Qualities and Effects of Teaching

Integrating findings across subjects and cultures

Eckhard Klieme
Deutsches Institut für Internationale Pädagogische Forschung

EARLI Sig Educational Effectiveness
Zurich, August 23, 2012
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Towards a Conceptual Theory of Teaching

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Zurich, August 23, 2012
Outline

1. „Quality talk“ in didactics and empirical research \((F,E)\)
2. Qualities of Teaching: Finding a „latent“ structure by abduction (based on TIMSS-Video/Germany) \((D)\)
3. Theoretical foundation for three „Basic dimensions of teaching quality“ \((C,B)\)
4. Empirical Support for the latent structure of teaching (Observations, student perceptions)
5. Effects of teaching (Multi-level analysis of longitudinal data)
6. Application to international data sets (TALIS, PISA „2011“): Observable (OTL, practices) vs latent structure; dimensions vs. profiles vs. hierarchies; cultural differences
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Ways to talk about teaching, I: Didactics → Marketing of specific approaches to the „art“ of teaching

„Interest in student-centered learning and learner-centered design has grown dramatically. The emergence of varied teaching-learning frameworks, coupled with technological developments such as the World Wide Weg, has made possible approaches that were heretofore impossible, infeasible, or unimaginable. Open learning environments (OLEs) have proven particularly intriguing.“

Hannafin, Land & Oliver, 1999
Ways to talk about teaching, II: Process-Product-Research in Educational Psychology

→ Lists / Taxonomies of „quality aspects“

1. A supportive classroom climate
2. Opportunity to learn
3. Curricular alignment
4. Establishing learning orientations
5. Coherent content
6. Thoughtful discourse
7. Practice and application activities
8. Scaffolding students’ task engagement
9. Strategy teaching
10. Co-operative learning
11. Goal-oriented assessment
12. Achievement expectations

Brophy (2000)
Ways to talk about teaching, II: Process-Product-Research in Educational Psychology → Lists / Taxonomies of „quality aspects“

1. Appropriate expectations
2. Proactive and supportive classrooms
3. Opportunity to learn
4. Curriculum alignment
5. Coherent content
6. Thoughtful discourse
7. Scaffolding students’ ideas and task involvement
8. Practice/application
9. Goal-oriented assessment

In G. Dworkin (Eds.), International Handbook of Research on Teachers and Teaching. New York: Springer, pp. 803-816
Ways to talk about teaching, III: Comparative Teaching as „cultural activity“

Scripts = generalized knowledge about an event that resides in the heads of participants. These scripts guide behavior and also tell participants what to expect.

...learned through observation and participation. Within a culture, these scrips are widely shared, and therefore they are hard to see.

Ways to talk about teaching, III: Comparative → Teaching as „cultural activity“

Percent of teaching time used for challenging tasks vs. practicing (TIMSS Video Study)
Ways to talk about teaching, III: Comparative Teaching as „cultural activity“

For Core instructional behaviors, most of the variation occurred within nations, not between nations.

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2nd order factors of classroom practice
based on high-inference video-ratings (Clausen, Klieme & Baumert 2002)
(TIMSS-Video 1994 Germany: national sample, 100 + 86 lessons)

<table>
<thead>
<tr>
<th>Structure and Classroom Management</th>
<th>Supportive climate</th>
<th>Cognitive Activation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective treatment of interruptions</td>
<td>Social orientation: „teacher takes care of his students‘ problems“ Teachers diagnostic competence with regard to social behavior Individual reference norm in evaluation Rate of interaction (-) Pressure on students (-)</td>
<td>Teacher’s ability to motivate students: „can present even abstract content in an interesting manner“ Errors as opportunities Demanding tasks Practicing by repetition (-)</td>
</tr>
<tr>
<td>„teacher intervenes immediately, before disturbance may evolve“</td>
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<tr>
<td>Clarity of rules</td>
<td></td>
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<tr>
<td>Interruptions (-)</td>
<td></td>
<td></td>
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<tr>
<td>Waste of time (-)</td>
<td></td>
<td></td>
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<tr>
<td>Monitoring</td>
<td></td>
<td></td>
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<tr>
<td>Time on task</td>
<td></td>
<td></td>
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<tr>
<td>Teacher Unreliability (-)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarity and structuredness of the Instruction</td>
<td></td>
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</tbody>
</table>
## Correlations with types of utterances

