPC.CodingExpert.Manager application window. The title bar indicates the server is S-SQL-CE and the database is CE_TIMSS07. The interface is divided into two main sections. On the left, a tree view under 'Projects' shows 'TIMSS_07' expanded, revealing a list of 'Coding Items'. A blue box highlights a selection of items: M031009 [GEORGIA NEEDS PAGES TO SEND LETTERS (1)], M031016 [WHAT IS THE PRIZE WINNING NUMBER (1)], M031030 [12.36 MINUS 9.7 (1)], M031041 [TRIANGULAR TILES TO COVER THE FIGURE (1)], and M031068 [TIME DON, ROB, LYNN TO LEAVE SCHOOL (1)]. On the right, a detailed view for item M031009 is shown. It includes fields for ID (233), Name (M031009), and Alias (GEORGIA NEEDS PAGES TO SEND LETT). Below these, a table lists various codes and their descriptions. The table has three columns: Code, Name, and Description. The data rows are as follows:

Code	Name	Description
10	Akzeptable_Antwort	18
70	Nicht_akzeptable_Antwort	24
71		36
77		Abgeschnitten, nicht lesbar
79		Andere nicht akzeptable
99	Frage_nicht_beantwortet	Leer

At the bottom of the right panel, a green status bar indicates 'No warnings' and a 'Save' button is present.

The CE-Manager

Item Definitions



The screenshot displays the 'IEADPC.CodingExpert.Manager' application window. The title bar indicates the server is 'S-SQL-CE' and the database is 'CE_TIMSS07'. The main window is titled 'Project Setup' and contains a 'Projects' tree on the left with 'TIMSS_07' selected. The central pane, titled 'Coding Items', lists several items, with 'M031009 [GEORGIA NEEDS PAGES TO SEND LETTERS (1)]' highlighted. A right-hand pane shows a table of 'Akzeptable_Antwort' (Acceptable Answer) and 'Nicht_akzeptable_Antwort' (Not acceptable Answer) for the selected item. The table lists various numerical answers and their corresponding status.

Akzeptable_Antwort	
10	18
Nicht_akzeptable_Antwort	
70	24
71	36
77	Abgeschnitten, nicht lesbar
79	Andere nicht akzeptable
Frage_nicht_beantwortet	
99	Leer

At the bottom of the window, a status bar shows 'No warnings' and a 'Save' button.

The CE-Manager

Code Plan and Code Definitions

The screenshot shows the IEADPC.CodingExpert.Manager (Server = S-SQL-CE; Database = CE_TIMSS07) --- Project Setup window. The interface is divided into two main panes. The left pane displays a tree view of the project structure, including 'Projects', 'TIMSS_07', and 'Coding Items'. The right pane shows the details for a selected coding item, with tabs for 'Allgemein', 'Code-Optionen', 'Variablen', and 'Dokumente'.

The 'Allgemein' tab is active, showing the following fields:

- ID: 233
- Name: M031009
- Alias: GEORGIA NEEDS PAGES TO SEND LETT
- Description: (empty)

Below these fields is a table with columns 'Code', 'Name', and 'Description'. The table contains the following data:

Code	Name	Description
	Akzeptable_Antwort	
10	18	
	Nicht_akzeptable_Antwort	
70	24	
71	36	
77	Abgeschnitten, nicht lesbar	
79	Andere nicht akzeptable	
	Frage_nicht_beantwortet	
99	Leer	

At the bottom of the window, there is a status bar indicating 'No warnings' and a 'Save' button.

The CE-Manager

Code Plan and Code Definitions

IEADPC.CodingExpert.Manager (Server = S-SQL-CE; Database = CE_TIMSS07) --- Project Setup

Projects Packaging Administration About

Projects

- TIMSS_07
 - Coding Items
 - M031009 [GEORGIA NEEDS PAGES TO SEND LETTERS (1)]
 - M031016 [WHAT IS THE PRIZE WINNING NUMBER (1)]
 - M031030 [12 36 MINUS 9 7 (1)]

Allgemein Code-Optionen Variablen Dokumente

ID: 233 Description:

Name: M031009

Code	Name	Description
	Akzeptable_Antwort	
10	18	
	Nicht_akzeptable_Antwort	
70	24	
71	36	
77	Abgeschnitten, nicht lesbar	
79	Andere nicht akzeptable	
	Frage_nicht_beantwortet	
99	Leer	

