



KoKoHs Working Papers

No. 3

Sigrid Blömeke & Olga Zlatkin-Troitschanskaia (Eds.)

The German funding initiative “Modeling and Measuring Competencies in Higher Education”: 23 research projects on engineering, economics and social sciences, education and generic skills of higher education students

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„Modeling and Measuring Competencies in Higher Education“**

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The research initiative is funded by the German Federal Ministry of Education and Research under grant no. 01PK11100A and 01PK11100B.

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The German funding initiative “Modeling and Measuring Competencies in Higher Education”

23 research projects on engineering, economics and social sciences, education and generic skills of higher education students

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Blömeke, S. & Zlatkin-Troitschanskaia, O. (Eds.) (2013). The German funding initiative “Modeling and Measuring Competencies in Higher Education”: 23 research projects on engineering, economics and social sciences, education and generic skills of higher education students. (KoKoHs Working Papers, 3). Berlin & Mainz: Humboldt University & Johannes Gutenberg University.

The German funding initiative “Modeling and Measuring Competencies in Higher Education”: 23 research projects on engineering, economics and social sciences, education and generic skills of higher education students

Abstract:

Assessing competencies of students in higher education has long been a neglected research field. Given the diversity of higher education institutions, programs, objectives and processes as well as the diversity and dynamic of the labor markets' demands, the challenges of such assessments seemed overwhelming. In order to close this research gap at least partially, the editors of the current working paper developed the funding initiative “Modeling and Measuring Competencies in Higher Education (KoKoHs)” in cooperation with the German Federal Ministry of Education and Research (BMBF) which was announced in 2011. Out of more than 100 applications, 23 research projects – including more than 70 higher education institutions – were selected to examine fundamental research issues concerning the assessment of competencies in higher education. The first funding period lasts from 2012 to 2015; and the projects cover engineering, economics and social sciences, teacher education and generic skills of higher education graduates. They focus on how to model conceptually the respective competencies and how to transfer these theoretical models into measurement models and reliable test instruments. As part of the first funding period, the instruments have to be applied to a sample of higher education students, too, and the test scores obtained have to be validated. As a second step, it is intended to follow up on this research with longitudinal studies modeling the development of competencies during higher education. This working paper presents the theoretical framework of the funding initiative and it documents the research questions, the study designs and the expected results of its 23 research projects.

Keywords:

Competence development, large scale assessment, measurement model, testing, higher education

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Introduction

Skills and competencies have become the backbone of economic prosperity in the knowledge society of the 21st century. Even though researchers have recognized this fact, they have long neglected modeling and measuring competencies acquired in higher education (cf. Kuhn & Zlatkin-Troitschanskaia, 2011; Tremblay, 2012; Blömeke, Zlatkin-Troitschanskaia, Kuhn, & Fege, 2013). To assess these competencies is rather challenging given the intra- and international diversity of higher education institutions, programs, objectives and processes as well as the diversity and dynamics of the labor markets' demands.

However, first assessment approaches exist. Groundbreaking research was done as part of the "Teacher Education and Development Study: Learning to Teach Mathematics (TEDS-M; Blömeke, Suhl, & Döhrmann, 2013; Blömeke, Suhl, Kaiser, & Döhrmann, 2012)", carried out by the International Association for the Evaluation of Educational Achievement (IEA), and in OECD's feasibility study "Assessment of Higher Education Learning Outcomes" (AHELO; Tremblay, 2013). At the same time, these studies revealed, on the one hand, the challenges higher education research has to deal with when attempting to measure competencies in a reliable and valid way. On the other hand, these studies were limited to a narrow set of higher education domains. Thus, an urgent need exists to develop assessments for a broader set of higher education domains.

To close this research gap at least partially, the funding initiative "Modeling and Measuring Competencies in Higher Education (KoKoHs)" was initiated by the German Federal Ministry of Education and Research (BMBF) in 2011 to create a systematic framework for such an effort. Out of more than 100 applications, 23 research projects – including more than 70 higher education institutions – were selected to examine fundamental research issues concerning the assessment of competencies in higher education. The first funding period lasts from 2012 to 2015; and the projects cover engineering, economics and social sciences, teacher education and generic skills of higher education graduates (http://www.kompetenzen-im-hochschulsektor.de/index_ENG.php).

The main research questions of the KoKoHs projects are:

- How can the respective competencies be modeled conceptually?
- How can opportunities to learn offered during a program (curricular validity) and job-related demands (predictive validity) be balanced?
- How can these theoretical models be transformed into measurement models and reliable test instruments?
- How can test scores obtained with these instruments and interpreted with respect to the effectiveness of higher education be validated?

In the joint multi- and interdisciplinary research program of KoKoHs, experts from various disciplines are working together and they are part of an international network. The main objectives of the funding initiative are to advance the state of research on higher education, to create a framework for the evaluation of higher education performance so that policy decisions and institutional measures can be based on empirical evidence, and to maintain and improve the quality of the German higher education system in the face of growing international competition.

To meet the methodological and organizational challenges of the research effort, a KoKoHs office was installed in Berlin (under the direction of Prof. Dr. Sigrid Blömeke, Humboldt University of Berlin) and Mainz (under the direction of Prof. Dr. Olga Zlatkin-Troitschanskaia, JGU Mainz) that coordinates the research program and the projects. In cooperation with an advisory board, the office brings together the 23 research projects, advances their methodological skills and initiates collaboration across domains and expertise to create synergy and thus to jointly meet the requirements of measuring competencies in higher education.

The 23 projects of the research initiative can be grouped into four clusters:

- 1) Engineering
- 2) Economics and social sciences
- 3) Education
- 4) Generic skills of higher education students

This working paper presents the theoretical framework of the funding initiative KoKoHs and it documents for the first time the research questions, the study designs and the expected results of its 23 research projects, including a poster that visualizes their basic structure. For each project, we provide in addition information about the participants involved and their contact details so that more information can be obtained by looking at their websites or approaching them directly via email.

It is intended to follow up on this research of the first funding period with longitudinal studies modeling the development of competencies during higher education. This second step can be expected to be in place from 2015 on.

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Cluster 1: Engineering**KOM-ING**

Modeling and Measuring Competencies of Engineering Mechanics within the Training of Mechanical Engineers

KOM@ING

Modeling and Developing Competence: Integrated IRT-Based and Qualitative Studies with a Focus on Mathematics and its Usage in Engineering Studies

MoKoMasch

Modeling Competencies of Mechanical Engineering Students in the Areas of Construction, Design and Production Engineering

KOM-ING – Modeling and Measuring Competencies of Engineering Mechanics within the Training of Mechanical Engineers

Spöttl, G., Musekamp, F.

Aims and Research Questions

There is a disproportionately high amount of drop-outs in mechanical engineering (cf. Heublein, Hutzsch, Schreiber, Sommer, & Besuch, 2009, p.159). One of the main causes seems to be performance problems of drop-outs in the basic engineering courses. One such basic sub-section of the engineering sciences is engineering mechanics, or EM. It provides theoretical concepts for application-oriented engineering disciplines (including mechanical engineering). In order to assess and improve the performance of students in EM a competence model has been developed as a basis (EM-model).

The aim of the study is the validation of this EM-model as well as the construction and testing of two related instruments for measurement. It will be examined whether the study shows empirical evidence for the EM Model (1) and to what extent the EM competence of students can be differentiated and described on the basis of the postulated dimensions of competence. (2)

On the Concept of Competence

The starting point for theoretical considerations is the constitutive characteristic of the concept of competence which applies to the ability to use one's mental skills in new situations (cf. Klieme & Hartig, 2007, p. 14). Situations are in turn characterized by conditions of the surrounding environment, which are presented to the actor as objective circumstances (often described as "context"). Straka and Macke (2009a) make it clear that context cannot (or not only) be interpreted as an existing natural condition but, in most situations, is determined by a socially-assigned responsibility. Thus, competence is a dual construct, which deems those persons competent who are able to accomplish *what they are supposed to accomplish* (Spöttl & Musekamp, 2009). Against the background of these conditions and restrictions, the EM-model explicitly differentiates between objective requirements (Context) and mental disposition in order to determine which of them are crucial for meeting the requirements (Context-Specific Performance Dispositions).

For the description of competence within the aspect of responsibility (context) we differentiate "subject matter" and "level of requirements." In order to describe the disposition part of the model we refer to the four processes of mechanical analysis (1) Abstract real objects to a mechanical model (2) Convert a mechanical model into mathematical equation (3) Solve equations and (4) Evaluate results (see figure). The context and disposition sides are related to each other insofar as the solution of every requirement defined on the context side requires a specific combination of the dispositions.

Design of the Study (Sample, Instruments and Data Analysis)

Two assessment instruments are to be developed within the KOM-ING Project. In the case of a successful validation of the EM-model, the first allows to account for different training pathways and can be used for comparative work at the institutional level (summative assessment). The second instrument provides more profound information for the sub-discipline static engineering of EM regarding the desired and actual state of the learning process for particular points in time, which can be used for the configuration of teaching (formative assessment).

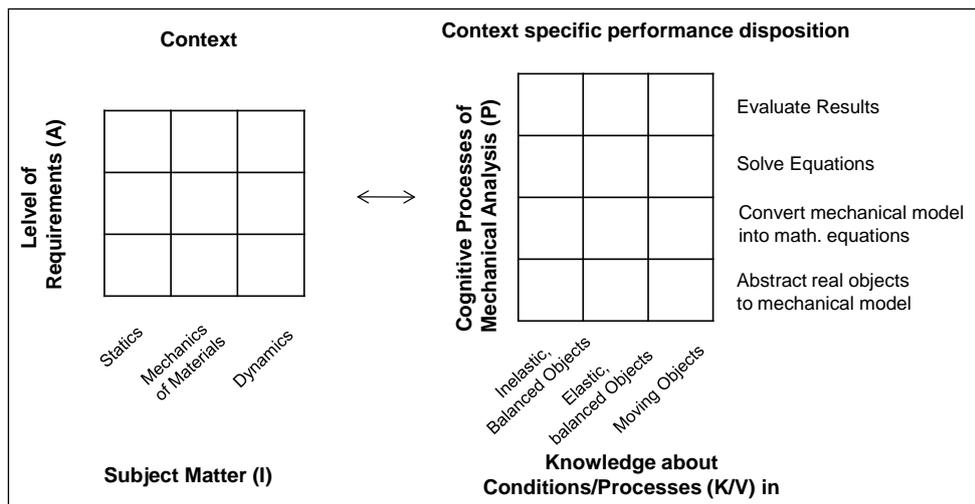


Figure: Competence Model "Engineering Mechanics" for the KOM-ING Project

Furthermore, competence levels will be identified for the test of summative assessment. With the aid of the results of the formative test it will be verified whether it is possible to identify typical competence profiles in students via latent-class-analysis on the seven cognitive dimension categories. The sample will encompass 900 students per instrument at a minimum of five universities (of applied science).

Internal validation will be carried out by applying multidimensional item-response-modeling (MIRT), mixed-rasch-modeling, and analysis of differential item functioning (Dif). External Validation will be realized by relating the EM-model to other constructs, esp. general abilities, and by predicting item difficulties through item attributes (construct validation). Further, content validation by expert judgments and standard-setting procedures will be carried out. The study is organized into the phases of identification of curriculum content and systematization (1), item construction and quality control (2), piloting (3), review of items (4), main survey (5) as well as data analysis and identification of the results and their documentation (6).

Project data

Project management	Prof. Dr. Georg Spöttl
Contact person	Dr. Frank Musekamp, Dr. Andreas Saniter
Homepage	www.kom-ing.de
Time frame	01/04/2012 – 31/03/2014

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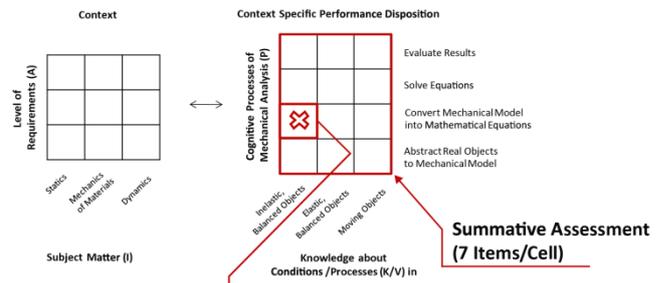


Modelling and Measuring Competences of Engineering Mechanics within the Training of Mechanical Engineers

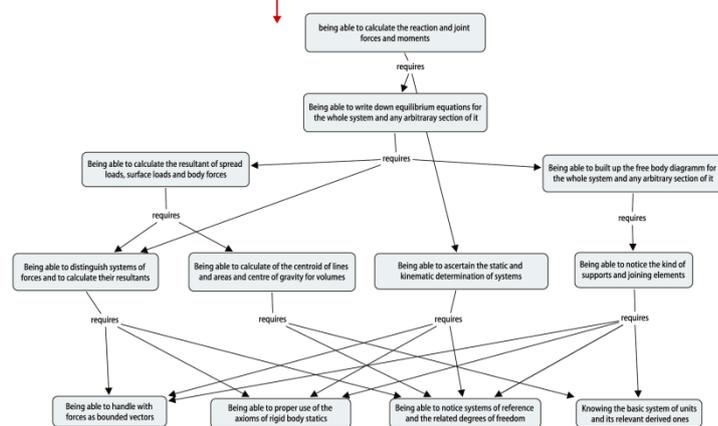
Subject Matter and Research Questions

Engineering Mechanics, or EM, is one sub-section of the engineering sciences. It provides theoretical concepts for application-oriented engineering disciplines (including mechanical engineering) and is a basic discipline for the approximately 370,000 students of the engineering sciences in Germany. It will be examined whether the study shows empirical evidence for the EM Model (1), and to what extent the EM competence of students can be differentiated and described on the basis of the dimensions of competence being postulated (2).

Competence Model



Learning Hierarchy



Formative Assessment and Research Design

Cognitive Processes	Evaluation (21 Items)	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Mathematical Solution (21 Items)	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Mathematical Definition (21 Items)	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Mechanical Abstraction (21 Items)	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		8	8	8	8	8	8	8	8	8	8	8	8	8	8
	Topic 1	Topic 2	Topic 3	...											
	Inelastic, balanced Objects (80 Items)														

Duration: 01.04.2012 - 31.03.2014
 Sample: Mechanical Engineering Students
 Pilot: February 2013
 n= 700 (formative, End of 1. Semester)
 n= 700 (summative, End of 3. Semester)
 Main Study: February 2014:
 n= 900 (formative, End of 1. Semester)
 n= 900 (summative, End of 3. Semester)

Control Variables:
 - General abilities
 - Personality Variables
 - Motivation

www.KOM-ING.de

KOM@ING – Modeling and Developing Competencies: Integrated IRT-Based and Qualitative Studies with a Focus on Mathematics and its Usage in Engineering Education

Heiner, M., Hochmuth, R., Nickolaus, R.

