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Cultural Sensitivity in Assessing Mathematics Teachers' Professional Competence

Adapting Instruments for Diverse Contexts, The Case of Chile

03.10.2024

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Agenda

1. Introduction and motivation
2. Theoretical considerations
3. State of the art
4. An example
5. Summary and discussion

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Adapting german instruments and validating their use to measure chilean mathematics teachers' professional competence

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ABSTRACT

Improving the effectiveness of teacher professional development programmes is crucial for enhancing education, and assessing teacher professional competence is vital. This study aimed at adapting and validating instruments originally developed in Germany as part of a follow-up study to TEDS-M (Teacher Education Development Study-Mathematics), intending to present a valid instrument that can measure professional competence among Chilean teachers. The study encompassed 79 Chilean mathematics in-service teachers. The methods used to assess the validity evidence of the noticing instrument are outlined., including evidence based on test content, evidence of internal structure, and evidence of relations to other variables. Challenges related to terminology and cultural references were addressed. The applied Rasch model revealed a strong correlation between situation-specific skills in both general pedagogy (P_PID) and mathematics teaching aspects (M_PID). Regarding the correlations between the noticing and other facets of teachers' professional knowledge, positive significant associations were found between M_PID and mathematics knowledge components. General pedagogical knowledge showed connections with P_PID. The findings demonstrate the validity of instrument use in the Chilean context based on various validity measures; however, the results show the importance of considering the cultural influence of competence measurements considering the educational practices of the target population. Overall, the study contributes to the ongoing effort to develop culturally sensitive measurement tools for teacher competence.

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KEYWORDS
Mathematical knowledge; mathematics teacher education; pedagogical knowledge; professional competence; noticing skills

Introduction

Teacher professional development and its evaluation serve as crucial catalysts for educational advancement, empowering the education system to consistently enhance and adapt instructional qualities (Darling-Hammond & Sykes, 2003). This, in turn, fosters a dynamic and active learning environment and nurtures students' skills and abilities essential for their success (Blömeke et al., 2022). Research acknowledges that defining and measuring teacher competence is complex, as it is context-dependent and evolves over time (Blömeke & Kaiser, 2017; Blomeke, König, et al., 2015;

Saadati, F., Larrain Jory, M., Bastian, A., Felmer, P., & Kaiser, G. (2024).

1

Introduction and motivation

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Photo: Unsplash | Yosef Futsum

(United Nations, 2015)

Quality education

- High-quality teaching with rich learning opportunities
  (Doyle, 1986; Jentsch et al., 2021; Kounin, 1970; Klieme et al., 2001; Schlesinger et al., 2018)

Classroom management	Constructive support	Cognitive activation	Mathematics pedagogical quality
			

- Adaptation due to ever new challenges and requirements
  (Köller et al., 2019; UNESCO, 2017)
- Coping with extensive demands in stimulus-rich situations
  (B. Sherin & Star, 2011)

- Knowledge
- Situation-specific skills
- Attitudes
- Performance

⇒ **Teachers' professional competence**

(Dindyal et al., 2021; Kaiser et al., 2017; Krauss et al., 2020 Metsäpelto et al., 2021)

Teachers' professional competence

- Professional competence and its conceptualization in the focus of educational sciences and especially mathematics education
  (Blömeke et al., 2015; Kaiser et al., 2017; Koeppen et al., 2008; König et al., 2022; König, 2020)
- Influences on student performance and teaching quality (Blömeke et al., 2022; Hill et al., 2008)

Development of teachers' competence

- Need for effective teacher education
- Need for assessment instruments to measure teachers' competence
- Lack of studies of methodological rigor

(König et al., 2023)

