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

**Example: TIMSS 95 (advanced Physics)**
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)
- Portioning of test booklets to facilitate the coding process, taking into account
  - Number/type of test booklet
  - Groups of coders
  - Reliability 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
The CE-Manager

Item Definitions
The CE-Manager

Item Definitions
The CE-Manager

Code Plan and Code Definitions
The CE-Manager

Code Plan and Code Definitions

[Image of a software interface showing code definitions]
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
C. Zeichne eine Figur mit 6 gleich langen Seiten in den Kreis.

10 2 Siehe Kodieranweisung
11 3 Siehe Kodieranweisung
70 1 Siehe Kodieranweisung
77 0 Abgeschnitten, nicht lesbar
79 0 Andere_nicht_akzeptable
99 0 Leer
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
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
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

- **Logistics**
- **Scanning**
- **Images**
- **Image Server**
- **CE Manager**
- **CE Database**
- **Interpreter**
- **Database**
- **Data Processing**
- **CE Trainer**
- **Coder 1**
- **Coder 2**
- **Coder 3**
- **Coder 4**
- **CE Client**
Thank you for your attention!