This project focuses on modeling competence on the one hand and studies of developing competence on the other hand. The relevant developmental conditions are based on mathematics and its usage in central fields of two engineering studies, electrical and mechanical engineering. The usual habit of separating mathematical and engineering courses at universities makes modeling competence a big challenge. We are using two research approaches, a quantitative and IRT based approach as well as a qualitative and process analytical approach. Both approaches are conducted parallel in three sub-projects in order to use their individual strengths and to compensate their individual limits. In terms of an applied basic research, fundamentals for competence diagnostics shall be created. Among other things, these diagnostics are meant to serve as a basis for organizing and evaluation teaching innovations which is contemplated at a second promotional stage.

Sub-project A and B focus on two stages in the studies of electrical and mechanical engineering with regard to developing engineering competence: Stage I: “Basis stage” (first 2-3 semesters), stage II: “Advanced Bachelor and Master stage” (3rd-10th semester). The competence modeling at stage I is to highlight what beginners perceive as new metacognitive, volitional and motivational challenges in their studies on the one hand. On the other hand, connections and tensions between competencies developed in mathematical and engineering training shall be examined. Modeling competencies at stage II refers to advanced courses such as project or laboratory learning which call for an integrative use of sub-competencies in order to solve engineering problems.

The contents of sub-project C cover central fields of various engineering studies, particularly mathematics for engineers and its fields of application. IRT based modeling for engineering mathematics, technical mechanics, materials and construction technology is included. The central aim of this sub-project is to model, measure and develop competence in undergraduate studies of mechanical engineering. Civil engineering is also incorporated due to a cross-domain data collection in the subjects of higher mathematics and technical mechanics. Academical as well as non-academical studies are to be considered. The research design is compiled longitudinally in order to generate initial statements on competence development.

- 1) **Sub-project A (University of Paderborn & Leuphana University of Lüneburg):** Central to this sub-project are modeling, gathering and developing competence with regard to electrical engineering and stages I and II. It starts with qualitative analyses and provides initial results on IRT based items in higher mathematics being part of sub-project C. Built upon the results of the first two years and taking into account the experiences of the two other sub-studies, qualitative analyses of electrical engineering are used to pilot and develop IRT based modeling of competence.
- 2) **Sub-project B (Technical University of Dortmund & Ruhr University of Bochum):** Central to this sub-project are modeling, acquiring and developing competence with regard to mechanical engineering at stages I and II. Competence is analysed qualitatively, scaled items of higher mathematics from sub-project C are incorporated as well as, for the location of Bochum, IRT scaled items on technical mechanics. Built on that, IRT based competence modeling concerned with the problematic application of higher mathematics in project and laboratory learning in the studies of mechanical engineering are developed. The modeling is

compared with sub-project C and the studies made in sub-project A. The University of Dortmund investigates competencies and their acquisition with a focus on the application of higher mathematics in project and laboratory learning in the studies of mechanical engineering at stage II. The analyses consider aspects of learning socialization and learning environment. Particularly, opportunities of using quantitative and qualitative instruments are taken into account. In a second step, the results are put into practice and piloted following an integrated approach of competence development and gathering based on the constructive alignment concept.

- 3) **Sub-project C (University of Stuttgart & IPN Christian-Albrechts-University of Kiel):** Central to this sub-project are modeling, acquiring and developing competence focussing on mostly “quantitative approaches” with regard to mechanical engineering at stage I. Civil engineering is included as far as test development and data gathering in the subjects of higher mathematics and technical mechanics are conducted on a cross-domain basis. IRT based modeling for engineering mathematics, technical mechanics, materials and construction technology are examined. Using a longitudinal approach, the competence development can be described and connections between sub-competencies can be analysed.

Project data

Homepage

<http://www.zhb.tu-dortmund.de/hd/komating/>

Time frame

01/03/2012 – 30/04/2015

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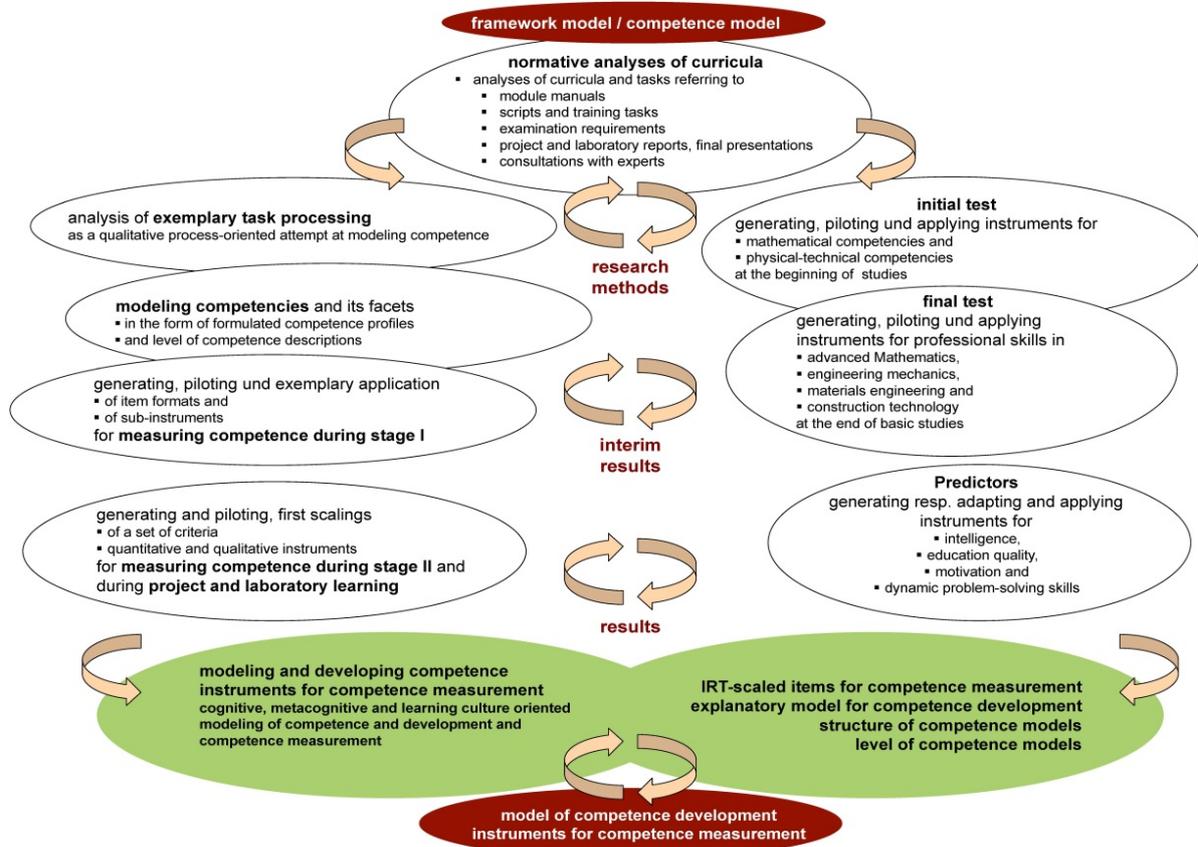
KoM@ING **modeling and developing competence** integrated IRT-based and qualitative studies with a focus on mathematics and its usage in engineering studies

contributions to modeling of competence and studies on developing competence and their relevant conditions based on mathematics and its usage in central central fields of the engineering studies electrical, mechanical and construction engineering

subproject A/B subproject A: Leuphana University of Lüneburg / University of Paderborn subproject B: Technical University of Dortmund / Ruhr-University of Bochum	subproject C University of Stuttgart IPN – Leibniz Institute for Science and Mathematics Education, Kiel
modeling, acquiring and developing competence generating and piloting quantitative and qualitative instruments for the measurement of competence and a set of criteria	IRT-based modeling of central fields in the engineering studies generating explanatory models for developing competence
electrical and mechanical engineering stage I: „Basic stage“ (semester 1 to 3) stage II: „Advanced stage“ (semester 3 to10) Project and laboratory learning	mechanical and construction engineering during „basic studies“ (semester 1 to 4) at universities and universities of applied sciences (N=1.000) in mathematics; engineering mechanics; materials engineering; construction technology

qualitative and quantitative studies on task and process analyses technical-cognitive, metacognitive and learning culture conditions

long-term study (2 measurements): Professional competencies, IQ, features of education quality, curricular emphases



Project Management TU of Dortmund Prof. Dr. Uwe Wilkesmann, zhb Prof. Dr. Dr. h.c. Johannes Wildt (a.D.) Project Partners Ruhr-University of Bochum Prof. Dr. Bettina Rösken-Winter, FfM, Service centre Mathematics and Applications Prof. Dr.-Ing. Marcus Petermann, FVT, TeachING-LearnING.EU TU of Dortmund Prof. Dr. A. Erman Tekkaya, IUL, TeachING-LearnING.EU IPN - Christian-Albrechts-Universität zu Kiel Prof. Dr. Aiso Heinze, dept. Mathematics Education	Project Coordination TU of Dortmund Matthias Heiner, zhb Leuphana University of Lüneburg Prof. Dr. Reinhard Hochmuth, IMD, khdm University of Paderborn Prof. Dr. Rolf Biehler, IfM, khdm Prof. Dr. Niclas Schaper, IHW, khdm University of Stuttgart Prof. Dr. Reinhold Nickolaus, IEP dept. BWT	GEFÖRDERT VOM Bundesministerium für Bildung und Forschung Projektträger im DLR Projektträger für das BMBWF
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MoKoMasch – Modeling Competencies of Mechanical Engineering Students in the Areas of Construction, Design and Production Engineering

For further information see:

http://www.kompetenzen-im-hochschulsektor.de/217_DEU_HTML.php

<http://www.mokomasch.tu-darmstadt.de>

Cluster 2: Economics and Social Sciences

WiKom-SoWi

Modeling and Measuring Scientific Competencies in Social Sciences

WiwiKom

Modeling and Measuring Competencies in Business and Economics among Students and Graduates by Adapting and Further Developing Existing American and Mexican Measuring Instruments (TUCE/EGEL)

KoMeWP

Modeling and Measurement of Professional Competence of Pre-Service Teachers in Business and Economic Education

HEED

Higher Entrepreneurship Education Diagnostics

WiKom-SoWi – Modeling and Measuring Scientific Competencies in Social Sciences

Zhang, Y., Klopp, E., Dietrich, H., Brünken, R., Krause, U.-M.,
Spinath, B., Stark, R., Spinath, F.M.

Aims and research questions

One of the major aims of higher education is to foster scientific competencies. However, there is still a lack of formal models of scientific competencies in the social sciences.

The WiKom-SoWi project pursues the aims of developing a comprehensive model of scientific competence for the domains of psychology, sociology and political science. Furthermore and derived from these models, appropriate assessment methods are developed and validated. Additional aims of the Wikom-SoWi project are to clarify the relevance of individual traits (intelligence, personality, motivation, etc.) and organizational characteristics (structure and content of the study courses) for the development of scientific competencies.

Based on these aims, the following main research questions are investigated:

1. What characterizes scientific competencies in the social sciences? Which competence facets are domain-general and which ones are domain-specific?
2. How can various (domain-general and domain-specific) facets and levels of scientific competence be measured in the context of the developed competence model?
3. What kinds of levels and facets of competence can be identified among students from different social domains in qualification phases?
4. Which individual and organizational variables are relevant for the development of scientific competence?

Theoretical framework

In our theoretical models, input, operation, and output are distinguished to describe the processes of developing scientific competencies (cf. Guilford & Hoepfner, 1971).

Input includes all kinds of scientific information such as contents of the study courses and scientific articles. In the models, methods input (research methods, experimental design, quantitative methods etc.) and content input (social psychology, sociological theories, and international relations etc.) are distinguished.

Operation refers to cognitive processes of varying complexity. Individuals process input using chosen operations. The operations conceptualized in our approach are based on the cognitive processes described by Anderson and Krathwohl (2001) and including the following six processes dimensions: remembering, understanding, applying, analyzing, evaluating, and creating. As observable expression of using chosen operations on inputs, written as well as verbal communication is defined as output of scientific competence that can be assessed by quality of argumentation and presentation using criteria of didactic, language, and content (Dietrich et al., 2013).

In addition, the theoretical models comprise personal characteristics such as personality, motivation, and intelligence which are considered relevant prerequisites for the acquisition of scientific competence and its respective application to solve scientific problems (Dietrich et al., 2013). This process-oriented model emphasizes the use of different operations to elaborate on different inputs.

Study design and methods

Sample and design

The study design is based on the combination of longitudinal and cross-sectional assessments. The sample consists of students from different German universities who study psychology, sociology, and political science in different qualification phases (bachelor, master, and doctorate programs). The competence development of students is investigated longitudinally over the course of three years within their respective qualification phase. In addition, cross-sectional comparisons between different qualification phases and different domains are explored.

Variables

To investigate the development of scientific competencies, both individual and organizational variables are integrated into a multivariate predictive model. Not only intelligence, personality, motivation, and self-concept, but also general educational background, professional aims as well as socio-demographic variables are assessed on the level of the individual. In addition, organizational variables including structure and contents of the study courses from various locations are taken into account.

Methods for the development of model and assessment methods

Based on a qualitative content analysis of interviews with a representative sample of domain experts and module handbooks from German universities, the theoretical competence models for the academic domains of psychology, sociology and political science have been developed (Dietrich et al., 2013). According to the models, a Tyler-matrix consisting of the contents and cognitive processes of scientific competencies is specified. Using this Tyler-matrix as a framework, assessment methods applying scenario-based tests are introduced which consist of authentic and complex assessment tasks (Shavelson, 2013; c.f. Wiggins, 1993).

Project data

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Modeling and Measuring Scientific Competences in Social Sciences (WiKom-SoWi)

Ying Zhang¹, Eric Klopp¹, Heike Dietrich², Roland Brünken¹, Ulrike-Marie Krause³, Birgit Spinath², Robin Stark¹, Frank M. Spinath¹,¹Saarland University, Germany, ²Heidelberg University, Germany, ³Oldenburg University, Germany**Aims and research questions**

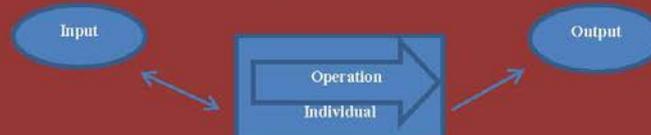
The WiKom-SoWi project pursues the aims of developing a comprehensive model of scientific competence for the domains of psychology, sociology and political science. Furthermore and derived from these models, appropriate assessment methods are developed and validated. Additional aims of the WiKom-SoWi project are to clarify the relevance of individual traits (intelligence, personality, motivation, etc.) and organizational characteristics (structure and content of the study courses) for the development of scientific competences.