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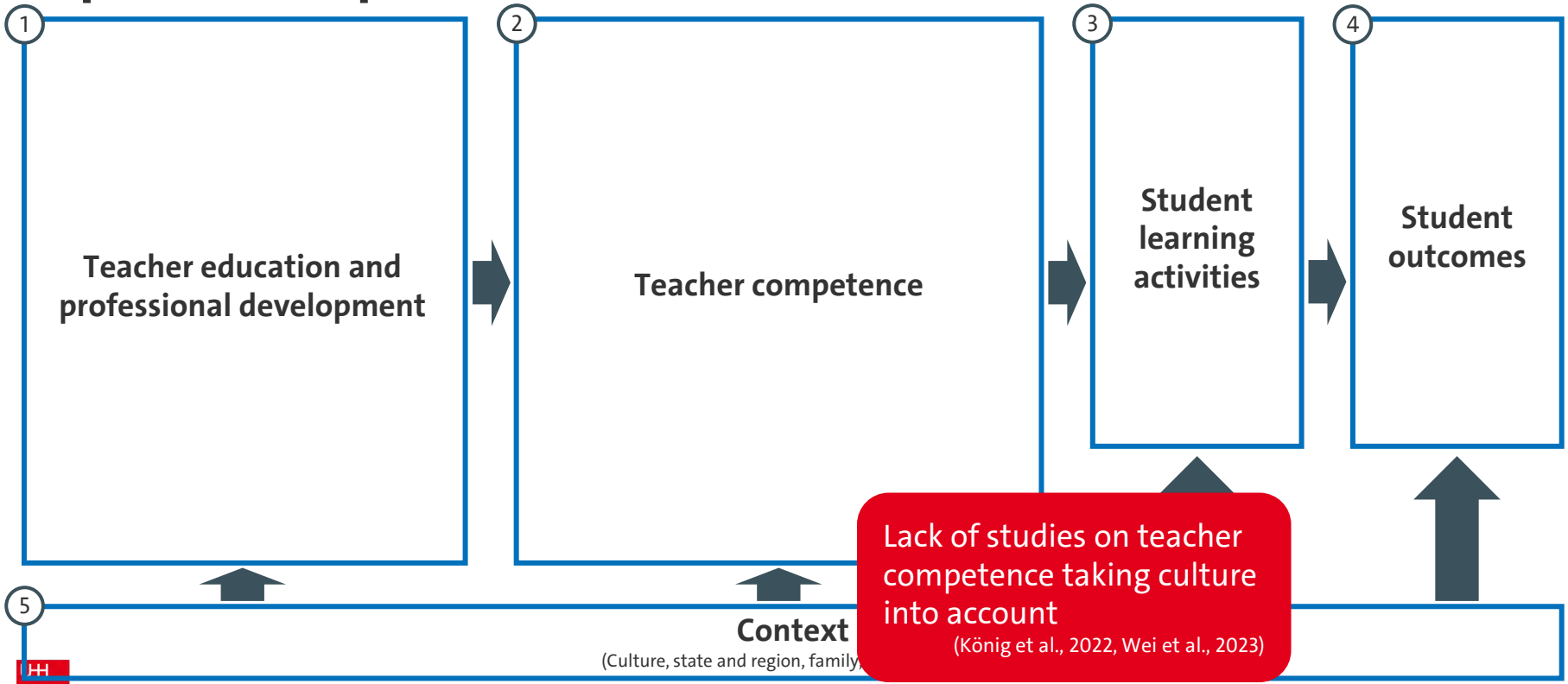
Expanded impact model on student outcomes



Cultural influences in the measurement of teacher competence

- How can we conceptualize and model (mathematics) teachers' professional competence under a culturally sensitive perspective?
- How can we assess/measure (mathematics) teachers' professional competence in a culturally sensitive way?

2

Theoretical considerations and frameworks

Photo: UHH | Henri Röttger

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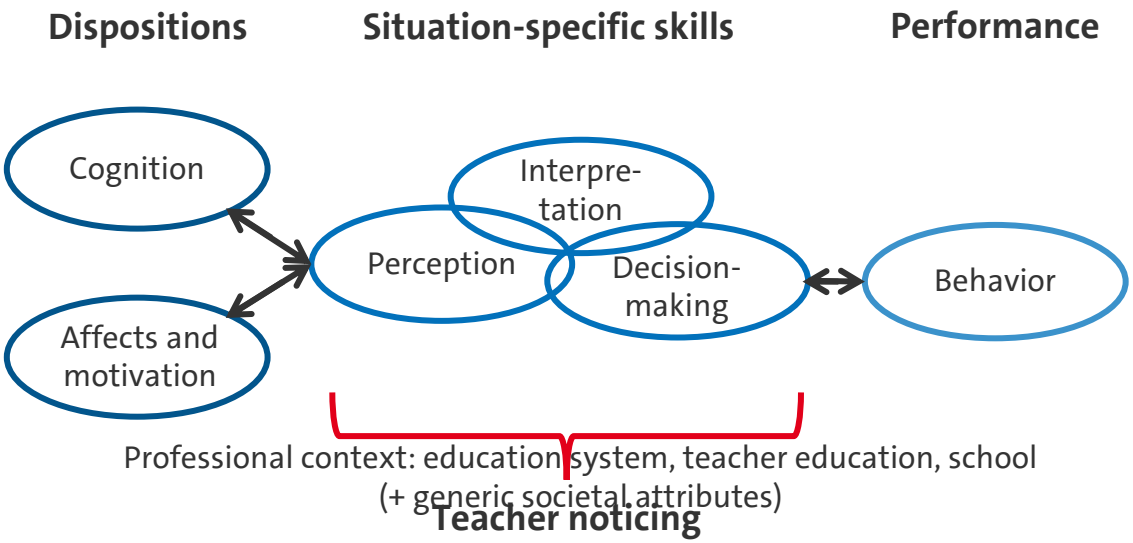
Competence as the available and learnable cognitive skills for successfully managing complex professional demands, as well as the motivational, volitional, and social willingness to apply these skills successfully and responsibly in various situations

