Modeling teachers’ professional competence as a multi-dimensional construct

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4 years later: TEDS-M Follow-Up (TEDS-FU)
Modeling competencies in higher education (KoKoHs)

Humboldt University of Berlin, Department of Education, Chair for Instructional Research

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**Professional competence**

(Weinert, 1999)

- **Professional Knowledge**
  - Content knowledge (CK)
  - Pedagogical content knowledge (PCK)
  - General Pedagogical knowledge (GPK)
    (Shulman, 1987)

- **Affective-motivationale characteristics**
  - Beliefs, attitudes
    - content,
    - instruction,
    - schooling
  - Job motivation
  - Personality
  - Anxiety
    (Richardson, 1996; Thompson, 1992 et al.)

(many recent studies: TEDS-M, MT21, COACTIV, LMT)
### GPK dimensions

<table>
<thead>
<tr>
<th>GPK dimensions</th>
<th>Covered by the TEDS-M 2008 test</th>
</tr>
</thead>
</table>
| Structuring lessons/lesson planning | - components of lesson planning and lesson process  
- lesson evaluation  
- structuring of learning goals     |
| Motivating students/Classroom management | - achievement motivation  
- strategies to motivate single students / the whole group  
- strategies to prevent and counteract interferences  
- effective use of allocated time / routines     |
| Adaptivity                       | - strategies of differentiation  
- variety and use of teaching methods     |
| Diagnosing student achievement    | - assessment types and functions  
- central criteria  
- teacher expectation effects     |

Teacher Education and Development Study (TEDS-M)
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<table>
<thead>
<tr>
<th>TEDS-M 2008</th>
<th>Cognitive processes involved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>recalling</td>
</tr>
<tr>
<td>GPK dimensions</td>
<td>structuring</td>
</tr>
<tr>
<td></td>
<td>motivation/management</td>
</tr>
<tr>
<td></td>
<td>adaptivity</td>
</tr>
<tr>
<td></td>
<td>diagnosing</td>
</tr>
</tbody>
</table>

85 dichotomous and partial-credit items (MC, CR and OR) assessing elementary teachers’ GPK, 77 items assessing middle school teachers’ GPK
=> Validity confirmed in Germany, Taiwan, U.S.

Imagine you are helping a future teacher to evaluate her lesson because she has never done this before. To help her adequately analyze her lesson, what question would you ask? Formulate ten essential questions and write them down.

1) *Do your students have prior knowledge about the subject?*
2) *What are your objectives?*
3) *Are the students working individually or in groups?*
   ...
10) *Have your students gained the knowledge from the lesson?*

*(genuine response from the U.S. TEDS-M study of middle school teachers)*

### Elementary

<table>
<thead>
<tr>
<th>Country</th>
<th>M</th>
<th>SE</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>601</td>
<td>3.7</td>
<td>95</td>
</tr>
<tr>
<td>international</td>
<td>500</td>
<td>0.7</td>
<td>100</td>
</tr>
<tr>
<td>USA</td>
<td>462</td>
<td>2.7</td>
<td>72</td>
</tr>
</tbody>
</table>

### Middle School

<table>
<thead>
<tr>
<th>Country</th>
<th>M</th>
<th>SE</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>576</td>
<td>4.9</td>
<td>85</td>
</tr>
<tr>
<td>Taiwan</td>
<td>572</td>
<td>3.2</td>
<td>52</td>
</tr>
<tr>
<td>International</td>
<td>500</td>
<td>2.2</td>
<td>100</td>
</tr>
<tr>
<td>USA**</td>
<td>440</td>
<td>3.0</td>
<td>66</td>
</tr>
</tbody>
</table>

GPK as a facet of teachers‘ professional competence

What has been accomplished?
- Reliable assessment of an important cognitive resource
- Analytical approach allows precise diagnostics of strength and weakness
- Feasible option of competence assessment

Limits of GPK test
- Low face validity resulting in large proportions of non-response and missings
- Gap with respect to transformation into classroom performance
- Gap with respect to student achievement because it is domain-specific
Improving the validity with respect to classroom performance

- Blömeke, Gustafsson and Shavelson developed the »P-I-D model of competence»
- **Perception**, **Interpretation** and **Decision-making** represent situation-specific skills
- P-I-D mediate the effects of teacher knowledge on their performance
- P-I-D bridge between knowledge as a disposition (or *trait*) and observable classroom performance as a context-related teacher characteristic (or *state*)