Based on these aims, the following main research questions are investigated:

1. What characterizes scientific competences in the social sciences? Which competence facets are domain-general and which ones are domain-specific?
2. How can various (domain-general and domain-specific) facets and levels of scientific competence be measured in the context of the developed competence model?
3. What kinds of levels and facets of competence can be identified among students from different social domains in qualification phases?
4. Which individual and organizational variables are relevant for the development of scientific competence?

Theoretical framework

In our theoretical models, input, operation, and output are distinguished to describe the processes of developing scientific competences (c.f. Guilford & Hoepfner, 1971).



Input includes all kinds of scientific information such as contents of the study courses and scientific articles. In the models, methods input (experimental design, quantitative methods etc.) and content input (social psychology, sociological theories, and international relations etc.) are distinguished. Operation refers to cognitive processes of varying complexity. Individuals process input using chosen operations. The operations conceptualized in our approach are based on the cognitive processes described by Anderson and Krathwohl (2001) and including the following six processes dimensions: remembering, understanding, applying, analyzing, evaluating, and creating.

As observable expression of using chosen operations on inputs, written as well as verbal communication is defined as output of scientific competence that can be assessed by quality of argumentation and presentation using criteria of didactic, language, and content (Dietrich et al., 2013).

In addition, the theoretical models comprise personal characteristics such as personality, motivation, and intelligence which are considered relevant prerequisites for the acquisition of scientific competence and its respective application to solve scientific problems (Dietrich et al., 2013). This process-oriented model emphasizes the use of different operations to elaborate on different inputs.

Study design and methods

Sample and design The study design is based on the combination of longitudinal and cross-sectional assessments. The sample consists of students from different German universities who study psychology, sociology, and political science in different qualification phases (bachelor, master, and doctorate programs). The competence development of students is investigated longitudinally over the course of three years within their respective qualification phase. In addition, cross-sectional comparisons between different qualification phases and different domains are explored.

Variables To investigate the development of scientific competences, both individual and organizational variables are integrated into a multivariate predictive model. Not only intelligence, personality, motivation, and self-concept, but also general educational background, professional aims as well as socio-demographic variables are assessed on the level of the individual. In addition, organizational variables including structure and contents of the study courses from various locations are taken into account.

Methods for the development of model and assessment methods Based on a qualitative content analysis of interviews with a representative sample of domain experts and module handbooks from German universities, the theoretical competence models for the academic domains of psychology, sociology and political science have been developed (Dietrich et al., 2013). According to the models, a Tyler-matrix consisting of the contents and cognitive processes of scientific competences is specified. Using this Tyler-matrix as a framework, assessment methods applying scenario-based tests are introduced which consist of authentic and complex assessment tasks (Shavelson, 2013; c.f. Wiggins, 1993).

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- Shavelson, R. J. (2013). On an approach to testing and modeling competence. *Educational Psychologist*, 48, 73-86.
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WiwiKom – Modeling and Measuring Competencies in Business and Economics among Students and Graduates by Adapting and Further Developing Existing American and Mexican Measuring Instruments (TUCE/ EGEL)

Förster, M., Zlatkin-Troitschanskaia, O., Brückner, S., Hansen, M.

In the literature on Germany's current reform of study models in higher education, there is a broad consensus across disciplines that students should be taught and should acquire "competencies". However, the underlying concept of competence still needs to be complemented by suitable measurement methods and instruments; otherwise, the accomplishments might not exceed a mere rhetoric of competence (Blömeke et al., 2013). This is particularly true in the disciplines of business and economics. Despite being the most popular subjects of study among beginning and advanced students (Federal Statistical Office, 2012), they are still lacking a German-language instrument that meets academic requirements for the assessment of (professional) business and economic competence (Zlatkin-Troitschanskaia & Kuhn, 2011). Previous approaches have either focused on target groups outside of higher education or have conceptualized and operationalized professional business and economic competence in a different way (Nickolaus, 2011).

Funded by the Federal Ministry of Education and Research, the project WiwiKom strives to remedy this research deficit by pursuing two goals in an iterative way. One goal consists in developing a competence model that is valid with respect to content and curricula and is based on Weinert's understanding of competence (2001). In the first instance, this model is to narrow down the object of study in line with research pragmatism (Koeppen et al., 2008), and it is to comprise basic contents of the curricular sub-domains of business (e.g. accounting, marketing, and management) and economics (e.g. micro- and macroeconomics). The other goal consists in adapting international assessment instruments and merging them into one German instrument so that the theoretically postulated competence structures and levels become measurable empirically as incremental occurrences of professional business and economic competence. Thus, the developed competence model and the corresponding testing method are an important contribution to a valid assessment of business and economic competence in German-speaking higher education. Furthermore, the adapted test also enables the pursuing of international comparative perspectives. For instance, it becomes possible to compare German students to their peers in the U.S. and Mexico, and to analyze whether they acquire the same or different competencies during their studies.

To achieve the two goals in the project WiwiKom, the Chair of Business Education has associated with the Faculty of Translation Studies at the Johannes Gutenberg University Mainz and with the Chair for Statistics at the Humboldt University of Berlin. This interdisciplinary team has set itself to adapt and validate nationally two key instruments: the Spanish-language test "Examen General para el Egreso de la Licenciatura en Administración" (EGEL) by the Mexican Centro Nacional de Evaluación para la Educación Superior (CENEVAL) and the "Test of Understanding in College Economics" (TUCE) by the U.S. Council for Economic Education (CEE; Walstad, Watts, & Rebeck, 2007). Both are internationally approved testing instruments, both were designed for higher education, and they include both business content (EGEL) and economic content (TUCE). In the first instance, the developed competence model adopts the taxonomic foundations and understandings of competence of the original tests. The TUCE uses a modified version of the Taxonomy of Educational Objectives by Bloom (1956) and differentiates between the three cognitive levels "Recognition and Understanding", "Explicit Application", and "Implicit Application". For the EGEL, proficiency levels were extracted post hoc from the answers of the students using the Bookmark method. In the further process, the competence model is being iteratively tested, modified, and expanded.

The project is currently halfway through its runtime (October 2011 – September 2014), and the two international tests have been translated in cooperation with translation experts, their content has been validated through analysis of module manuals, expert interviews, and cognitive interviews with students, and the validated items have been compiled into a preliminary German test version and submitted to pilot testing in a pretest as well as in a first major field study.

At the beginning, several workshops were held to develop a categorization matrix suitable for the analysis of module manuals from various courses of study. Afterwards, the analysis was conducted on module manuals from 96 study courses at 64 business and economics faculties at universities and universities of applied sciences. Among these faculties were the largest faculties in Germany and the ones that participated in the survey.¹ The items were further evaluated by experts from the respective fields. In a specifically designed online questionnaire, 78 lecturers evaluated all presented items with regard to their curricular validity and their relevance for practice, and they also gave general feedback on the items. Furthermore, students were interviewed at four survey dates in cognitive interviews in order to validate the deployed test items also with evidence from the target group of the test. Over this period of time, additional expert interviews were conducted recurrently with various experts in order to establish the correctness of the content and the unambiguousness of the items.

During the following pilot stage in the summer term 2012, several critical items were for the first time submitted to empirical testing at two universities. All of the above-mentioned methods contributed to a thorough selection of items, which was thus based on multiple quantitative statistical criteria (e.g. item difficulties) and qualitative content-related criteria (e.g. performance in the cognitive interviews or the judgment of the experts). In total, 220 of the initial 402 items were successfully adapted this way and were subsumed in 43 test booklets in the form of several nested Youden square designs (Frey, Hartig, & Rupp, 2009).

During the winter term 2012/2013, these 43 booklets were deployed in a first major field study with about 3800 students of business and economics at 15 universities and 8 universities of applied sciences. The data from this survey will be analyzed with methods from classical test theory and item response theory in order to determine whether the items are adequate and suited for further empirical modeling of competence structures and levels. The results will be used to compile a valid version of the test for the German-speaking area and to test and modify the hypothesized competence model. Subsequently, revised booklets and test versions will be used in the main study to be conducted at further business and economics universities and universities of applied sciences during the summer term 2013 (planned sample around 4000 students at 25 higher education institutions). The main study will both measure professional business and economic competence on the national level and evaluate the measurements' international comparability with student performances in other countries. Through selection of an appropriately large sample, the main study is also meant to enable normalization of the assessment instrument. At the same time, the theoretical model of competence will be continuously examined and consistently developed.

¹ Curricular validation and conduction of the surveys are carried out in cooperation with the team of "stage 7" of the German National Educational Panel Study (NEPS).

Project data

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Modeling and measuring competencies in business and economics among students and graduates by adapting and further developing existing American and Mexican measuring instruments (TUCE/ EGEL) – the WiwiKom project



Summary

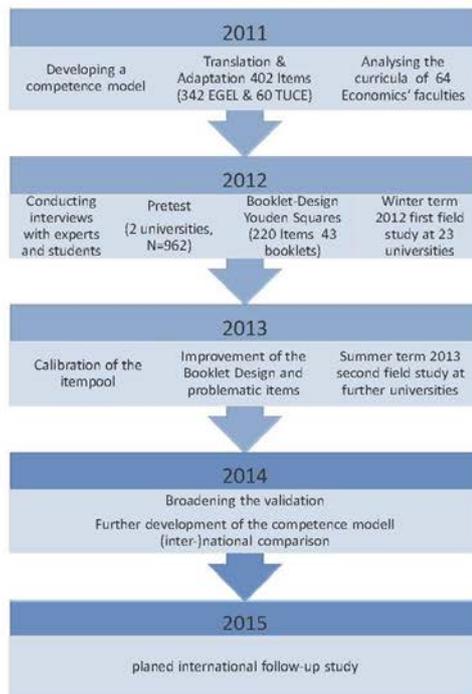
Funded by the Federal Ministry of Education and Research, the project WiwiKom focuses on two goals in an iterative way. One goal consists in developing a competence model that is valid with respect to content and curricula and is based on a common and international valid understanding of competence. In the first instance, this model is to narrow down the object of study in line with research pragmatism and it is to comprise basic contents of the curricular sub-domains of business and economics. The other goal consists in adapting international assessment instruments and merging them into one German instrument so that the theoretically postulated competence structures and levels become measurable empirically as incremental occurrences of professional business and economic competence.

To accommodate the various areas of responsibility and to address the multiple challenges an interdisciplinary team has set itself to adapt and validate nationally two key instruments: the "Test of Understanding in College Economics" (TUCE) by the U.S. Council for Economic Education (CEE) and the Spanish-language test

"Examen General para el Egreso de la Licenciatura en Administración" (EGEL) by the National Center for the Evaluation of Higher Education in Mexico (CENEVAL). Both are internationally approved testing instruments, both were designed for higher education, and they include both business content (EGEL) and economic content (TUCE). To the ends of this project, they were translated in cooperation with translation experts, and their content was validated through several expert interviews, an online-rating including 78 university lecturers, an analysis of module manuals from 64 business and economics faculties¹ and through cognitive interviews with several students. After the qualitative judgements, the 220 items left, were assigned to a multi-matrix booklet design and being deployed in two major field studies at 23 universities in Germany (winter term 2012/2013, N=3800, summer term 2013, N=4000). The results of the project will be used to compare the students' competencies on both a national and an international basis.

¹ Curricular validation and conduction of the surveys are carried out in cooperation with the team of "stage 7" of the German National Educational Panel Study (NEPS).

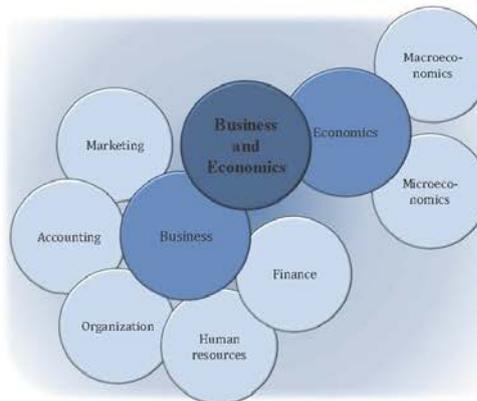
Milestones



Booklet-Design Youden Squares

Position	Booklet						
	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7
2	2	3	4	5	6	7	1
3	4	5	6	7	1	2	3

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Federal Ministry of Education and Research

KoMeWP – Modeling and Measurement of Professional Competence of Pre-Service Teachers in Business and Economic Education

Seifried, J., Wuttke, E., Schmitz, B., Berger, S., Bouley, F.,
Fritsch, S., Mindnich, A., Schnick-Vollmer, K.

The professional competence of prospective teachers still remains rather unexplored in the field of Business and Economic Education (Beck, 2005, 548). Therefore, the joint research project KoMeWP aims to model and assess pre-service teachers' content knowledge and pedagogical content knowledge as well as motivational and self-regulation aspects in Business and Economic Education in order to evaluate the effectiveness of teacher education. It combines the fields of economics and teacher education. We focus on the domain of financial accounting since this content area is crucial for the understanding of economic contexts and processes in corporations. Due to the lack of instruments in this domain, a test will be developed by the research group.

A competence model forms the basis for the development of our test instrument. It considers competence as an interaction between domain-related professional knowledge, beliefs, motivational factors, and self-regulation skills (Weinert, 2001). Following Shulman's taxonomy of teacher knowledge (1986), the domain-related professional knowledge, as the most powerful predictor of expert achievement, consists of content knowledge (CK) and pedagogical content knowledge (PCK).

Relevant studies were analysed to operationalize pedagogical content knowledge (e.g. Blömeke et al., 2011; Kunter et al., 2011). Three competence facets overlapping different perspectives on PCK were identified, namely: The competence (1) to anticipate possible learning difficulties and identify students' errors, (2) to evaluate the potential of domain-specific tasks for learning, and (3) to offer multiple approaches to problems. To mirror the demands of prospective teachers' field of activity, curricula of selected fulltime schools and apprenticeships as well as relevant textbooks were analysed with regard to the contents in the domain of financial accounting. Thereby, five key contents were elaborated: (1) purpose, relevance and legal basis of financial accounting, (2) system of double bookkeeping, (3) system of value added tax, (4) sales and purchases, and (5) annual accounts.