M031282 [NUMBER OF BOYS AND GIRLS IN A SCHOOL (2)]

No warnings

Save

Step 2: Coder recruitment - qualifications

- Familiarity with education and students
- Familiarity with the content domain
- Willingness to implement coding guidelines (even if disagreement with a particular category or definition in the guidelines)
- Computer based coding: PC with Windows OS
- High bandwidth internet connection
- All of the above needs to be ensured in the country



Step 3: Training of coders

- Preparation of training material (photo copying!!)
- Training
- Analysis of training results (coder agreement)
- Identification of difficult items or coding instructions
- Identification of deviating coders



Training with Coding Expert Trainer

- Creating packages for training
- Done at the DPC and send to country via FTP
- Teaching of coding instructions
- Introduction into the Coding Expert Client
- Assigning training material to coders
- Comparison of results
- Needs to be ensured in the country
- Workshops with IEA DPC staff are envisaged



The Coding Expert Trainer

Image Window, Master Code, Code Comparisons

M041302C - M041302C(DRAW A 6-SIDED SHAPE (1)) - D:\... \GA_Example - IEADPC.CodingExpert.Trainer - ...

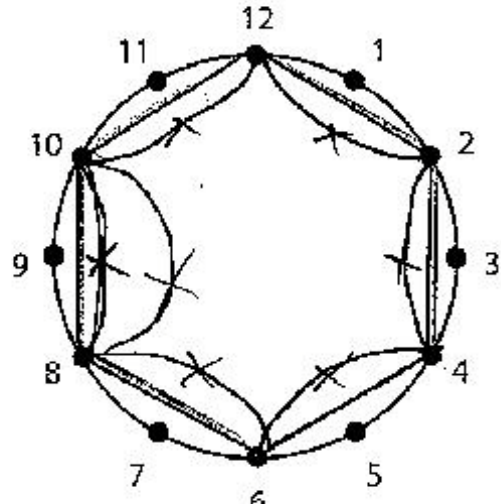
File << < > >> View Window Setting About

Coders

MASTER	10
steffen	10
timssm01	11
timssm02	70
timssm03	11
timssm04	10
timssm05	11

55%

C. Zeichne eine Figur mit 6 gleich langen Seiten in den Kreis.



1. of 100 document(s). - 73353

The Coding Expert Trainer

Main Functions:

- Display and compare training material on screen
- (Pre-)define master codes
- Display coder agreement
- Display coder annotations and discuss code plan for improvements



Step 4: Coding

- Test booklets to be allocated to coders
- Documentation
- Material complete?



Coding: The Coding Expert Manager

- Sophisticated package management
- Handling of different coding purposes
 - Coding for the data base
 - Coding of multiple marking items (within and between coder reliability)
 - Coding of training items (comparisons)
 - Coding of transcribed items (occupations)
- Import/export functionalities (code plans, rules)
- Basic statistics to monitor the process
- Coding material assembled at the DPC and send to country
- Coding results returned from the national center and imported into database



Coding: The Coding Expert Client

- Coding
- Transcription
- Recoding of problematic responses or missing codes (single station or network)
- Creation of return files (codes) to be submitted to the national center
- Used and monitored in the country



The Coding Expert Client

Image Window, Code Plan Window, Assigned Codes

The screenshot displays the IEADPC.CodingExpert.Client application window. The main text area contains a German math problem and its handwritten answer. Below the text area is a 'Code plan' table with columns for Code, Name, and Description. To the right of the code plan is a 'Navigation' panel with a list of 'Assigned codes'.

Text in the main window:

Gisela möchte an 12 Freunde Briefe schicken. Für die Hälfte der Briefe braucht sie je 1 Blatt, für die andere Hälfte je 2 Blätter. Wie viele Blätter braucht sie insgesamt?