<table>
<thead>
<tr>
<th>Structure and Classroom Management</th>
<th>Supportive Climate</th>
<th>Cognitive Activation</th>
</tr>
</thead>
<tbody>
<tr>
<td>More public talk</td>
<td>Less public talk</td>
<td>More public talk</td>
</tr>
<tr>
<td>More teacher utterances</td>
<td>Fewer teacher utterances</td>
<td>High proportion of teacher utterances related to mathematical content</td>
</tr>
</tbody>
</table>
| **High proportion of teacher utterances**:  
  Related to mathematical content  
  Questions, especially about facts  
  Reactions to student answers  
  Positive evaluations | **High proportion of teacher utterances**:  
  Questions: describe/explain personal ideas | **High proportion of teacher utterances**:  
  Questions: decisions, describe/explain |
Profiles for regions within Germany

- Classroom management
- Student Orientation
- Cognitive Activation

Graph showing profiles for regions within Germany with categories:
- Structure / Classroom Management
- Supportive climate
- Cognitive activation

Regions:
- East
- North / West
- South

Sample sizes:
- East: N=18
- North / West: N=41
- South: N=23
Structure/Classroom Management is a prerequisite for Cognitive Activation

The graph illustrates the relationship between Structure/Classroom Management and Cognitive Activation. The data points indicate that higher levels of Structure/Classroom Management are associated with higher levels of Cognitive Activation. The green squares represent 'mit Beweis' (with evidence) and the red squares represent 'ohne Beweis' (without evidence). The trend shows a positive correlation between the two variables.
1. „Quality talk“ in didactics and empirical research \((F,E)\)
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In G. Dworkin (Eds.), International Handbook of Research on Teachers and Teaching. New York: Springer, pp. 803-816

Opportunity to learn
→ available time, degree of student involvement
Curriculum alignment → visible and coherent plan
Goal-oriented assessment → focus on what is important

Proactive and supportive classrooms → caring communities
Appropriate expectations → help students to exceed

Coherent content → sufficient depth
Thoughtful discourse
Scaffolding students‘ ideas and task involvement
→ understand at a higher level)
Practice/application (→ concepts in diverse contexts)
Historical paradigms in the theory of teaching
following Diederich/Tenorth (1997)

1. Herbart:
   well-structured course of instruction

2. Reform pedagogics:
   fostering student activity, self regulation and social embeddedness

3. Subject didactics:
   building up knowledge, understanding, and skills systematically
Borrowing from psychological research

Process-Product-Research; Behavioral learning theory

→ Classroom Management, Clarity & Structure

Humanistic pedagogy and psychology;
  Self determination Theory (Deci & Ryan)

→ Supportive climate & Structured learning environment

Cognitive Theory (e.g. Brown 1997, Mayer 2004);
  concepts from (moderate) constructivism

→ Cognitive Activation & Deep Content
Hypothesis

- Structure/Classroom Management,
- Support and
- Challenge/Cognitive Activation

are basic qualities of teaching that encompass the „latent“ structure of (good ?) teaching in a non-redundant way. .