(Weinert, 2001)

Professional competence



(Blömeke et al., 2015, Blömeke & Kaiser, 2017)

- Competence as a continuum between dispositions and performance (Blömeke et al., 2015; Kaiser et al., 2017)
- Bidirectional relationship (Santagata & Yeh, 2016)

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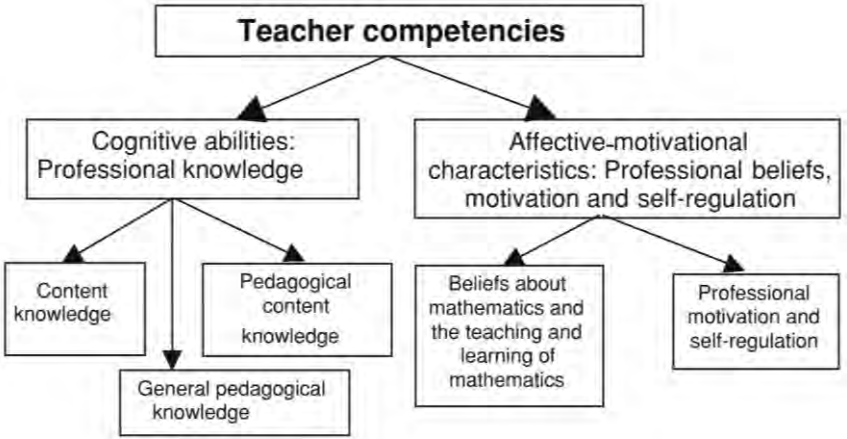
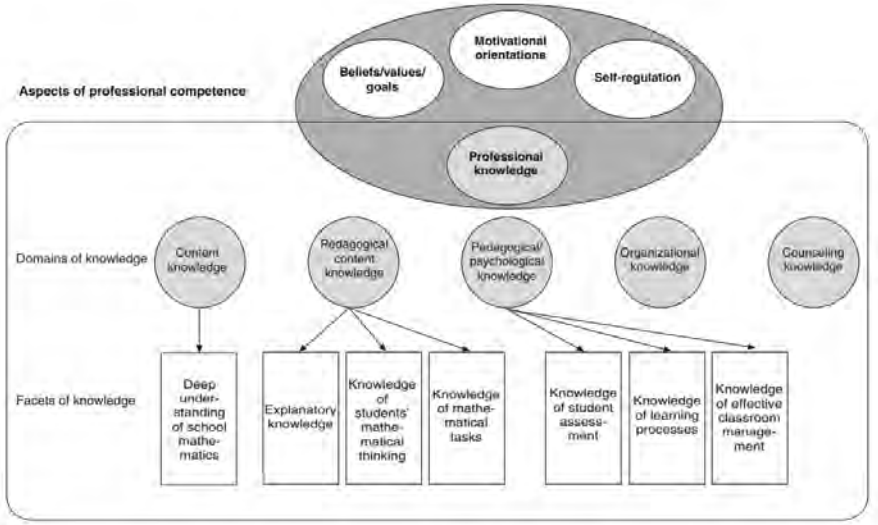
Competence frameworks in TEDS-M and COACTIV