Another central element to describe the characteristics of test items is the difficulty of tasks. In our instrument task difficulty is determined by three levels of taxonomy according to Anderson & Krathwohl (2001). They are: (1) Reproduction, (2) Application, and (3) Development and Evaluation. Furthermore, it is specified by complexity defining dimensions in the field of financial accounting, such as the number and type of relevant accounts, mathematical operations, technical terms, and connection of contents.

On this basis, around 200 items were created. About one third of them refer to domain-related knowledge. They vary among contents and task difficulty. Two thirds assess pedagogical content knowledge and vary in regard to content, facets, and difficulty. Three formats were chosen: Single choice, complex multiple choice, and open-ended questions.

In April 2013, a first piloting with all items was conducted at the University of Mannheim in a 60-minute paper-pencil-test. Apart from the test items, the pilot study included a questionnaire for biographic data, mainly concentrating on opportunities to learn in the field of financial accounting by asking the students about their school career, academic track as well as possible internships, student trainees, professional jobs, teaching activities, and private lessons. The sample covered 130 students

of Business and Economic Education. In order to apply all items, a Multi-Matrix-Design was chosen. Based on the upcoming results, existing items will be dropped or revised and new items might be created. In a second pretest in July 2013, which will take place at the University of Frankfurt, those items will be tested again together with instruments measuring beliefs, motivational, and self-regulation skills. They represent adaptations from existing test instruments (Fennema, Carpenter, & Loef, 1990; Grigutsch, Raatz, & Törner, 1998; Schmitz & Schwarzer, 2002) and own constructions. To guarantee a valid instrument, experts will be called to evaluate the final test items in regard to appropriateness and relevance for the teaching profession. In autumn 2013, the final paper-pencil-test will be carried out at 27 universities in Germany and – to validate the competence model – at four universities in Austria. A Multi-Matrix-Design will be used for this purpose. A sample of about 1,000 Master students of Business and Economic Education should be attained and the first results are expected by spring 2014.

Project data

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Time frame

01/11/2011 – 31/10/2014

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Modelling and Measurement of Professional Competence of Pre-Service Teachers in Business and Economic Education (KoMeWP)

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Aim and Method

Introduction

The professional competence of prospective teachers still remains rather unexplored in the field of Business and Economic Education (BECK 2005, 548) although there are several research activities in the domain of mathematics and science (BLOMEKE et al. 2011; KUNTER et al. 2011).

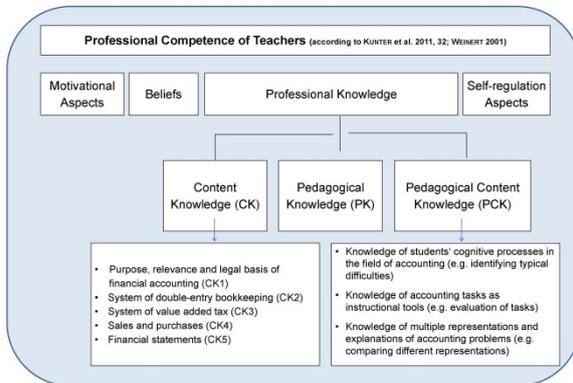
Purpose

The joint research project aims to model and assess pre-service teachers' content knowledge and pedagogical content knowledge as well as motivational and self-regulation aspects in Business and Economic Education. We focus on the domain of financial accounting since this content area is crucial for the understanding of economic contexts and processes in corporations.

Method

- Development of a paper-pencil-test to assess the cognitive aspects (CK and PCK) of professional competence in the field of financial accounting
- Adaptions from existing instruments (e.g. FENNEMA, CARPENTER & LOEF 1990) and own constructions measuring beliefs, motivational, and self-regulation skills
- Cross-sectional study of about 1,000 Master students of Business and Economic Education at 27 universities in Germany

Model and Pre-Test Design

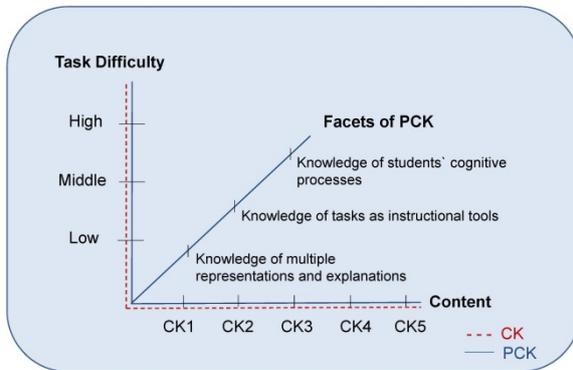


Task Difficulty

Each test item is categorized according to the following characteristics:

- (1.) Taxonomy (according to ANDERSON & KRATHWOHL 2001):
 - Reproduction
 - Application
 - Development /Evaluation
- (2.) Task Complexity (quantitative):
 - Number of accounts represented in the task
 - Number of technical terms mentioned in the task
 - Number of connections of contents necessary to solve the task
- (3.) Task Complexity (qualitative):
 - Type of accounts (e.g. stock vs. nominal account)
 - Quality of technical terms (algorithmic vs. economic)
 - Mathematical operations (e.g. summation vs. multiplication)
 - Representation of information in the task (direct vs. indirect)
 - Type of argumentation (algorithmic vs. economic)

Then an aggregate value is computed, representing difficulty on three levels: high, middle and low



Development of about 200 test items, representing different content areas, task difficulties and facets of PCK

Pilot study at the University of Mannheim (April 2013)

- (1.) 60-minute paper-pencil test
 - Test items
 - Questionnaire for biographic data (esp. learning opportunities)
- (2.) Multi-Matrix-Design
 - 31 clusters (6 items per cluster) with mean task difficulty
 - 5 clusters represent one booklet
 - Additionally 3 fixed items in each booklet → 30+3=33 items/booklet
 - 31 booklets
 - About 20 probands per item
- (3.) Sample
 - 130 undergraduates (Bachelor) and graduate students (Master) of Business and Economic Education at the University of Mannheim

Outlook



Literature:
 Anderson, L.W. & Krathwohl, D.R. (Eds.). (2001). A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Addison Wesley Longman.
 Beck, K. (2005). Ergebnisse und Desiderate zur Lehr-Lern-Forschung in der kaufmännischen Berufsausbildung. Zeitschrift für Berufs- und Wirtschaftspädagogik, 101(4), 533-556.
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 Fennema, E., Carpenter, T.P., & Lovel, M. (1990). Teacher belief scale. Cognitively guided instruction project. Madison, WI: University of Wisconsin.
 Kunter, M., Baumert, J., Blum, W., Klusmann, U., Krauss, S., & Neubrand, M. (2011). Professionelle Kompetenz von Lehrkräften – Ergebnisse des Forschungsprogramms COACTIV (S. 29-53). Münster: Waxmann.
 Weinert, F. E. (2001). Concept of competence: A conceptual clarification. In D. S. Rychen & L. H. Salganik (Eds.), *Defining and selecting key competencies* (pp. 45-66). Seattle, WA: Hogrefe & Huber.

HEED – Higher Entrepreneurship Education Diagnostics

Knuth, A., Blanke, S., Weinberger, E., Danielczyk, P., Schneider, D.,
Schefczyk, M., Wagner, D.

Project objectives

The research project's objective is to contribute to the improvement of Entrepreneurship Education at universities and at other higher education institutions. The promotion of entrepreneurial spirit, skills and abilities is a matter of current interest and extremely relevant for science and politics. Firstly, academic start-up companies contribute to innovation and economic growth. That is why the support of new ventures spinning out from universities is an important component of German economic policy. Secondly, entrepreneurial competence is an important element of a student's general education and opens multiple career opportunities.

The project partners University of Potsdam, University of Wuppertal and Dresden University of Technology have gained rich experience in the fields of entrepreneurship research and Entrepreneurship Education. They, additionally, offer students, graduates and researchers of all faculties a wide variety of start-up support programmes, starting with basic entrepreneurial training and continuing with business consulting, incubator facilities and financing. They have received several awards for their work. One of the most important awards is the ranking "Best German entrepreneurial university" of the Federal Ministry of Economy and Technology; all three partners have been placed on position 1, 2 and 3 between 2001 and 2009, nearly continuously. This success is both obligation and motivation to drive further innovation in the field of Entrepreneurial Higher Education.

Theoretical framework

Laukkanen (2000) differentiates between education *for* and *about* entrepreneurship. In this project, we focus on education for entrepreneurship, i.e. fostering entrepreneurial competencies. Education about entrepreneurship, in contrast, refers mainly to teaching theories about entrepreneurs and entrepreneurship. Although, there is an amount of literature concerning entrepreneurial competencies (Mitchelmore & Rowley, 2010), it is unclear which entrepreneurial competencies of students are in the focus of German higher education institutions and how these competencies can be combined in an integrative competence model. Theories from the particular areas of Economic Pedagogy, "Gründungspädagogik und –didaktik", General, Business and Entrepreneurial Didactics are of interest to this research. In addition elements from entrepreneurship research and other psychological and organizational theories are being cross-referenced.

Research questions

- What set of entrepreneurial competencies should students develop in higher education?
- How can entrepreneurial competencies be measured?

Each of the three project partners approaches the research field from a specific perspective. It is thus a triangulation approach. All project partners use a qualitative explorative research design, although each sub-project has its own specific method mix. The findings of the three sub-projects are going to be consolidated and synthesized in a common research result.

Research Design

Sub-project TEP – The Entrepreneurial Perspective (University of Potsdam)

From the point of view of entrepreneurs, this approach aims at developing the competence model by analyzing the action field of former students and start-up founders, which have created new ventures directly after graduating. We plan to gather and categorize data about typical tasks and typical problems of the academic entrepreneurs and derive a set of competencies needed in order to meet the analyzed challenges.

Sub-project TUP – The University Perspective (University of Wuppertal)

The first work package by the University of Wuppertal targets the modulation of a competence model of the entrepreneur. The construct of entrepreneurial competence has to be re-conceptualized and newly operationalized. Existing academic competence models are being analyzed and theories from the areas of pedagogy and didactics (especially business and entrepreneurial pedagogy as well as didactics) are transferred to the subject field of entrepreneurial competence. The research aims at the development of a model that contains dimensions (structure, number) as well as grading.

By ways of literature analysis of relevant theories (global coverage) the data is compiled out of national and international academic publications (Journals and books) from the relevant disciplines. Accordingly those publications by professors of the German tertiary sector from the expertise field of Entrepreneurship Education research, didactics and pedagogy, Economic Pedagogy and "Gründungspädagogik und –didaktik" are being collected and evaluated. When the competence model has been modulated we intend on carrying out narrative interviews with experts from the domain of entrepreneurship research as well as covering problem-focused areas of the model.

Following the consolidation, a gap analysis is carried out by the University of Wuppertal. Actual processes/outcomes from the modulated and consolidated model are compared to potential processes/outcomes of the model via analysis from the field of "Gründungspädagogik und –didaktik" and economics, and Business Sciences Education as well as Entrepreneurship Education in the tertiary sector in the tradition of Robinsohn (1973). Further didactic factors are going to be included into the analysis in addition to educational objectives and the development of the curricula. The methods of this package are literature and documentary analysis. The data used consist of codified curricula (especially examination regulations and study guidelines) from German and international universities as well as chairs of Entrepreneurship Education of the German tertiary sector with a sample size of the top ten universities in Entrepreneurship Education (according to the Schmude ranking).

Sub-project TIP – The Instructor Perspective (Dresden University of Technology)

We conduct semi-structured telephone interviews with university and college professors of the leading entrepreneurship institutions in Germany (cf. rankings of Schmude, Aevermann, & Heumann, 2011; BMWi, 2008). Applying Delphi Method (Linstone & Turoff, 1975), we report the results to the experts and assess their replies in a second interview to achieve a greater consent and a refinement of the results. Interviews are analyzed by means of qualitative content analysis (Mayring, 2010). Building on the derived competence model, we are going to construct an instrument for measuring entrepreneurial competencies in a second study. This instrument shall serve for evaluation and improvement of Entrepreneurship Education in higher education.

Project data

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Homepage	http://bit.ly/NveFet
Time frame	04/2012 – 03/2015

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HEED:

HIGHER ENTREPRENEURSHIP EDUCATION DIAGNOSTICS

Assessing entrepreneurial competence in the higher education sector.

The research project aims at improving the Entrepreneurship Education at universities and at other higher education institutions. The tasks include developing a competence model and developing assessment instruments.

TEP The Entrepreneurial Perspective



Developing a competence model
FOCUS: The entrepreneurs' perspective

METHODs:

Qualitative empirical research using semi-structured interviews with entrepreneurs, Grounded Theory Method

TUP The University Perspective



Developing a competence model
FOCUS: The university perspective

METHODs:

Qualitative empirical research using literature analysis, document analysis, curricula analysis, interviews

TIP The Instructor Perspective



Developing a competence model
FOCUS: The instructors' perspective

METHODs:

Qualitative empirical research using semi-structured telephone interviews with university and college professors, Delphi Method

Consolidation of the competence models

- Analysing the gap between the competence model and current higher education curricula
- Analysing existing practices of assessment of entrepreneurial competencies in higher education
- Developing new approaches for the assessment of entrepreneurial competencies

Team University of Potsdam (coordinating)

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Head of Potsdam-Transfer
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Cluster 3: Education

KUI

Competencies for Teaching Computer Science

ProfiLe-P

Professional Knowledge of Physics Student Teachers

Ko-WADiS

Evaluating the Development of Scientific Inquiry Competencies in Academic Science Teacher Education

ExMo

Teaching Competencies and Assessment Competencies in Experimental Biology Lessons: Modeling, Validation and Development of a Test Instrument

KomMa

Structure, Level and Development of Professional Competencies of Pre-School (Kindergarten) Teachers in the field of Mathematics

SOSCIE

Future Social Sciences Teachers' Competencies: Modeling and Measuring Domain Specific Reasoning as a Professional Competence of Future History Teachers

M³K

Modeling and Measuring Pedagogical Media Competencies of Pre-Service Teachers

DaZKom

Professional Competencies of Pre-Service Teachers for Secondary Education in the Field of German as a Second Language

BilWiss-Beruf

The Relevance of Theoretical Broad Pedagogical Knowledge for Young Teachers' Transition to Practice

KomPaed

Task-Related Competencies in Fields of Educational Activities

KUI – Competencies for Teaching Computer Science

Schaper, N., Magenheimer, J., Schubert, S., Hubwieser, P.,
Bender, E., Margaritis, M., Ohrndorf, L., Berges, M.