These dimensions may be related to observable features (practices, methods, types of utterances and interactions), but they are not reducible to any of those.
Creemers & Kyriakides (2008)
The dynamic model of educational effectiveness
Classroom level factors

Overarching: „Management of time“ (-> Classroom Management)
Overarching: „Classroom as a learning environment“ (-> Support)
Specific factors:
   Structuring – Orientation – Assessment  (-> Structure/CM)
   Modelling – Application – Questioning   (-> Cogn. Activation)
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<table>
<thead>
<tr>
<th>Factor</th>
<th>Cognitive Activation</th>
<th>Autonomy</th>
<th>Support</th>
<th>Class Manag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenging problems</td>
<td>0.876</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing ideas from student conceptions</td>
<td>0.718</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher delivering knowledge</td>
<td>-0.714</td>
<td></td>
<td></td>
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<tr>
<td>Cooperative learning</td>
<td>0.660</td>
<td>0.527</td>
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<tr>
<td>Taking up student thinking styles</td>
<td>0.609</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Taking up pre-knowledge</td>
<td>0.595</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content made relevant for students</td>
<td>0.511</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student responsibility</td>
<td></td>
<td>0.858</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individualized instruction</td>
<td></td>
<td>0.856</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students can choose among alternatives</td>
<td></td>
<td>0.835</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constructive feedback</td>
<td></td>
<td></td>
<td>0.795</td>
<td></td>
</tr>
<tr>
<td>Teacher support</td>
<td></td>
<td></td>
<td>0.788</td>
<td></td>
</tr>
<tr>
<td>Learning from mistakes</td>
<td></td>
<td></td>
<td>0.722</td>
<td></td>
</tr>
<tr>
<td>Preventing disruptions</td>
<td></td>
<td></td>
<td></td>
<td>0.956</td>
</tr>
<tr>
<td>Disciplinary problems</td>
<td></td>
<td></td>
<td></td>
<td>-0.955</td>
</tr>
</tbody>
</table>
Pianta & Hamre: Classroom observation scales. (CLASS)

• Classroom organization
• Emotional support
• Instructional support

Ohio teacher efficacy scales (OSTES)
• Efficacy for classroom management
• Efficacy for student engagement
• Efficacy for instructional strategies

- Efficacy for classroom management
- Efficacy for student engagement
- Efficacy for instructional strategies
Coactiv Study (linked to PISA 2003-Germany)
Kunter, Baumert et al. (2005); Baumert et al. (2009)
### DESI Study (German National language Survey)
#### Klieme et al. (2008)
#### Student Questionnaires by A. Helmke et al.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item Example</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>At the end of a lesson, the teacher summarizes main issues</td>
<td>.79</td>
</tr>
<tr>
<td>Support</td>
<td>My teacher advises me how to improve.</td>
<td>.86</td>
</tr>
<tr>
<td>Cognitive Activation</td>
<td>My Teacher stresses that our writing should be grammatically correct</td>
<td>.89</td>
</tr>
</tbody>
</table>
IGEL Study - Classroom intervention: adaptive science education in primary schools

(Hardy, Klieme, Warwas, Büttner, Hertel, Kunter, Lühken et al.)
Student Questionnaire developed by B. Fauth et al.

<table>
<thead>
<tr>
<th>Document Title</th>
<th>Number of items</th>
<th>Example</th>
<th>Cronbach’s α</th>
<th>ICC1</th>
<th>ICC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Activation</td>
<td>7</td>
<td>“Our science teacher asks questions I have to think about a lot”</td>
<td>.71</td>
<td>.15</td>
<td>.75</td>
</tr>
<tr>
<td>Classroom Management</td>
<td>6</td>
<td>“In our science class nobody disrupts the lesson”.</td>
<td>.82</td>
<td>.20</td>
<td>.82</td>
</tr>
<tr>
<td>Supportive Climate</td>
<td>9</td>
<td>“Our science teacher is nice to me even though I might make a mistake“</td>
<td>.80</td>
<td>.20</td>
<td>.82</td>
</tr>
</tbody>
</table>

Sample: 1088 third grade students (mean age = 8.5 years) from 59 classes in 41 schools.
Within

Supportive Climate (w) - 0.67
Classroom Management (w) - 0.32
Cognitive Activation (w) - 0.23