TEDS-M framework



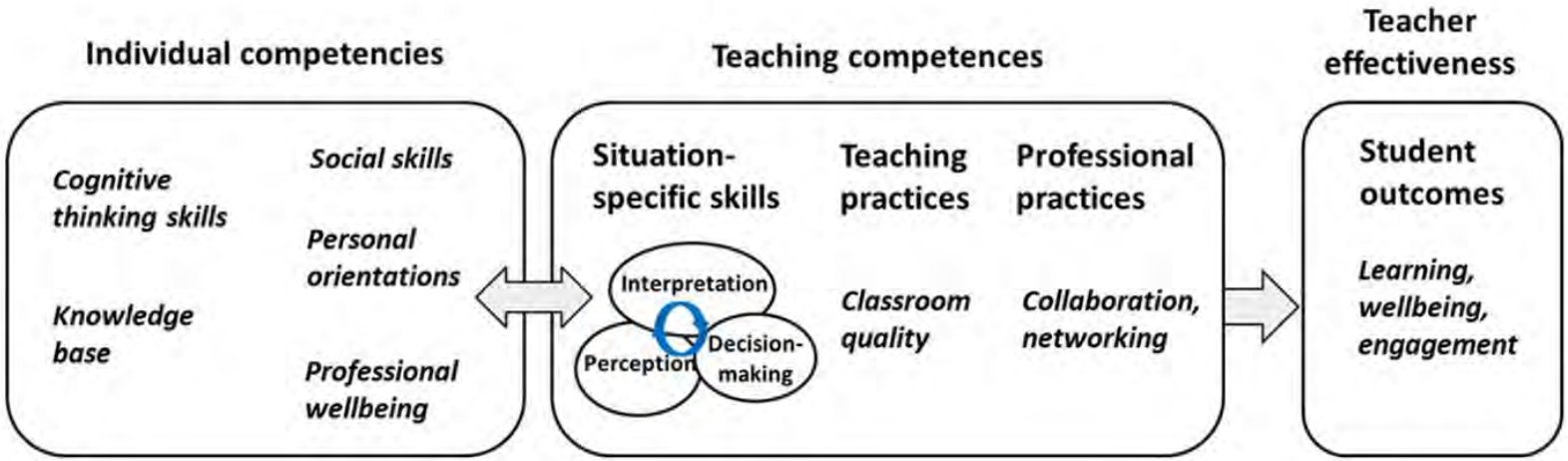
(Döhrmann et al., 2012)

COACTIV framework



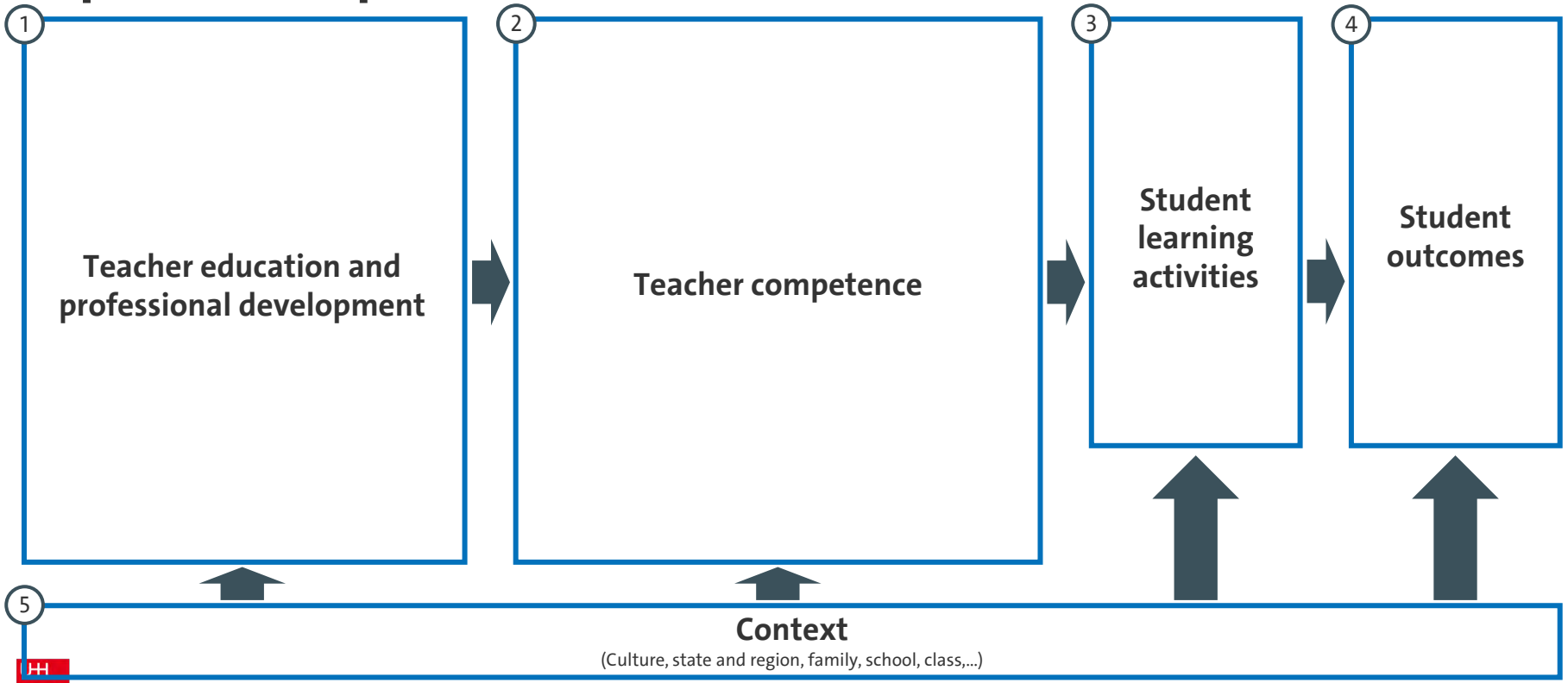
(Baumert & Kunter, 2013)