Abstract

The main goal of the project group KUI (German title “Kompetenzen für das Unterrichten in Informatik”) is to develop a competence model and measurement instruments for future teachers in Computer Science (CS) at secondary school level. Therefore relevant dimensions and facets of subject content competencies, competencies on subject oriented pedagogical content knowledge and non-cognitive competencies are derived on a theoretical and normative basis. The first empirical steps are the analyses of the competence facets on the basis of German curricula of CS-education. To validate and differentiate these facets expert interviews with experienced CS-teachers and CS-teacher educators will be accomplished. In a further step a competence measurement instrument will be developed and applied to a large sample of future CS-teachers. The data of this study will also be used to validate the competence model and the measurement instrument. The following project description explains the relevance for research in the field of Computer Science teacher education and the main goals and gains in connection with the derivation of the competence model. The theoretical framework, methodological approach and study design are briefly described. Furthermore the first results and some future recommendations are discussed.

Background

Analyses showed that the situation of how and to which degree Computer Science is taught as a school subject at secondary school level is not consistent among German schools. Furthermore recent research in Computer Science has shown a difference between existing challenging teaching concepts and difficulties in the transfer to the classroom which indicates that research in the field of teacher competencies should be advanced.

Research goals and questions

The main goal of the project KUI (German title “Kompetenzen für das Unterrichten in Informatik”) is to examine the competence facets which are necessary for teaching Computer Science classes at secondary school level. The main research questions are: By which competencies are professional Computer Science teachers characterized at secondary school level? How can an adequate competence model be developed and validated? Further important questions are: By which measurement instruments can the model and its facets can be operationalized and how can these measurement instruments be validated?

Theoretical framework

Based on the competence notion according to Weinert (2001) the basic dimensions of the competence model are theoretically and normatively derived. Recent empirical studies from related fields of research like teacher education in mathematics and the natural sciences serve as relevant references. We also take reference to existing models of teacher education presented in large scale studies and expert papers. Furthermore normative oriented documents, i.e. developed by the German “Kultusministerkonferenz (KMK)”, and particularly by the joint taskforce on Computer Science Curricula ACM and IEEE (2013) serve as important framework references.

Methodological approach and study design

The first methodological step is the theoretical and normative oriented derivation of a suitable competence model with reference to the dimensions of subject content competencies, competencies on subject oriented pedagogical content knowledge and non-cognitive competencies.

In a next step the derived competence model is applied to 43 curricula for Computer Science teacher education at German universities. We conducted a qualitative content analysis which focused on the question which competencies are covered by the curricula and by which degree. To get an impression of the competencies of pupils in Computer Science lessons and to compare pupil's and future teacher's competencies in Computer Science the developed category system is also applied to curricula of German schools. The question is as well, which competencies are covered and by which degree. In a further empirical step the competence model is differentiated and validated by expert interviews based on the critical incident technique. Based on this empirical analysis test items for measuring the described competencies in teaching Computer Science are constructed. It is planned to cover all facets of the competence model by special measurement instruments. Therefore appropriate types of instruments will be chosen, developed and pre-tested. Furthermore these instruments for measuring the competence facets will be empirically tested at a large sample. It is planned to test the instruments at a sample of 250 – 500 future Computer Science teachers from different university locations.

Discussion

The analysis of the university curricula has shown a broad variety of contents in Computer Science teacher education. Besides smaller differences in didactical contents, the largest differences can be found in main subject contents. The primary reason for these differences is the lack of Computer Science courses arranged exclusively for teacher education due to the small number of student teachers in the programs.

Future teachers have to take lessons, which do not focus on their special professional requirements and their Computer Science courses are often just equivalent to the beginner courses for Computer Science students. This confirms the need of an adequate definition of competence facets. In a further step the school curricula are compared with the university curricula to analyze which contents of Computer Science teachers really have to teach.

Altogether the competence model might be a helpful tool for the future design of university curricula, since it defines competencies to be acquired in a clear and intelligible way. Furthermore the test-instrument will help to reveal weak spots in Computer Science teacher education. These could be basic competencies, which are not acquired properly during the education.

Nevertheless the results of the measurement will reveal further questions. For instance the question, which impact the measured teacher competencies have on the quality of lessons, will be an interesting research topic on the long run.

KUI - Competences for Teaching Computer Science

Modeling and Measuring Competencies in Higher Education



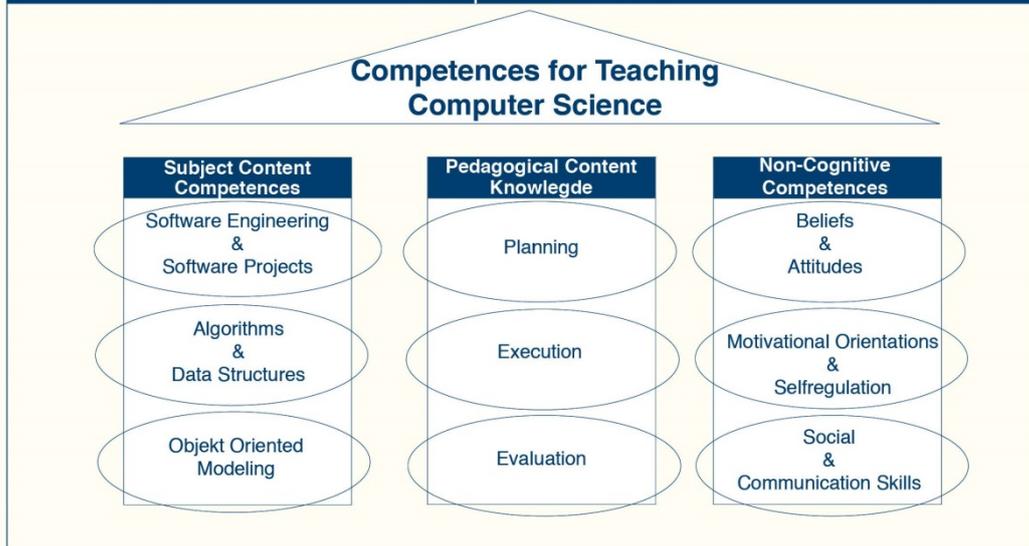
Background

- Teaching Computer Science in German secondary schools is not consistent
- There are differences between existing teaching concepts
- There are difficulties to transfer the existing teaching concepts into classes
- It does not exist a competence framework or model to guide Computer Science teacher education

Research Goals & Questions

- The main goal is to examine the competence facets which are necessary for teaching computer science at the secondary school level
- By which competences are computer science teachers characterized at secondary school level?
- How can an adequate competence model be differentiated and validated?
- How can measurement instruments be developed and validated?

Competence Model



Theoretical Framework

- The basic dimensions of the model are theoretically and normatively derived
- Normative oriented documents of Computer Science Education (e.g. ACM Computer Science Curricula, 2013) serve as an important framework
- Competence models and empirical research on teacher education (e.g. Blömeke et al., 2008) build a solid foundation
- Competence models and empirical studies of related fields of research (e.g. teacher education in mathematics and physics build relevant references

Methodological Approach & Study Design

- Development of a competence framework model
- Empirical requirements analysis
- Validation of the competence model
- Development of a measurement instrument
- Measuring competences of future Computer Science teachers in a large sample
- Model and test validation
- Curricula recommendation

Sponsorship period: 07/2012 - 06/2015

University of Paderborn: Prof. Nicolas Schaper, Prof. Johannes Magenhelm, Elena Bender, Melanie Margartlis

University of Siegen: Prof. Sigrid Schubert, Laura Ohmdorf

Technical University of Munich: Prof. Peter Hubwieser, Marc Berges

The research initiative is funded by the German Federal Ministry of Education and Research under grant no. 01PK11019A,B,C



Profile-P – Professional Knowledge of Physics Student Teachers

Riese, J., Borowski, A., Fischer, H., Yvonne Gramzow, Y., Kulgemeyer, C., Reinhold, P., Schecker, H., Tomczyszyn, E., Walzer, M.

Aims and research questions

For improving teacher educational systems, there is a rising interest in describing specific (physics) teachers' professional competencies and their development in the course of educational programs. However, there is a lack of empirical research findings. Up to now it is not clear to which extent expected competencies and skills are acquired and how they develop, especially within the university part of teacher education programs. Against this background, the focus of the presented project lies on modeling domain-specific and generic competencies student teachers acquire at academic level. The model comprises characteristics and interdependencies between physics content knowledge (CK), pedagogical content knowledge (PCK) and explaining skills that are expected to have an effect on teaching physics. The theoretical model is transferred into a measuring model and instruments and then tested and validated.

Theoretical framework

In accordance with Shulman (1986) teachers' professional knowledge is usually separated in three domains: content knowledge (CK), pedagogical content knowledge (PCK) and pedagogical knowledge (PK). In science education, these three domains and their development in higher education have been researched extensively (c.f. Fischer, Borowski, & Tepner, 2012). The prior studies however either focused on only one of the three domains or correlated only global ability scores to get an insight into the interaction between the domains (e.g. Riese & Reinhold, 2012). Furthermore, professional knowledge is so far usually measured by written tests. Whether or not these tests are really a valid way to predict teachers' actual performance quality in science classroom remains an open question. Thus, we are working on a theoretical and empirically validated model of physics teachers' professional knowledge, focusing on CK and PCK, that is able to predict performance in exemplary physics teaching scenarios.

Design

Based on the sub-models of physics student teachers' CK and PCK, we develop and validate assessment instruments for these domains using item response theory. For including actual performance in an assessment, we focus on explaining science phenomena as an important part of physics teachers' instructional actions in classrooms. We develop a test on explaining quality in process, using the expert-novice dialog method proposed by Kulgemeyer and Schecker (2013). After several steps of trialing and validating our instruments, we collect data in a sample that is composed of physics student teachers in higher and lower teacher education programs as well as exercise instructors for undergraduate physics students, assuming that the instructors need similar instruction-related competencies as teachers. For validating the developed instruments they will also be used in a group of mathematics student teachers and physics bachelors.

In a nutshell, the following aims will be pursued: 1) development of a competence model and related test instruments for the academic knowledge of future physics teachers; 2) convergent and discriminant validation of the model's sub-domains; 3) describing the development of students' knowledge combining longitudinal and quasi-longitudinal studies; 4) clarification of interdependencies between CK, PCK and explaining competencies using multivariate statistics.

Project data

Project management

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Time frame

1/11/2011 – 30/04/2015

References

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Modeling and measuring physics teachers' professional content knowledge

Peter Reinhold, Andreas Borowski, Hans E. Fischer, Christoph Kulgemeyer, Josef Riese, Horst Schecker

Purposes

- Modeling content knowledge (CK) and pedagogical content knowledge (PCK) of prospective physics teachers and lecturers
- Developing and validating model based test instruments
- Exploring the relationship between physics content knowledge (CK), pedagogical content knowledge (PCK) and explaining skills
- Comparing students of university courses for different types of physics teachers

Projects

FaWis: Prospective physics teachers' content knowledge (H.E. Fischer, A. Borowski, M. Walzer)

- Relationship between university and school based physics knowledge and the knowledge of students on entry level of university
- Quasi-longitudinal study to analyse the development of content knowledge in academic physics education of prospective physics teachers



Offen im Denken

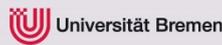


DaWis: Prospective physics teachers' pedagogical content knowledge (P. Reinhold, J. Riese, Y. Gramzow)

- Description of the internal structure of pedagogical content knowledge
- Longitudinal study to research the development of pedagogical content knowledge in the academic physics education

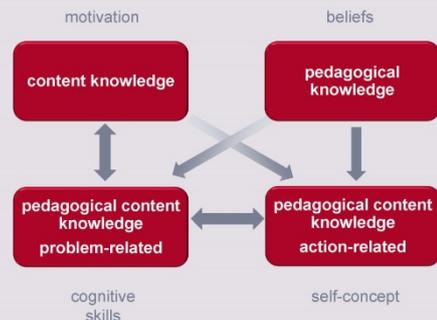
EWis: Explaining physics – explaining skills of prospective physics teachers (C. Kulgemeyer, H. Schecker, E. Tomczyszyn)

- Relationship between CK, PCK and the explaining skills of prospective physics teachers
- Expert-novice dialogue method to assess explaining skills: Prospective physics teachers explain physics to high-school students, who are trained to pose comparable challenges to all test subjects



Composite Project ProfileP

- Identical underlying model for all projects
- Harmonized assessment instruments
- Larger number of subjects by sharing the same test persons
- Shared pool of data for detailed analysis



ProfileP ist ein gemeinsames Projekt der drei Universitäten Paderborn, Bremen und Duisburg-Essen und der Rheinisch-Westfälischen Technischen Hochschule (RWTH) Aachen



Ko-WADiS – Evaluating the Development of Scientific Inquiry Competencies in Academic Science Teacher Education

Straube, P., Stiller, J., Mathesius, S., Hartmann, S., Nordmeier, V.,
Tiemann, R., Upmeier zu Belzen, A., Krüger, D.

Relevance and aims

According to various researchers, there is a need for empirical, competence-based studies in academic science teacher education (Reinhold, 2004; Schecker & Parchmann, 2006; von Aufschnaiter & Blömeke, 2010; Zlatkin-Troitschanskaia & Kuhn, 2010). Such studies will be necessary to evaluate the success of university courses, and to develop academic education (Wissenschaftsrat, 2008). Thereby, modeling and assessing competencies serve as a basis for policy control.

Project Ko-WADiS sets out to establish a reliable instrument to evaluate the development of competencies in the field of scientific inquiry during the phase of academic science teacher education. It is conducted in collaboration of the departments of biology education and physics education at Freie Universität Berlin and the departments of biology education and chemistry education at Humboldt-Universität zu Berlin.

Research questions

The main research questions of project Ko-WADiS are: What empirical evidence can be found to support a theoretically predicted model of competencies? How do competencies in the field of scientific inquiry develop during the phase of academic science teacher education?

Theoretical background

Competencies in the field of scientific inquiry are often described as science syntactic knowledge (Abell, 2007) and thus constitute a component of teachers' professional knowledge (Baumert & Kunter, 2006). Scientific inquiry competencies are assumed to be a fundamental part of scientific literacy (American Association for the Advancement of Science [AAAS], 1993; Bybee, 2002; National Research Council [NRC], 2012) and play a key role in the education of (future) science teachers (Sekretariat der Ständigen Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland, 2010). "Scientific inquiry refers to characteristics of the scientific enterprise and processes through which scientific knowledge is acquired" (Schwartz, Lederman, & Crawford, 2004, p. 611). According to Mayer (2007), the way of acquiring scientific knowledge is a complex problem solving process. Based on assumptions made by Mayer (2007) and Upmeier zu Belzen and Krüger (2010), the underlying theoretical model of the competence structure in the field of scientific inquiry consists of two domains: conducting investigations and using models. These domains can be further divided into sub-dimensions (fig 1).