Between

Supportive Climate (b) - 0.69
Classroom Management (b) - 0.51
Cognitive Activation (b) - 0.49

3/3 factor model of perceived instructional quality (Fauth 2012)
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Supportive Climate predicts motivational development

Change in math interest over 1 year

Supportive Climate
(one selected lesson)
Cognitive and motivational effects of teaching

<table>
<thead>
<tr>
<th>Quality of instruction (opportunities provided)</th>
<th>Mediation (take up)</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure, clarity &amp; Classroom management,</strong></td>
<td>(Behavior regulation; time on task)</td>
<td>Knowledge and understanding</td>
</tr>
<tr>
<td><strong>Challenge &amp; Cognitive Activation</strong></td>
<td>(Depth of processing, reflective learning)</td>
<td></td>
</tr>
<tr>
<td><strong>Supportive Climate</strong></td>
<td>(self determination, positive emotions)</td>
<td>Motivation and affective outcomes</td>
</tr>
</tbody>
</table>

(Klieme, Pauli & Reusser, 2009; Klieme, Schümer & Knoll, 2001)

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
<th></th>
<th>Model 3</th>
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<th>Model 4</th>
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<td>$\beta$</td>
<td>SE</td>
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<td>$\beta$</td>
<td>SE</td>
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<td>SE</td>
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<tr>
<td>Performance at pretest</td>
<td>.33**</td>
<td>.06</td>
<td>.32**</td>
<td>.06</td>
<td>.35**</td>
<td>.06</td>
<td>.33**</td>
<td>.06</td>
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<tr>
<td>Time spent on Pythagorean-Theorem content</td>
<td>.12**</td>
<td>.04</td>
<td>.12**</td>
<td>.04</td>
<td>.11*</td>
<td>.04</td>
<td>.12**</td>
<td>.05</td>
</tr>
<tr>
<td>Classroom management</td>
<td></td>
<td></td>
<td>.09*</td>
<td>.04</td>
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<tr>
<td>Cognitive activation</td>
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<td>.10*</td>
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<td>Supportive climate</td>
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<td>.05</td>
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<tr>
<td>Performance at pretest</td>
<td>.15**</td>
<td>.03</td>
<td>.15**</td>
<td>.03</td>
<td>.15**</td>
<td>.03</td>
<td>.15**</td>
<td>.03</td>
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<tr>
<td>Prior mathematics-related interest</td>
<td>.07*</td>
<td>.03</td>
<td>.07**</td>
<td>.03</td>
<td>.07*</td>
<td>.03</td>
<td>.07*</td>
<td>.03</td>
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<tr>
<td>Basic cognitive ability</td>
<td>.22**</td>
<td>.03</td>
<td>.21**</td>
<td>.03</td>
<td>.21**</td>
<td>.03</td>
<td>.22**</td>
<td>.03</td>
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<tr>
<td>Perceived cognitive activity</td>
<td>.09**</td>
<td>.03</td>
<td>.09**</td>
<td>.03</td>
<td>.09**</td>
<td>.03</td>
<td>.09**</td>
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<td>Dependent variable:</td>
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<td><strong>Class level:</strong></td>
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<tr>
<td>Cultural background&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Mean interest</td>
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<tr>
<td>Mean prior knowledge</td>
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<tr>
<td>Structured organisation of the LE</td>
<td>.09*</td>
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<tr>
<td><strong>Individual level:</strong></td>
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<tr>
<td>Gender&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Interest</td>
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<tr>
<td>Prior knowledge</td>
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</tr>
</tbody>
</table>

<sup>a</sup>: 0=Germany, 1=Switzerland; <sup>b</sup>: 0=Girls, 1=Boys

* p<.05: - Variable not in model
Standardized effects (controlling for individual and school-level context)
In ninth grade (440 classrooms, 11,000 students)