Multidimensional adapted process model of teaching



(Metsäpelto et al., 2021)

Expanded impact model on student outcomes



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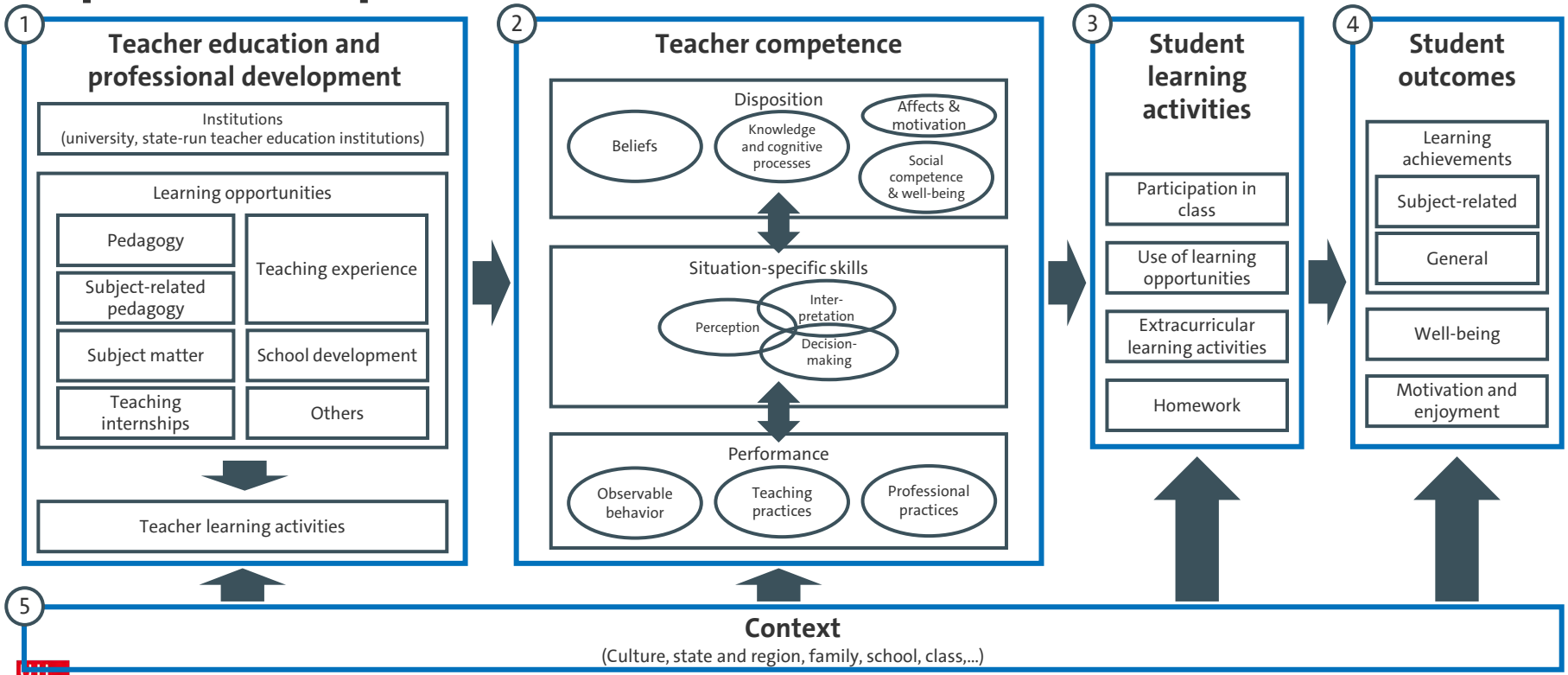

(Blömeke et al., 2015; Blömeke & Kaiser, 2017; Helmke & Schrader, 2022; Kaiser et al., 2017; Kaiser & König, 2019; Krauss et al, 2020; Metsäpelto et al., 2021; Lipowsky, 2010; Yang & Kaiser, 2022)