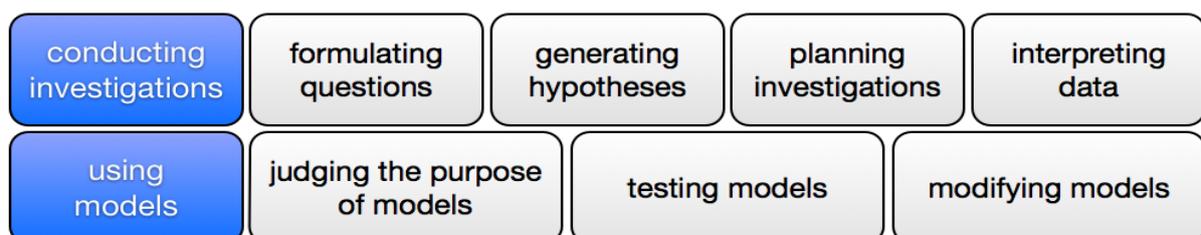


Figure 1. Domains (blue) and sub-dimensions (grey) of scientific inquiry.

Research design

To assess these competencies, a paper-pencil test with 146 multiple-choice items was developed. A pilot study (N ~ 650) is scheduled for summer 2013. The instrument will be used in a longitudinal survey assigned to different text booklets (multi-matrix design) in order to answer the central research questions. The longitudinal survey will start at the end of summer semester 2013. Every student will be tested twice during the bachelor stage and twice during the master stage of academic teacher education. Data will be analyzed using methods of Item-Response-Theory.

The project is funded by the Federal Ministry of Education and Research as part of the program Modeling and Measuring Competencies (KoKoHs). The first stage of the project ends in April 2015.

Project data

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Time frame	01/11/2011 – 30/04/2015

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Project Ko-WADIS

Evaluating the development of scientific inquiry competencies in academic science teacher education

Jurik Stiller, Sabrina Mathesius, Philipp Straube, Stefan Hartmann, Volkhard Nordmeier, Rüdiger Tiemann, Annette Upmeyer zu Belzen & Dirk Krüger

Educational Significance & Aims

Modelling and assessing competencies is currently promoted as the basis for policy control (e.g. Klieme, Leutner, & Kenk, 2010), particularly in the area of primary and secondary education. Most recently, a transfer of the term competency to the field of teacher education can be stated (Kunter, 2010). Von Aufschnaiter and Blömeke (2010) now demand a competence-oriented teacher education research in the natural sciences (see also Schecker & Parchmann, 2006; Reinhold, 2004). Of particular importance are the skills in terms of scientific inquiry, understood as a component of teachers' professional knowledge (see Baumert & Kunter, 2006). These have mainly been investigated in the field of primary and secondary education. However, in higher education, so far only a few studies exist (e.g. in physics Woitkowski, Riese, & Reinhold, 2011). For an evaluation of skills in scientific inquiry, there is a lack of adequate measurement instruments.

In this project, this desiderate is met through a large-scale assessment of science student teachers' competencies in the field of scientific inquiry.

Therefore, a paper-and-pencil-test with multiple-choice (single-select) items has been constructed, based upon theoretical models of Mayer (2007) and and Upmeyer zu Belzen and Krüger (2010; see figure 1).

Competence structure model

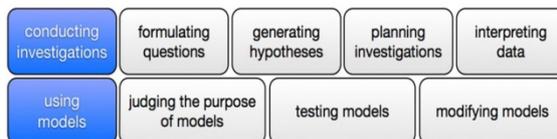


Figure 1. Domains (blue) and sub-dimensions (grey) of scientific inquiry.

Selected project publications

Hartmann, S., Krüger, D., & Upmeyer zu Belzen, A. (2012, September). *Ko-WADIS. Kompetenzmodellierung und -erfassung zum Wissenschaftsverständnis über naturwissenschaftliche Arbeits- und Denkweisen bei Studierenden (Lehramt) in den drei naturwissenschaftlichen Fächern Biologie, Chemie, Physik*. Poster presented at the annual meeting of Arbeitsgruppe für empirische pädagogische Forschung (AEPF), Bielefeld.

Mathesius, S., Upmeyer zu Belzen, A., & Krüger, D. (2013, March). *Kompetenzmodellierung naturwissenschaftlicher Erkenntnisgewinnung bei Lehramtsstudierenden (Ko-WADIS)* [Modeling student teachers' competencies in scientific inquiry]. Poster presented at the annual meeting of Internationale Frühjahrschule der Fachsektion Didaktik der Biologie im VBiO, Leipzig.

Stiller, J., & Tiemann, R. (2013). Scientific Inquiry im Studium — Längsschnitt zur Kompetenzerfassung im Lehramt Chemie [Scientific inquiry in higher education — longitudinal assessment of chemistry student teachers' competencies]. In S. Bernholt (Ed.), *Inquiry-based Learning - Forschendes Lernen. Gesellschaft für Didaktik der Chemie und Physik. Jahrestagung in Hannover 2012* (pp. 641–643). Kiel: IPN.

Straube, P., & Nordmeier, V. (2013). Längsschnitt zur SI-Kompetenzerfassung Physik[Lehramts]-Studierender. [Longitudinal survey to investigate the SI-competencies of physics student teachers]. In S. Bernholt (Ed.), *Inquiry-based Learning – Forschendes Lernen. Gesellschaft für Didaktik der Chemie und Physik. Jahrestagung in Hannover 2012* (pp. 539–541). Kiel: IPN.

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Methodology

- longitudinal large-scale assessment of science student teachers' competencies in the field of scientific inquiry
- multiple-choice (single-select) items in paper-and-pencil-booklets
- $N \approx 3\,500$ student teachers (biology, chemistry and physics) in Berlin, Innsbruck and Vienna in different stages of their studies



- $N = 650$ student teachers (biology, chemistry and physics) of Humboldt-Universität zu Berlin and Freie Universität Berlin
- essay-items dealing with "conducting investigations" and "using models" in various fields of chemistry, biology and physics
- item-pool of 150 items was used to generate booklets
- data are analysed towards choosing of distractors and item parameters (e.g. discrimination, difficulty)
- findings will serve as basis for item selection

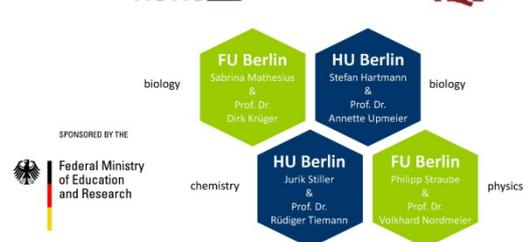
Research questions

- What empirical evidence can be found to support this theoretical predicted model of competencies?
- How does the competencies in the field of scientific inquiry develop during the phase of academic teacher training?

Outlook

By 2015, information about the structure and development of science students teachers' competencies in the field of scientific inquiry shall be elicited, and thereby tangible recommendations concerning the conception of university courses shall be derived.

Ko-WADIS is part of **KoKoHs**, in cooperation with the **IQI**:



ExMo – Teaching Competencies and Assessment Competencies in Experimental Biology

Lessons: Modeling, Validation and Development of a Test Instrument

Bögeholz, S., Carstensen, C., Hammann, M., Hasse, S., Joachim, C.

The project focusses on teacher education students' teaching competencies and assessment competencies in experimental biology lessons. Since experiments are a central method for solving scientific questions in biology lessons, the advancement of student competencies in experimentation plays a prominent role in biology education (KMK 2004, 2008). As little is known about the question which competencies biology teacher education students need for teaching experimental lessons and assessing student achievement in experimental lessons, this project aims to contribute to this knowledge by developing a theoretical model for biology teacher education students' competencies, validating the model and developing a test instrument based on the model. The model focuses on the competencies of planning and analyzing experimental biology lessons and on the competencies of assessing student achievement in experimental biology lessons.

ExMo is a joint research project of Westfälische-Wilhelms-Universität Münster, Georg-August-Universität Göttingen and Otto-Friedrich Universität Bamberg. At Westfälische Wilhelms Universität Münster, Prof. Dr. Marcus Hammann and Sascha Hasse work on the subproject **"Teaching Experimental Biology Lessons"**. At Georg-August Universität Göttingen, Prof. Dr. Susanne Bögeholz and Cora Joachim work on the subproject **"Assessment of Student Achievement in Experimental Biology Lessons"**. At Otto-Friedrich Universität Bamberg, Prof. Dr. Claus Carstensen works on multi-dimensional modeling.

The subproject **"Teaching Experimental Biology Lessons"** aims at developing a normative framework specifying the competencies biology teacher education students need to effectively plan and analyze experimental biology lessons at high schools. A range of different frameworks and models have been combined for this purpose, in particular PCK models, the SDDS model (Klahr, 2000), and frameworks of educational standards for higher education. Also, this project aims at developing a test instrument consisting of open-ended and context-based test items, which confront teacher education students with authentic classroom scenarios to be planned and analyzed. Item development follows the approach of rational item construction (Schmidt-Atzert & Amelang, 2012). In consideration of Hammann's (2004) competence model of pupils experimentation skills, test items focus on teacher education students' ability to foster pupils' competence to i) form hypotheses, ii) plan experiments and iii) analyze data. The approach to item development is generalizable beyond the specific field of teaching and analyzing experimental biology lessons, as items focus on making informed decisions about teaching goals, teaching strategies, methods and media. Test items are pre-tested via think-aloud protocols (N = 15; Ericsson & Simon, 1993).

The subproject **"Assessment of Student Achievement in Experimental Biology Lessons"** aims at the theoretical foundation of biology teacher education students' competencies of assessing student achievement. In order to check empirically and validate assessment competencies in experimenting, a test is being developed according to a theory-based model. In consideration of Hammann's (2004) competence model of pupils experimentation skills, the items for testing teacher education students' assessment competencies present student achievement concerning i) forming hypotheses, ii) planning experiments and iii) analyzing the data. Typical high-school student conceptions, frequent mistakes and specific challenges when experimenting are taken into account. The test items incorporate specific methodological aspects of experimenting. They are context-based and present authentic classroom scenarios as well as descriptions of high-school students' achievement. Test

items are developed and tested with think-aloud protocols (N = 17; Ericsson & Simon, 1993). The protocols will be analyzed by means of qualitative content analysis according to Mayring (2010). The findings are expected to provide insights into teacher education students' conceptions of assessing student achievement as well as into improving the test items for the following quantitative study with respect to competence modeling.

For both subprojects, the development of the normative framework and the item development take place in an iterative process described by Wilson (2005). Up to now, the items make use of the contexts of seed germination and photosynthesis. Further, the test instruments will be validated. In particular, content validation is examined in expert workshops. Test items and teacher education students' responses are closely examined to refine the theoretical assumptions that inform item development. After two pilot studies (N = 60; N = 300), involving teacher education students at all three universities, the main study (N = 500) will be undertaken. The constructs will be validated (convergent and discriminant validity) (Moosbrugger & Kelava, 2007). After combining the data of the two subprojects of ExMo, **multi-dimensional modeling** at Otto-Friedrich Universität Bamberg will provide information about interrelations between planning experimental lessons, analyzing experimental lesson and assessing student achievement in experimental biology lessons.

The findings are applicable beyond the context of national teacher education programs for biology teachers. The findings have implications for other science subjects and for higher education programs in other countries. Further, long-term goals of the project are the development of diagnostic tests for measuring the outcomes of teacher education and for testing the effectiveness of specific trainings in this area.

Project data

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Time frame	01/03/2012 – 30/06/2015

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ExMo

Teaching Competencies and Assessment Competencies in Experimental Lessons: Modeling, Validation and Development of a Test Instrument

Prof. Dr. Susanne Bögeholz*, Prof. Dr. Claus Carstensen** Prof. Dr. Marcus Hammann***, Sascha Hasse***, Cora Joachim*

*Georg-August Universität Göttingen, **Otto-Friedrich Universität Bamberg, ***Westfälische Wilhelms-Universität Münster

Project Goals

The project aims at the theoretical foundation, empirical verification and validation of a competence model for teaching competencies and assessment competencies of biology teacher trainees in experimental lessons. The focus lies on analyzing and planning experimental lessons as well as on assessing students' experimentation competencies for grade five to ten. A reliable and valid test instrument will be developed.

Subproject Teaching Competencies

Westfälische-Wilhelms-Universität Münster

The subproject deals with the theoretical foundation of teaching competencies in experimental lessons. Two specific aspects – "analyzing the instruction of experiments" and "planning the instruction of experiments" – will be modeled using Item-Response-Theorie (IRT).

Subproject Assessment Competencies

Georg-August-Universität Göttingen

The subproject deals with the theoretical foundation of the competence "assessing student achievement in experimental lessons". This competence will be modeled using Item-Response-Theory (IRT).

Subproject Multidimensional Modeling - Otto-Friedrich-Universität Bamberg

This subproject focusses on "multidimensional modeling" (IRT) of teaching competencies and assessment competencies of biology teacher trainees in experimental lessons. This will take place in close collaboration with Westfälische Wilhelms-Universität Münster and Georg-August-Universität Göttingen.

Theoretical Background

A range of different frameworks and models have been combined to provide a theoretical background for the competence model depicted below. The competence model is based, in particular, on normative standards and frameworks of teacher competencies in higher education (e.g., KMK 2008, GFD 2005), PCK models (e.g., Shulman 1987), the SDDS model (Klahr 2000), and national and international subject didactic findings on scientific experimentation in the biology classroom (i.a. Ford 2008, Klahr 2000, Hammann 2006, Höttecke 2008, Labudde & Möller 2012, Kanari & Millar 2004, Schauble 1995).

Considering the GFD (Gesellschaft für Fachdidaktik) standards for teacher education, which specify the competencies "Theory-guided reflection in subject didactics", "Teaching a specific subject" and "Assessing student achievement in a specific subject" the ExMo-project postulates three competences: "Analyzing experimental lessons", "Planning experimental lessons" and "Assessing student achievement in experimental lessons" (see below).

Teaching Competencies and Assessment Competencies of Biology Teacher Trainees

Analyzing experimental lessons

Planning experimental lessons

Assessing student achievement in experimental lessons

Development of Test Instruments

Test items focus on planning experimental lessons, analyzing experimental lessons and assessing student competencies in experimental lessons. Test items are context-based and content-specific. They confront teacher trainees with realistic descriptions of classroom scenarios and student achievement.