<table>
<thead>
<tr>
<th></th>
<th>German</th>
<th></th>
<th>English</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Achievement</td>
<td>Interest</td>
<td>Achievement</td>
<td>Interest</td>
</tr>
<tr>
<td>Cognitive Activation</td>
<td>.242</td>
<td>.073</td>
<td>.150</td>
<td>.001</td>
</tr>
<tr>
<td>Structure</td>
<td>-.147</td>
<td>.188</td>
<td>-.069</td>
<td>.113</td>
</tr>
<tr>
<td>Support</td>
<td>.050</td>
<td>.239</td>
<td>.030</td>
<td>.303</td>
</tr>
</tbody>
</table>

For German, effects remain significant if intake is controlled for.
### IGEL Study - Classroom intervention:
adaptive science education in primary schools

(Fauth et al., in prep.)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Achievement</th>
<th>Interest</th>
</tr>
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<tbody>
<tr>
<td><strong>Individual-level</strong></td>
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</tr>
<tr>
<td>Intakte</td>
<td>.20 (.03)*</td>
<td>.11 (.05)*</td>
</tr>
<tr>
<td>Science competence</td>
<td>.27 (.03)*</td>
<td>.11 (.04)*</td>
</tr>
<tr>
<td>Cognitive abilities</td>
<td>.23 (.03)*</td>
<td>.20 (.03)*</td>
</tr>
<tr>
<td>Teacher popularity</td>
<td>.04 (.03)</td>
<td>.14 (.04)*</td>
</tr>
<tr>
<td>Cognitive activation</td>
<td>-.02 (.03)</td>
<td>.18 (.04)*</td>
</tr>
<tr>
<td>Supportive climate</td>
<td>-.03 (.03)</td>
<td>.20 (.05)*</td>
</tr>
<tr>
<td>Classroom management</td>
<td>-.01 (.04)</td>
<td>.11 (.04)</td>
</tr>
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<td><strong>Classroom-level</strong></td>
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<tr>
<td>Intake</td>
<td>.09 (.15)</td>
<td>.16 (.14)</td>
</tr>
<tr>
<td>Science competence</td>
<td>.22 (.13)</td>
<td>.33 (.14)*</td>
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<td>Teacher popularity</td>
<td>.39 (.09)*</td>
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<td>Classroom Management</td>
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<td>.16 (.15)</td>
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</table>
Outline

1. „Quality talk“ in didactics and empirical research \((F,E)\)
2. Qualities of Teaching: Finding a „latent“ structure by abduction (based on TIMSS-Video/Germany) \((D)\)
3. Theoretical foundation for three „Basic dimensions of teaching quality“ \((C,B)\)
4. Empirical Support for the latent structure of teaching (Observations, student perceptions)
5. Effects of teaching (Multi-level analysis of longitudinal data)
6. Application to international data sets (TALIS, PISA „2011“): Observable (OTL, practices) vs latent structure; dimensions vs. profiles vs. hierarchies; cultural differences
### PISA 2012 Field Trial: Predicting Math Achievement and Interest

<table>
<thead>
<tr>
<th>Level</th>
<th>Cognitive Activation</th>
<th>Teacher Support</th>
<th>Achievement</th>
<th>Interest</th>
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<td><strong>Individual Level (L1)</strong></td>
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<tr>
<td>Teacher Support</td>
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</tr>
</tbody>
</table>
OECD Teaching and Learning Survey (TALIS)

- **“Structuring practices”**
  e.g. “I explicitly state learning goals.”
  Other items: summary of earlier lessons, homework review, checking the exercise book, checking student understanding during classroom talk by questioning students

- **“Student oriented practices”**
  e.g. “Students work in small groups to come up with a joint solution to a problem or task.”
  Other items: ability grouping, student self-evaluation, student participation in classroom planning

- **“Enhanced activities”**
  e.g. “Students work on projects that require at least one week to complete”.
  Other items: making a product, writing an essay, debating arguments.
TALIS: Latent profiles within countries (Vieluf, Kaplan, Klieme & Bayer, 2012)
Enhanced activities | S (debate), F (participation in planning), J (projects), Q (essay), O (product)

>0,8

Student-oriented practices | L (students evaluate own work), E (differential assignments), K (work with individual students), D (small groups), P (tests and quizzes), N (homogeneous groups)

<0,8

Structured practices | M (check by questioning), B (state goals), H (present summary), C (review homework), A (lecturing), R (individual practice), I (check exercise books), G (ask to remember)
TALIS: Country DIF
(Klieme, Vieluf et al., in prep.)