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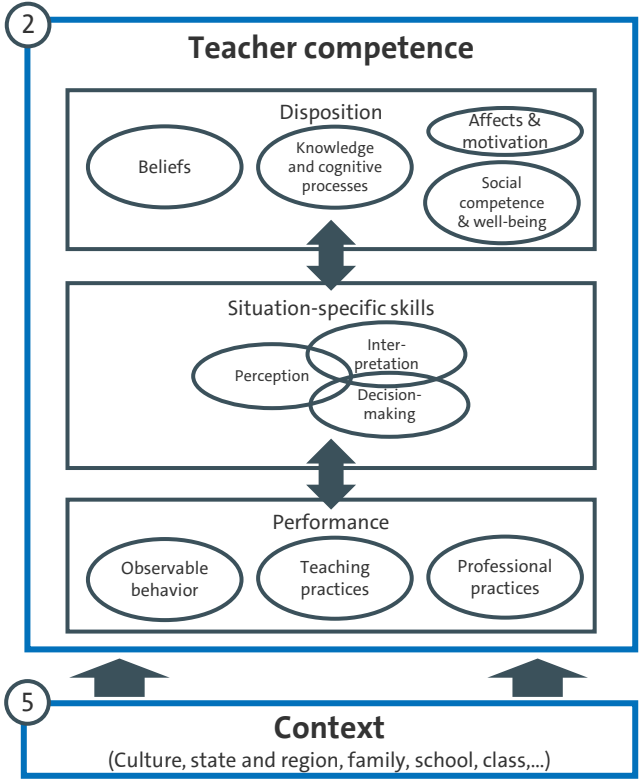

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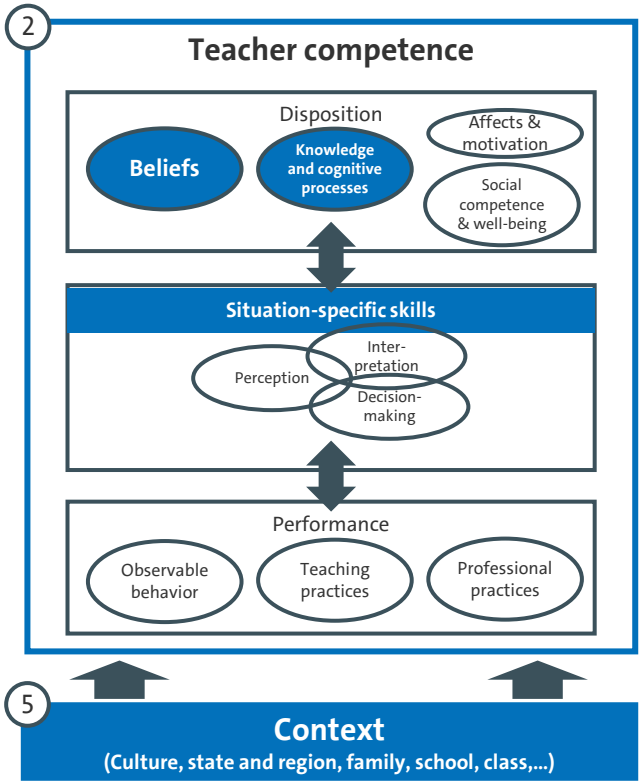
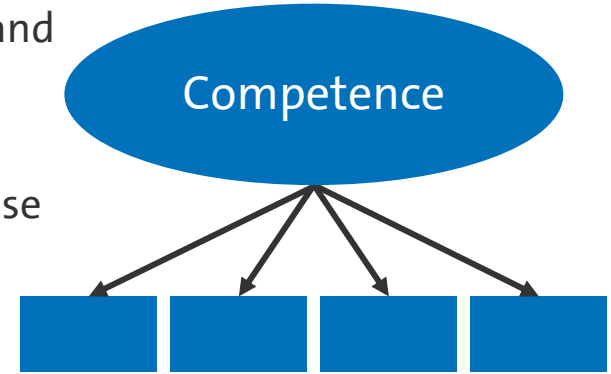


(Blömeke et al., 2015; Blömeke & Kaiser, 2017; Helmke & Schrader, 2022; Kaiser et al., 2017; Kaiser & König, 2019; Krauss et al, 2020; Metsäpelto et al., 2021; Lipowsky, 2010; Yang & Kaiser, 2022)

Assessment of teachers‘ professional competence

- Competence as a latent construct with a precise definition
  (Klieme & Hartig, 2008; Shavelson 2010)
- Preferable: criterion-oriented real-life testing
  (McClelland, 1979; Shavelson, 2010)
- Feasible for large samples and quantitative data and working with reliable scales: combination of knowledge, personality, and situation-specific tests
  (Blömeke et al., 2015; Hughes & Huby, 2002; Koeppen et al., 2008; Piwowar et al., 2018)
- Application of complex statistical testing such as item response theory (IRT) (Klieme & Hartig, 2008)