For item development, both subprojects use a competence model specifying dimensions and levels of students' competencies in biological experimentation (Hammann 2004; Hammann, Phan & Bayrhuber 2007). In the subproject "teaching competencies", teacher trainees are required to plan and analyze instruction that focuses on fostering the students' competencies of forming hypotheses, planning experiments and analyzing data. In the subproject "assessing student competencies", teacher trainees are required to assess student achievement when forming hypotheses, planning experiments and analyzing data.

Approaches to item development are generalizable beyond the specific field of teaching experimental biology classes, as items focus on making informed decision about teaching goals, methods, media and student achievement described in the teaching scenarios. Item development and item revision is an iterative process (Wilson 2005), with think-aloud protocols used for testing hypotheses and refining theoretical assumptions.

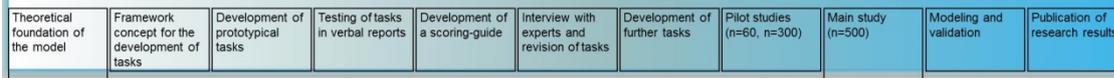
Methodology and Arguments for Test Validity

Item frameworks and prototypical test-items are developed and tested with think aloud protocols (Ericsson & Simon 1993). This step is intended to show, among other things, whether or not the test items trigger the specific cognitive processes necessary for analyzing experimental lessons, planning experimental lessons and assessing student achievement in experimental lessons. Further, a quantitative test instrument is developed for each competence. Findings of pilot studies will be used to optimize the test items. Expert ratings will further contribute to evaluate the model and the items.

The main study is going to involve 500 biology teacher trainees. The sample will be drawn from students at the universities of Münster, Göttingen and Bamberg. Data will be used for one-dimensional and multidimensional modeling. For the modeling, a *between-item-multidimensionality* approach is used. Construct validity will be analyzed by convergent and discriminant validation.

Selected Literature:

GFD (2005). Fachdidaktische Kompetenzbereiche, Kompetenzen und Standards für die 1. Phase der Lehrerbildung. KMK (2008). Ländergemeinsame inhaltliche Anforderungen für die Fachwissenschaften und Fachdidaktiken in der Lehrerbildung.
Klahr, D. (2000). Exploring science: The cognition and development of discovery processes. Cambridge, Mass.: The MIT Press.
Phan, T. T. H., Hammann, M., & Bayrhuber, H. (2008). Testing levels of competencies in biological experimentation. In M. Hammann, M. Reiss, C. Boudier & S. D. Tunnicliffe (Eds.), *Biology in context: learning and teaching for the twenty-first century. A selection of papers presented at the 15th conference of european researchers in didactics of biology (ERIDCB)* (pp. 349-360). London: Institute of Education of the university of London.



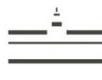
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Sascha Hasse



Georg-August Universität Göttingen



Prof. Dr. Susanne Bögeholz



Cora Joachim



Otto-Friedrich Universität Bamberg



Prof. Dr. Claus Carstensen



KomMa – Structure, Level and Development of Professional Competencies of Pre-School (Kindergarten) Teachers in the field of Mathematics

Dunekacke, S., Jenßen, L., Baack, W., Schmude, C.,
Wedekind, H., Grassmann, M., Blömeke, S.

Relevance, objectives and research questions

Early math education is crucial for the mathematical development of children (Krajewski, 2009). Studies reveal that early mathematical education depends on a stimulus-rich learning environment and the quality of the pedagogical support (van Oers, 2010). There is a lack of research, nationally and internationally, about the professional competence of teachers, particularly in the field of mathematics (National Advisory Panel, 2008). As part of the KoKoHs initiative (Blömeke & Zlatkin-Troitschanskaia, 2013), the professional competence of prospective kindergarten teachers of mathematics within the project KomMa is being examined.

Project aims are: (1) the development of a theoretical model of pre-school teachers' professional competencies to foster mathematical literacy in kindergarten that covers core job tasks and is valid with respect to their training opportunities at the same time; (2) the development of a domain-specific test that reliably and validly measures the competencies of pre-school teachers to foster mathematical literacy in the informal settings of the kindergarten; (3) a data-based confirmation of our theoretical model of pre-school teachers' professional competencies to foster mathematical literacy in kindergarten with different cohorts of teachers from different training institutions, (4) a longitudinal analyses of the level, the structure, and the development of pre-school teachers' professional competencies from the beginning of their training through their first years in their job; (5) the identification of effective training characteristics through within-country and cross-country¹ comparisons.

Theoretical background and model of competence

Professional competence of educational staff has previously been studied in the context of primary and secondary teacher education research. The research suggests that professional competence (in mathematics) is composed of three knowledge facets (mathematical content knowledge (MCK), mathematical pedagogical content knowledge (MPCK), general pedagogical knowledge (GPK)), as well as general and math-related beliefs (Shulman, 1986; Blömeke, Suhl, Kaiser, & Döhrmann, 2012; Blömeke, Suhl, & Döhrmann, 2013). Currently, only exploratory competence models exist with respect to pre-school teachers. A conceptual design has been developed by Fröhlich-Gildhoff, Nentwig-Gesemann, & Pietsch (2011). It is assumed that kindergarten teachers' professional competence is a composition of different facets of knowledge, skills and attitudes. A competence structure model (figure 1) was developed based on the findings described within the project.

Based on this state of research, a competence model was developed in KomMa. The model takes into account the three knowledge facets (MCK, MPCK, GPK) as well as beliefs. The substantive operationalization of the model was based on an analysis of formal curriculums for kindergarten facilities in all 16 federal states in Germany as well as on the literature.

Competence can be learned (Hartig, Klieme, & Leutner, 2008) and its level varies within the population. In addition, competence involves more performative aspects rather than just factual

¹ A similar study is carried out from an associated research group in Norway.

knowledge ("inert knowledge"). To account for these two aspects of competence acquisition, a competence level model was developed with references to psychometric literature (e.g. Embretson & Daniel, 2008). The model is depicted on figure 1 and considers six characteristics that are assumed to predict the difficulty of tasks to be solved. It serves as a heuristic for the item construction and the subsequent data analysis.

Research design

The data collection is planned for the 2013/14 winter term. The sample (N = 1,500) is collected in Germany and should be representative of the characteristics of sex and trainings institutions. The training institutions take into account that kindergarten teachers in Germany are trained at vocational training schools (part of the secondary education system) and universities of applied sciences (part of the tertiary education system).

A performance test is utilized, which was developed on the basis of the competence structure and level of competence model, and which includes 62 mostly self-designed items according to the three knowledge facets (MCK, MPCK, GPK). Several pre-tests and a Cognitive Lab were used for quality assurance in terms of reliability and validity in addition to discussions conducted with an interdisciplinary project team. Finally, an expert rating was conducted where the content validity of the items was assessed in a standardized way. Due to the complex construct to be examined and the large number of items necessary to assess this, a rotated multi-matrix design (PISA, 2004) will be utilized. Socio-demographic data, opportunities to learn (OTL) in the context of education, as well as self- and math-related beliefs, will be addressed with questionnaires.

The data are analyzed by using item-response-models and confirmatory factor analyzes. The answers to the research questions are then evaluated using complex regression analysis, which take into account the multilevel structure of the data. In addition, further steps are planned to check the validity of the test or scales of the test (construct validity on item level, verification of the dimensional structure, criterion validity and differential validity).

Project data

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Time frame

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References

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Structure, level and development of professional competencies of pre-school (kindergarten) teachers in the field of mathematics

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2011 - 2014

KoKoHs

HUMBOLDT-UNIVERSITÄT ZU BERLIN



Project management: Prof. Dr. S. Blömeke¹, Prof. Dr. M. Grassmann¹, Prof. Dr. C. Schmude², Prof. Dr. H. Wedekind²
Research Assistants: Wibke Baack¹, Simone Dunekacke¹, Lars Jenßen¹
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Relevance

- Development of mathematical skills in preschool needs specific learning opportunities
- Early mathematical education depends on the quality of the pedagogical support
- there is a lack of research, nationally and internationally, about professional competence of pre-school teachers

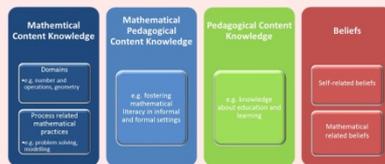
Project Aims

- Development of a valid competence model in the fields of mathematics which includes job based tasks
- Development of a domain-specific test to measure competencies of pre-school teachers
- Longitudinal analyses of level, structure and development of pre-school teachers' professional competence in mathematics
- Identification of effective training characteristics

Theory-based development of our competence model

Structural model:

Qualitative content analysis (Mayring) of formal curricula for kindergartens including early educational literature



(Blömeke, Suhl & Döhrmann, 2013; Shulman, 1986)

Level Model:

Definitions of characteristics that are assumed to predict the difficulty of tasks to be solved (with references to psychometric literature; e.g. Embretson & Daniel, 2008)



Assessment of Competence

- **Questionnaires:** 1st opportunities to learn (OTL), 2nd self-related and mathematical related beliefs
- **Achievement test:** general pedagogical knowledge (16 items), mathematical pedagogical content knowledge (22 items) and mathematical content knowledge (24 items)
- **Response formats:** multiple choice, open and mapping tasks
- **Fairness:** gender-free task formulation according to stereotype threat
- **Content validity:** panel of expert analysts (7 to 9 experts for each domain), cognitive lab
- **Construct validity:** verification of the dimensional structure, construct validity on item level, criterion validity (OTL and competence), differential validity (pre-school teachers vs. primary school teachers)

Item of the domain „Pedagogical Content Knowledge“

Two children (both 5 years old) are standing in the garden in front of a patch in which sunflowers were seeded to observe the process of growth of the plants. With which pedagogical concept would you explain the following dialogue?

Child 1: Why are the flowers here so little? We seeded some in plant pots on the windowsill back home and those are already bigger.
Child 2: They certainly grow longer.
Child 1: No, I and my father seeded them at the same day.
Child 2: However, something must be different on your windowsill than here in the garden, isn't it?
Child 1: It is much warmer there than here outside because we turned the heater on.
Child 2: I think your flowers grow faster because it is warmer there than here in the garden.

Please indicate your answer with a cross.

According to instructional learning

According to interactional theory

According to co-construction

According to the theory of split attention

Item of the domain „Mathematical Content Knowledge“

Chris has a blue, a green, a red and a yellow cube.
Chris wants to pile up a tower with the four cubes.
Which arithmetic expression provides the number of possibilities of the different towers?

Please indicate your answer with a cross

$4 + 4 + 4 + 4$

$4 \cdot 4 \cdot 4 \cdot 4$

$4 \cdot 3 \cdot 2$

$4 + 3 + 2$

Item of the domain „Mathematical Pedagogical Content Knowledge“

You are playing a dice game with three children.
Please explain, in short, why the following mathematical contents are fostered.

x1: Figures, quantities and operation (i.e. calculating)	
x2: Data, combinatorics, and chance (i.e. probability)	

Data collection and analysis

Data collection:

- N=1,500; representative survey with respect to characteristics like gender, training institutions and federal states of Germany
- rotated multi-matrix design
- combined longitudinal and cross-sectional design

Data analysis:

- descriptive data analysis
- item-response models and confirmatory factor analysis
- complex regression analysis, which take into account the multilevel structure of the data

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Blömeke, S., Suhl, U. & Döhrmann, M. (2013). Assessing strengths and weaknesses of teacher knowledge in Asia, Eastern Europe and Western countries: Differential item functioning in TEDS-M. *International Journal of Science and Mathematics Education*, 2013. DOI: 10.1080/00207179.2013.841500

Embretson, S.E. & Daniel, R.C. (2008). Understanding and quantifying cognitive complexity level in mathematical problem solving items. *Psychology Science Quarterly*, 50, 3.

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SOSCIE – Future Social Sciences Teachers’ Competencies: Modeling and Measuring Domain Specific Reasoning as a Professional Competence of Future History Teachers

Pusch, F., Kury, S., Brauch, N., Nückles, M.

Purpose of the Study and Research Questions

Future history teachers are challenged with the complex task of integrating their knowledge of historical science (i.e. content knowledge (ck)), educational psychology (i.e. pedagogical knowledge (pk) and history specific teaching methods (i.e. pedagogical content knowledge (pck)) in order to conceptualize learning enhancing tasks that focus on pupils’ thinking. Meeting this challenge, they have to develop domain specific reasoning as they have to decide *what content* fits best to engage pupils in historical reasoning *and how* they can be triggered to do so. Studies on the teaching performance to be observed in history classrooms, however, draw a different picture emphasizing that many teachers – both with and without teaching experience – fail in integrating the concepts of ck, pk and pck when it comes to reflect how to engage pupils in historical reasoning. Instead, they often depend heavily on the content and teaching approach of history textbooks and predominantly focus on the construction of factual and descriptive knowledge and less on engaging pupils in authentic and meaningful historical reasoning.

To overcome this shortcoming, we are conceptualizing a model of domain specific reasoning in history education that is aimed at training undergraduate students in how to design assignments that can foster historical reasoning of pupils in secondary education. Therefore we developed a standardized course in history education designed to give the students in a first step learning opportunities to interrelate disciplinary concepts (ck, pck, pk) by prompting them to reflect what consequences the appliance of theoretical concepts would practically have for the design of a learning enhancing task for pupils. In a second step the students had to translate their knowledge of a particular historical topic, educational psychology and history specific teaching methods into concrete history assignments.

Our research questions are thus:

- (i) How can we describe the concept of “domain specific reasoning” as students’ achievement of integrating the disciplinary concepts of ck, pk and pck?
- (ii) How can we identify and define distinct levels of this competence by analyzing the learning journals and learning assignments the students produced in the course(s)?
- (iii) How can we help students to achieve better in integrating the disciplinary concepts of ck, pk and pck (by restructuring the given text sample and prompts)?

Study Design and Theoretical Background

To answer these research questions a course on “How to teach about the Holocaust” was conducted in four subsequent terms, with a restructured fifth course being in progress. In these courses, undergraduate students (N = 200) were given texts representing current standards of historical science, educational psychology and history didactics.

In the first two terms the focus was on pck dealing with the challenge to teach the topic Holocaust at school. The third term dealt with research literature on how to foster historical reasoning at school. The fourth term was dominated by recent historical research literature concerning the Holocaust and the micro-historical context of the Anne Frank diary in the occupied Netherlands. We were interested in the question, what kind of text sample helped students most in dealing with the

problem of how to design a learning enhancing task. To understand this better, we started to analyze both the quality of students' domain specific reasoning in the learning journals and the learning enhancing quality of collaboratively designed assignments. On the basis of the results of a pre-study conducted at the beginning of this year, we have restructured the given text-sample and prompts for a fifth course that is currently taking place at the University of Bochum.