Debates

State learning goals

Individual assignments

Work with Individual Students

Small groups

State learning goals

Australia

Denmark

Korea
Final Conclusions

1. „Quality talk“ in didactics and empirical research \((F,E)\)
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4. Empirical Support for the latent structure of teaching (Observations, student perceptions)
5. Effects of teaching (Multi-level analysis of longitudinal data)
6. Application to international data sets (TALIS, PISA „2011“): Observable (OTL, practices) vs latent structure; dimensions vs. profiles vs. hierarchies; cultural differences
• The Three basic dimensions of Teaching Quality can be identified in different samples, subjects, and countries with different instruments.
  → The structure seems to have some universal validity.

• The quality dimensions tend to have specific effects on cognitive vs. non-cognitive outcomes:
  support → motivation, interest (on all levels)
  cognitive activation → achievement (mainly classroom/school level; at least in secondary education)
  Structure/classroom management → mostly achievement, but heterogeneous findings → needs specification

• Cross-sectional data have to be treated with caution:
  (a) support is oftentimes negatively related to achievement. → Reserve causality?
  (b) student perceptions are subject to response bias
Alternative Structure: Distinguishing between interaction-related and content-related aspects

- **Structure**
  - Managing the Classroom
  - Structuring content
  - Socio-emotional support

- **Support**
  - Adaptive/individualized instruction
  - Challenging questions

- **Cognitive Activation**
  - Deep Content

- **Teacher-Student-Interaction** (Teachers' PK)
- **Content/subject Didactics** (Teacher's CK, PCK)
• The model should be tested by targeted intervention studies (cp. Shechtman/Abu Yaman, AERJ 2012, on „affective teaching“)

• In addition to the „latent“ structure of structure, support, and cognitive activation, teaching can be described by Opportunity to learn (e.g., content coverage) and classroom practices. Practices show a culture-general structure, with some specific deviations (DIF for frequency of practices).

• The relationship between latent dimensions and observable practices needs further research. In PISA, both contribute to the prediction of achievement and student interest.

• All in all, teaching effectiveness research is moving towards a better, and more sophisticated understanding of both qualities and effects – beyond simple „quality talk“.
Thank you!

klieme@dipf.de
Kognitive Anspruchsniveau

Leistungszuwachs

Kognitive Aktivierung
PISA 2000: School-level effects by country

... on Reading **Literacy:**
Discipline > Relations

... on **Interest** in Reading:
Relations > Discipline

---

Impact on literacy: discipline, school level

Impact on interest: discipline, school level
### PISA 2012 Field Trial: Predicting Math Achievement

<table>
<thead>
<tr>
<th>Activity</th>
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<th>Country level</th>
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<tbody>
<tr>
<td>Student SES (ISEI)</td>
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<td><strong>.034</strong>*</td>
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<tr>
<td>OTL: Concept Familiarity</td>
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<td><strong>.279</strong>*</td>
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<td>Concepts: Overclaiming</td>
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<td><strong>-0.614</strong>*</td>
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<td>OTL: Math Tasks</td>
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<td>Cognitive Activation: Challenging Problems</td>
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<td>Disciplinary climate</td>
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<td>Instructional Practices: formative</td>
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## PISA 2012 Field Trial: Predicting Math Interest

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<tr>
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<td>Disciplinary climate</td>
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<td>Teacher Support</td>
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<td>Instructional Practices: student oriented</td>
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<td>Instructional Practices: formative</td>
<td>.055</td>
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