3

State of the art

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Photo: UHH | von Wieding

Teachers' professional competences in international comparison

- International comparisons as insights into cultural differences, e.g., TEDS-M (Blömeke et al., 2014)
- Culture-specific developments of dispositions such as knowledge and situation-specific skills such as teacher noticing
  (Blömeke & Kaiser, 2014; Kleickmann et al., 2015; Yang et al., 2020)
- Situation-specific skills as especially influenced by culture
  (Dreher et al. 2021; Wei et al., 2023; Yang et al. 2018)
- Comparison of European and East-Asian cultures: Strengths in general pedagogy and a conceptual focus against mathematics (pedagogy) and a product focus
  (Dreher et al., 2021; Lindmeier et al., 2020; Wang et al., 2020; Yang et al., 2018)

4

An example

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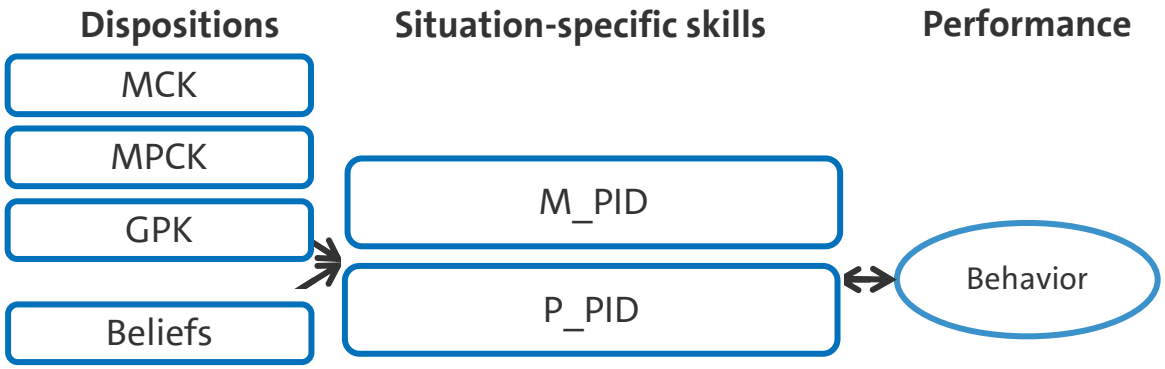
Constructs in the TEDS research program

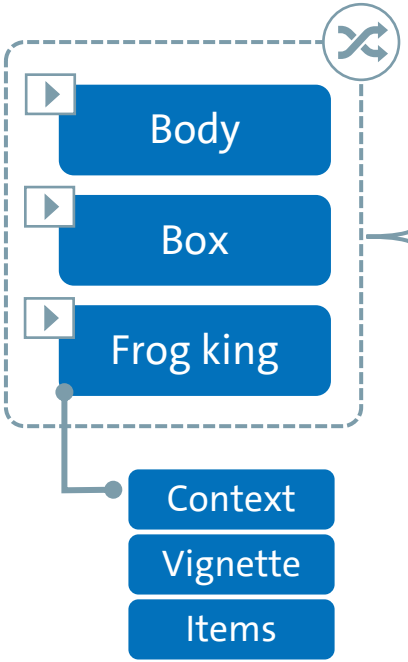


Note. M_PID - Mathematics Instruction: Perception, Interpretation, Decision-making; P_PID - Pedagogy: Perception, Interpretation, Decision-making; MCK - mathematics content knowledge; MPCK - mathematics pedagogical content knowledge; GPK - general pedagogical knowledge.

(Blömeke et al., 2015, Blömeke et al., 2022, Döhrmann et al., 2012, Kaiser et al., 2017, König et al., 2021)

- Existing tests from the TEDS research program for 6 competency facets

Measurement instrument



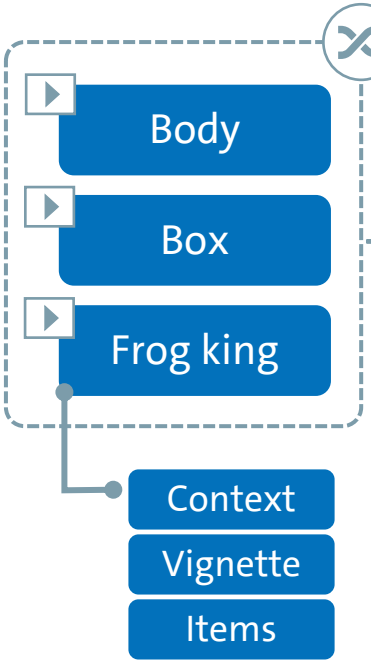
- three scripted (i.e., staged) video vignettes of approx. 3 mins. each
- Lessons in the 9th-10th grade
- Functions, surface & volume calculations, modeling and different teaching phases
- Items from a mathematics pedagogical and a general pedagogical perspective

(Kaiser et al., 2015)

Items

Facet	Total (rating-scale/ open response)
Perception	24 (19/5)
Interpretation	42 (22/20)
Decision-making	11 (0/11)
Total	77 (41/36)

Measurement instrument – example items



Rating scale item (Perception, PPID)

Most of the students are involved.