Antwort: 18

Code plan table:

Code	Name	Description
10	Akzeptable_Antwort	18
	Nicht_akzeptable_Antwort	
70	24	
71	36	
77	Abgeschnitten, nicht lesbar	
79	Andere nicht akzeptable	
	Frage_nicht_beantwortet	
99	Leer	

Assigned codes table:

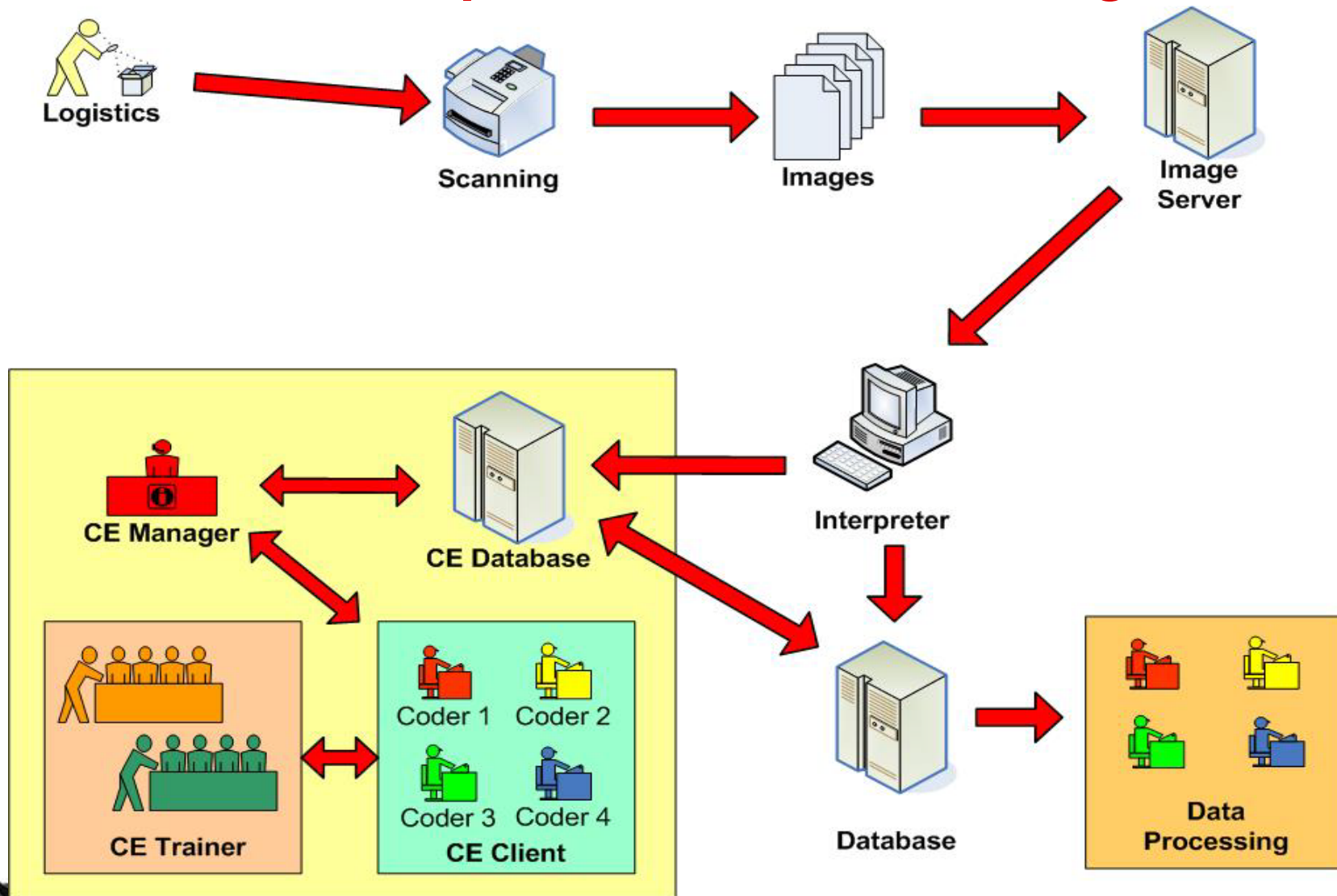
Code	Name
10	18

Step 5: Controlling

- Same items to all coders
- Calculation of agreement indices in the system
- Administered in the country
- Calculation of agreement indices at the IEA DPC



Process of Computer Based Coding



Thank you for your attention!



INTERNATIONAL ASSOCIATION FOR THE EVALUATION OF EDUCATIONAL ACHIEVEMENT

DPC
IEA DATA PROCESSING
AND RESEARCH CENTER
H A M B U R G
G E R M A N Y