TEDS-FU: **Video-based assessment** of perception, interpretation and decision-making of mathematics elementary and middle school teachers:

**Job requirements:**
Diagnosing student achievement, explaining content, dealing with heterogeneity (critical incidents)
## Teacher Education and Development Study (TEDS-M)
### 4 years later: TEDS-M Follow-Up (TEDS-FU)
### Modeling competencies in higher education (KoKoHs)
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<table>
<thead>
<tr>
<th>Orientation</th>
<th>Indicators of expertise</th>
<th>Novices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td>Long-term; sub-groups of students in mind</td>
<td>Short-term, whole class in mind</td>
</tr>
<tr>
<td>Lesson planning</td>
<td>Prior student achievement as starting point</td>
<td>Without checking preconditions</td>
</tr>
<tr>
<td></td>
<td>Linkage to specific long-term objectives</td>
<td>Step-by-step</td>
</tr>
<tr>
<td></td>
<td>Planning of alternatives</td>
<td>Only one strategy</td>
</tr>
<tr>
<td></td>
<td>Frequent evaluation of student achievement</td>
<td>Teaching methods in foreground</td>
</tr>
<tr>
<td>Classroom behavior</td>
<td>Smooth transfer between phases</td>
<td>Phases of seatwork without teacher support</td>
</tr>
<tr>
<td></td>
<td>Advance organizer to connect these</td>
<td>Many superficial questions</td>
</tr>
<tr>
<td></td>
<td>Teacher as instructor</td>
<td>Complexity is reduced</td>
</tr>
<tr>
<td></td>
<td>Cognitively demanding</td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>Rich repertoire of teaching strategies</td>
<td>Only few alternatives</td>
</tr>
<tr>
<td>Goal orientation</td>
<td>Individual understanding of students</td>
<td>Short-term motivation instead achievement/ long-term interest</td>
</tr>
<tr>
<td>Perception</td>
<td>High accuracy, quick identification and selection of problems</td>
<td>Low accuracy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recall only few details</td>
</tr>
</tbody>
</table>
Im Video wurden drei Paare in ihrem Arbeitsprozess genauer betrachtet. Diese Arbeitsprozesse sollen im Folgenden aus zwei Perspektiven – einer (a) MATHEMATIK/DIDAKTISCHE und einer (b) PÄDAGOGISCHE – betrachtet werden:

(a) MATHEMATIK/DIDAKTISCHE PERSPEKTIVE
In jeder der drei gezeigten Herangehensweisen wird die Aufgabe MATHEMATISCH auf eine GANZ EIGENE ART DARGELEGT UND BEARBEITET.
Beschreiben Sie kontrastierend die WESENTLICHEN Aspekte der Herangehensweisen aus mathematikdidaktischer Sicht (keine Stichworte).
Nennen Sie dabei – falls möglich – auch die zugehörigen Fachbegriffe.

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18 open items +
16/22 rating scales
(M_P-I-D/P_P-I-D)

M_P-I-D:
WLE = .67

P_P-I-D:
WLE = .70

(adapted from Clausen, Reusser & Klieme, 2003)

(Blömeke et al., in press; König et al., 2014)
Challenges of improving validity by video-cued testing (Kane, 1992)

⇒ sampling problems: situations (frequency, centrality), rater/ experts (number, relevance), test takers = 3 „fuzzy universes“

⇒ evaluation problems: definition of correct–incorrect, effective–not effective less straightforward in complex situations than in distinct MC/CR items

⇒ generalizability problems: across situations and towards real world given their low number and variability (Dunekacke et al., 2013; Gold, Förster & Holodynski, 2013; Kersting, 2008; Kersting et al., 2012; König et al., 2014; Stürmer, Könings & Seidel, 2012)

= „reliability-validity paradoxon“ (Brennan, 2000)
Improving the validity with respect to student achievement

Teacher/Class Level

- Mathematics Content Knowledge
- Mathematics Pedagogical Content Knowledge

Curricular Level of Tasks

- Cognitive Level of Tasks
- Individual Learning Support
- Classroom Management

Mathematics Student Achievement

Student Level

- Prior knowledge of mathematics
- Mental ability
- Reading literacy
- Socio-economic status
- Parent education
- Ethnic background