Fully correct	Partially correct	Partially incorrect	Not correct at all
○	○	○	○

Open-response item (Interpretation, MPID)

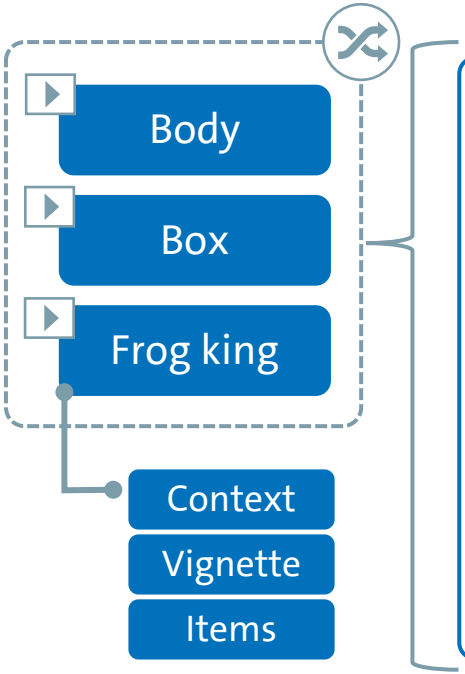

1


2


3

(b) MATHEMATICS-PEDAGOGICAL PERSPECTIVE
In each of the three approaches shown, the task is PRESENTED AND WORKED ON MATHEMATICALLY in a COMPLETELY DIFFERENT WAY.
Describe the ESSENTIAL aspects of the approaches from a mathematics pedagogical point of view (in keywords).
If possible, also name the corresponding technical terms.

Measurement instrument – example items



Open-response item (Decision-making, PPID)

The teacher ends the partner work with the words "Good, what did you find out?"
She is obviously aiming for an exchange of results and chooses a plenary discussion led by herself.

Outline in keywords two methodological ALTERNATIVES to achieve the goal of an exchange in a less teacher-centered way in this teaching situation.

Sample

In-service teachers

n = 79

- 81 % female
- on average 34 years old
- on average 6 years of teaching experience

Adaptation and validation process

1. Translation
   - Video dubbing
2. Validation of test score interpretation in the Chilean context
   - Test content
     - Interviews with experts
   - Internal structure
     - IRT: Rasch models
   - Relation to other variables
     - Correlations between competence facets

Selected results

Test content | Interviews with experts

- Exclusion of two items
- Changes in translations
- Discussion of one video vignette

Selected results

Internal structure | IRT: Rasch models

- Exclusion of additional 14 items due to poor item fit

Variable	WLE reliability	EAP reliability
M_PID	.67	.83
P_PID	.86	.89
MCK	.85	.87
MPCK	.76	.77
GPK	.89	.95

Note. M_PID - Mathematics Instruction: Perception, Interpretation, Decision-making; P_PID - Pedagogy: Perception, Interpretation, Decision-making; MCK - mathematics content knowledge; MPCK - mathematics pedagogical content knowledge; GPK - general pedagogical knowledge.

Selected results

Internal structure | IRT: Rasch models

- Exclusion of additional 14 items due to poor item fit

Variable	M	SE
M_PID	-1.28	.12
P_PID	-.03	.13

Note. M_PID - Mathematics Instruction: Perception, Interpretation, Decision-making; P_PID - Pedagogy: Perception, Interpretation, Decision-making.

Selected results

Relation to other variables | Correlations between competence facets

Variable	M_PID	P_PID	MCK	MPCK	GPK
M_PID	1				
P_PID	0.699**	1			
MCK	0.252*	0.119	1		
MPCK	0.240*	0.123	0.745**	1	
GPK	0.185	0.250*	0.237*	0.326**	1

Note. M_PID - Mathematics Instruction: Perception, Interpretation, Decision-making; P_PID - Pedagogy: Perception, Interpretation, Decision-making; MCK - mathematics content knowledge; MPCK - mathematics pedagogical content knowledge; GPK - general pedagogical knowledge.

5

Summary and discussion

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Summary and discussion

Conceptualization of professional competence

Clear integration of cultural influences in competence frameworks

Culturally sensitive measurement

Careful comprehensive adaption processes

Translation, teaching traditions, facet structure

Combination with beliefs scales?

Further development

Jointly developed instruments

Thank you very much for your attention!

Do you have any questions or comments?

If you are interested, you can access the **references** by scanning the QR code.