OECD’s ITEL project

Brussels, June 18, 2014

(model developed based on Baumert et al., 2010; Voss et al., 2014)
Improving the validity with respect to student achievement

Mathematics Content Knowledge

Mathematics Pedagogical Content Knowledge

General Pedagogical Knowledge

Curricular Level of Tasks

Cognitive Level of Tasks

Individual Learning Support

Classroom Management

Mathematics Student Achievement

Prior knowledge of mathematics

Mental ability

Reading literacy

Socio-economic status

Parent education

Ethnic background

(model developed based on Baumert et al., 2010; Voss et al., 2014)
Improving the validity with respect to student achievement

- TEDS-M tests of MCK and MPCK: international comparison of teacher education systems; assessed outcomes of tertiary education; IEA study
- Random samples of future teachers from 16 countries (stratified multi-stage sampling with routes, programs and regions as strata)
- Built on a prior 6-country study: MT21 (Schmidt, Blömeke & Tato, 2011)
- Led by MSU, ACER, DPC & Statistics Canada; carried out in 2008, release 2010/2012; IEA quality criteria: response rates, weights, BRR (Tatto et al., 2012)


Three students have drawn the following Venn diagrams showing the relationships between four quadrilaterals: Rectangles (RE), Parallelograms (PA), Rhombuses (RH), and Squares (SQ).

Check one box.

A. [Tian]  
B. [Rini]  
C. [Mia]

MCK/MPCK tests: 60 minutes, paper-and-pencil, 2/3 MC, 1/3 CR items; number/algebra/ geometry/data

O₁  
O₂  
O₃

More examples:  
tedsm@msu.edu
When teaching children about length measurement for the first time, Mrs. [Ho] prefers to begin by having the children measure the width of their book using paper clips, then again using pencils.

Give **TWO** reasons she could have for preferring to do this rather than simply teaching the children how to use a ruler?

**Reason 1:**

**Reason 2:**
Improving the validity with respect to cross-cultural validity

23,000 future teachers from 800 institutions in 16 countries

(Blömeke et al., 2011, 2012; Tatto et al., 2008, 2012)
## Mathematics Content Knowledge of future primary teachers

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taiwan</td>
<td>626 (3.3)</td>
</tr>
<tr>
<td>Singapore</td>
<td>603 (2.9)</td>
</tr>
<tr>
<td>Switzerland*</td>
<td>549 (1.9)</td>
</tr>
<tr>
<td>Russia</td>
<td>536 (10.2)</td>
</tr>
<tr>
<td>Thailand</td>
<td>531 (2.1)</td>
</tr>
<tr>
<td>Norway*</td>
<td>530 (2.5)</td>
</tr>
<tr>
<td>USA*</td>
<td>529 (4.1)</td>
</tr>
<tr>
<td>Germany</td>
<td>514 (3.0)</td>
</tr>
<tr>
<td>International</td>
<td>500 (1.2)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>493 (2.0)</td>
</tr>
<tr>
<td>Poland*</td>
<td>490 (2.0)</td>
</tr>
<tr>
<td>Spain</td>
<td>484 (2.9)</td>
</tr>
<tr>
<td>Botswana</td>
<td>438 (5.9)</td>
</tr>
<tr>
<td>Philippines</td>
<td>437 (8.7)</td>
</tr>
<tr>
<td>Chile*</td>
<td>409 (2.3)</td>
</tr>
<tr>
<td>Georgia</td>
<td>341 (3.3)</td>
</tr>
<tr>
<td>IEA</td>
<td>© TEDS-M Germany</td>
</tr>
</tbody>
</table>

- in general, stunningly similar country results to TIMSS/PISA: Can we shed light on factors influencing student achievement this way?

*(Reduced Coverage, Combined Participation Rate < 75% or other Limitations)*

(Blömeke et al., 2011; 2012)
Suggestions for OECD‘s ITEL project

- Modeling teacher competence in a multidimensional way
- Modeling teacher competence as continuum including P-I-D skills

Assessment of important resources

Paper-and-pencil GPK test (building on existing comparative studies)
Survey of affective-motivational characteristics (using existing instruments)

Taking into account the mediating role of P-I-D (or direct behavior)
Development of a video-based assessment (or classroom observations)

Taking into account the role of domain-specific resources
Assessment of CK and PCK (building on existing comparative studies)