In the first half of the term students read the texts and analyzed them didactically triggered by the task of writing prompted learning journals (Nückles et al., 2009). They were prompted first to summarize and evaluate the author's main idea(s), second to reflect these insights with respect to the course's aim to design a learning enhancing task and third to reflect about their own learning process. In the second half of the term, after they had been introduced to the constructional theory of problem solving tasks according to Blömeke and colleagues (2006), they constructed learning enhancing tasks for pupils. The Cognitive Activating Task theory (CAT model) Blömeke and colleagues developed within the discipline of mathematic didactics was adapted for the field of teaching history (Brauch, 2011). In teams of two, the students had to design two cohesive pages for a history textbook and reason about the choices they made concerning the text sample and the tasks.

At present four trained raters independently analyze the learning journals of the four courses according to a) level specific items and b) personal differences in students' reflecting competencies in terms of domain specific reasoning. In addition we are developing a set of quality criteria for determining the probability that the students' learning enhancing tasks engage pupils in domain specific reasoning (see Van Boxtel & Van Drie, 2008).

First Results and Discussion

First results from our rating of the learning journals indicate that it is a difficult task for future history teachers to integrate the knowledge they have gained in their university courses on the different disciplinary concepts (ck, pk, pck) when it comes to reflect how to engage pupils in historical reasoning. Thus, we have further to reflect about an appropriate course structure by which we can help students to develop domain specific reasoning.

When it comes to analyzing the quality of the learning enhancing tasks students constructed in the courses, we can observe that even for teams of students with a good level of domain specific reasoning it is hard to translate this theoretical knowledge into designing a learning enhancing task. Here we have to think of supportive strategies by which the students learn how to bridge this observed gap between theory and practice. Experiments being conducted in the next weeks will hopefully give us more insight on how to overcome this problem.

Project data

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Time frame

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References

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SOSCIE – Future Social Sciences Teachers' Competencies Modeling and Measuring Domain Specific Reasoning as a Professional Competence of Future History Teachers

Nicola Brauch (Universities of Freiburg & Bochum, History Department)
Matthias Nückles, Sarah Kury, Franziska Pusch
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Purpose of the Study

Future history teachers are challenged with the complex task to integrate content knowledge (ck), pedagogical knowledge (pk) and pedagogical content knowledge (pck) to engage pupils in historical reasoning. Meeting this challenge, they have to develop domain specific reasoning as they have to make appropriate choices of topics, texts and methods.

Research Questions

- How can we describe the concept of "domain specific reasoning" as students' achievement of integrating the disciplinary concepts of ck, pk and pck?
- How can we identify and define distinct levels of this competence by analyzing the learning journals and learning assignments the students produced in the course(s)?
- How can we help students to achieve better in integrating the disciplinary concepts of ck, pk and pck?

Study Design

Data Collection (in progress)

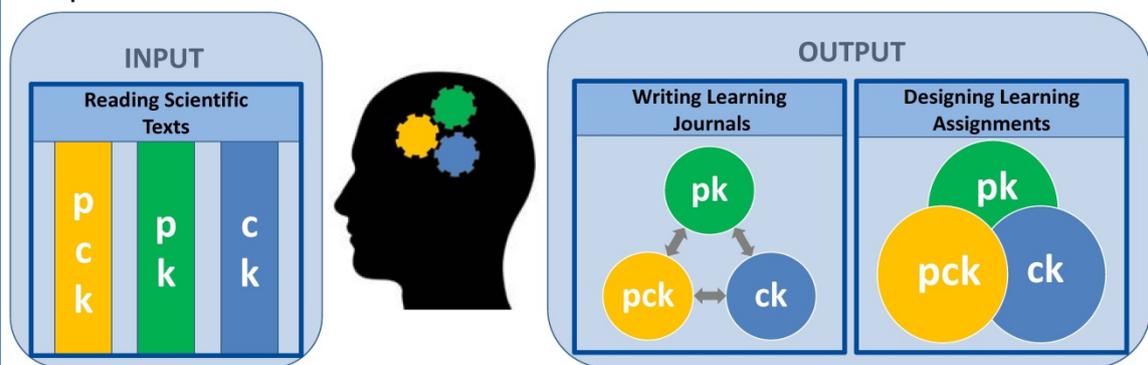
In a course on "How to teach about the Holocaust", students of five subsequent terms had the task to integrate the disciplinary concepts of ck, pk and pck by

- writing prompted learning journals (Nückles et al., 2009)
- designing learning assignments for a history textbook (cf. the CAT model of Blömeke et al., 2006; adaptation to history by Brauch, 2011)

Data Analysis (in progress)

At present, four trained raters independently analyze the learning journals according to a) level specific items and b) personal differences in students' reflecting competencies in terms of domain specific reasoning.

Concept of the Course



First Results and Discussion

- By analyzing the first learning journals: Students often fail in integrating the different disciplinary concepts (ck, pk, pck) → *What course structure helps students best to develop domain specific reasoning?*
- By analyzing the first learning assignments: Even students with a good level of domain specific reasoning often fail in translating their theoretical knowledge into designing concrete learning enhancing tasks for pupils → *Which supportive strategies help students to perform better in designing learning assignments?*

References

Blömeke, S. (2006). Future teacher's competence to plan a lesson: first results of a six-country study on the efficiency of teacher education. In: *ZDM Mathematics Education*, 40, 749-762.
Brauch, N. (2011). Fostering Competencies of Historical Reasoning Based on Cognitive Activating Tasks in Schoolbooks? Considerations Towards a Conceptual Change from Text to Task Books in History Learning Environments. In: Matthes, E. & Schütze, S. (Hrsg): *Aufgaben im Schulbuch*. Bad Heilbrunn: Klinkhardt, S. 237-253.
Nückles, W., Hübner, S. & Renkl, A. (2009). Enhancing self-regulated learning by writing learning protocols, in: *Learning and Instruction*, 19 (3), 259-271.

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M³K – Modeling and Measuring Pedagogical Media Competencies of Pre-Service Teachers

Herzig, B., Schaper, N., Breiter, A., Hartig, J., Grafe, S., Martin, A.,
Christoph, G., Ossenschmidt, D., Brüggemann, M., Langen, T.

Research on pedagogical media competencies of teachers has shown that teachers' own media literacy and their related pedagogical knowledge and skills of teaching with and about media are equally important for successful student learning. Both can lead to students' successful subject and cross-curricular competence development as well as to their ability to participate in a mediatized culture.

Against this background, the M³K project aimed at first the development and second the validation of a structural model of these competencies in the following three main areas:

- a) Teaching with media: Using media and educational technologies for teaching and learning.
- b) Teaching about media: Media education, related to critical reflection of media, commercialism, consumerism, and its political and social implications.
- c) School development: Technology planning within school development plans as an underlying competence to embed media in the overall improvement of schools.

Within the three competence areas, several competence levels were developed based on critical incident interviews with subject matter experts. Furthermore, additional predictors such as pedagogical knowledge, teachers' values and beliefs, and the media use of teachers were developed. Based on these empirical findings and the structural models, items were developed and tested in a three-step process: Beginning with internal and expert reviews, the items were secondly used in pretests, followed by a refinement with expert ratings for the competence levels before the actual use in the field.

Within the framework of these theoretical assumptions, the project focused on the confirmation of the competence model by developing a standardized test and collecting data from students in teacher education programs at different universities, in different subjects and qualifying for both primary and secondary schools). Based on the test data, the hypothesized three-dimensional structure was tested using multidimensional item response theory (IRT) models. The item difficulties from the IRT scaling were used to validate the expert ratings regarding the competence levels. This is correlated with the additional predictors pedagogical knowledge, teachers' values and beliefs, and media use of teachers.

As a result, the project will deliver the first comprehensive approach of measuring pedagogical media competencies of pre-service teachers. Starting with future teachers in teacher education programs will help to extend the model to in-service teachers. Additionally, standards might be derived to support media literacy programs in schools to improve teaching and learning.

Project data

Project management

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Time frame

06/2012 – 05/2015

M³K – Modeling and measuring pedagogical media competencies of pre-service teachers

Concept

Teachers' own media literacy and their related pedagogical knowledge and skills of teaching with and about media are equally important for successful student learning.



Pedagogical media competencies

Teaching with media: Using media and educational technologies for teaching and learning.

Teaching about media: Media education, related to critical reflection of media, commercialism, consumerism and its political and social implications.

School development: Technology planning within school development plans as an underlying competence to embed media in the overall improvement of schools.

Aim of the project

The project will deliver the first comprehensive approach of measuring pedagogical media competencies of pre-service teachers.

Methodology

Structural competence model



Leveling competence model



Test development



Data collection



Validation of the leveling competence model



Validation of test and model

Period of time: 06/2012 – 05/2015

Project participants:



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DaZKom – Professional Competencies of Pre-Service Teachers for Secondary Education in the Field of German as a Second Language

Koch-Priewe, B., Köker, A., Ohm, U., Ehmke, T., Carlson, S.,
Gültekin-Karakoç, N., Hammer, S., Rosenbrock, S.

Aims and research questions

The research study “DaZKom” is an interdisciplinary and inter-university project, funded by the German Federal Ministry of Education and Research (BMBF) program “Modeling and Measuring Competencies in Higher Education” (KoKoHs). The objective of the project “DaZKom” is to theoretically model and empirically validate teacher competencies in the field of German as a Second Language (*Deutsch als Zweitsprache – DaZ*).

Researchers from related disciplines have long been calling for a “pervasive and systematic language facilitation as an obligation for the educational institutions¹” (Riemer, 2009, 32). In several German federal states, reforms in the teacher education acts (cf. Ministry for Education and Further Education in the Federal State of North-Rhine Westphalia: LABG NRW dated from 12.05.2009²; Recommendations by the Commission of Experts for Teacher Education in Berlin in September 2012³) stipulate that pre-service teachers of all subject areas acquire competencies in German as a Second Language in addition to their disciplinary expertise. This is for the purpose of developing the ability to adequately offer language facilitation within the mainstream subject classroom particularly for students with German as a Second Language. However, empirical research work on the corresponding necessary professional competencies of teachers is yet to be presented, resulting in a lack of empirically based evidence for the elaboration of learning opportunities within academic teacher education.

The aim of the research study DaZKom is to develop a competence model which defines pre-service teachers’ DaZ-Competencies relevant for subject teaching, and a test instrument which is appropriate for measuring these competencies. For this purpose, the subject of mathematics serves as an exemplary frame of reference. The instrument is intended to give empirically based insights on how learning opportunities in academic teacher education must be designed for enabling the acquisition of substantiated and standardized DaZ-Competencies.

The central research questions are: Which competencies must mathematics teachers possess in order to be able to effectively support their students from non-German language backgrounds within their subject area? How can different levels of these competencies be described or measured?

Theoretical Framework

The knowledge-based and psychological perspective lays out the theoretical foundation for the research on professional competencies of teachers (Shulman, 1985; Bromme, 1992). The model for professional competency, which is considered the most elaborated in this context, is based on Krauss et al. (2004) and the project COACTIV (Brunner et al., 2006), and was extended in the international study on the preparation of teachers of mathematics (TEDS M, cf. Blömeke et al., 2008; König et al., 2010). In current studies, this approach has been further extended to examine pre-service teachers of the subjects English and German (TEDS-LT; Blömeke et al., 2011). Competencies in

¹ Translation by the drafter

² Ministerium für Schule und Weiterbildung des Landes Nordrhein Westfalen: LABG NRW vom 12.05.2009

³ Empfehlungen der Expertenkommission Ausbildung von Lehrkräften in Berlin vom September 2012

the field of German as a Second Language have not been considered so far. This research gap is to be filled by the study DaZKom.

Several key knowledge domains can be considered undisputable for DaZ-Competencies of teachers. Thus, for the field of second language acquisition (SLA) knowledge of the Interlanguage Hypothesis (Selinker, 1972; Selinker, 1992; Edmondson & House, 2006) is regarded as fundamental (Grießhaber, 2008). Besides knowledge of the stages of SLA, knowledge of the factors which influence SLA (so-called learner variables) belongs to the key knowledge-based competencies for teachers (Kniffka & Siebert-Ott, 2009). Essential for the knowledge of the demands of academic language in subject teaching (cf. Vollmer & Thürmann, 2009) is the distinction between conceptual orality and conceptual literacy (*konzeptuelle Mündlichkeit/konzeptuelle Schriftlichkeit*, Koch & Oesterreicher, 1986; Günther, 1997), as well as between BICS (Basic Interpersonal Language Skills) and CALP (Cognitive Academic Language Proficiency) (Cummins, 1979; Cummins, 2000).

The skills of teachers of all subject areas refer to attributes of “language sensitive” subject teaching (Leisen, 2010). Accordingly, teachers must have the ability to systematically scaffold students’ language proficiency integrated with content-area learning (Gibbons, 2002; Gibbons, 2006; Ohm et al., 2007; Ohm, 2010; Schleppegrell, 2007; Schleppegrell, 2008; Schmölzer-Eibinger, 2008). This requires, for example, the ability to evaluate subject area curricula and teaching materials with regard to their linguistic demands, subsequently incorporating these aspects into their lesson planning (Huneke & Steinig, 2000; Kniffka & Siebert-Ott, 2009; Rösch & Paetsch, 2011).

Teachers’ beliefs are defined as subjective perceptions, evaluative or normative expectations, or descriptive analyses evolving from experience (Blömeke & Oser, 2012; Pajares, 1992). These beliefs refer to second language acquisition in general, to the relevance of language in subject teaching, to the impact of language on content-based learning as well as to the (im)possibility of integrating language learning and language facilitation in subject teaching. Following the international study on the preparation of mathematics teachers MT21, the project DaZKom differentiates four categories of beliefs: epistemological beliefs, beliefs about teaching and learning, beliefs about school and the teaching profession, as well as self-related beliefs (Blömeke, Kaiser, & Lehmann, 2008). These are then further divided into subcategories.

Study design (sampling, instruments, data analysis methods)

As German as a Second Language is not a teaching subject in German schools, but moreover a requirement for teachers of all subject areas, there is an absence of standards – which already exist for instance for the subject areas mathematics or English – for the professional knowledge, skills and beliefs of pre-service teachers. The first step therefore comprises the conception of a model for DaZ-Competencies which are relevant for subject teaching. This includes (1) generating a framework for DaZ-Competencies through the analysis of 51 curricula and the subsequent validation by seven experts. During the second phase, (2) stimulus material and items are developed. Their (3) validity and reliability are ensured through cognitive labs (with a minimum of 30 persons), pretests (with a minimum of 150 pre-service teachers) and through interviewing seven experts. The succeeding (4) standardization ensues on the basis of representative sampling, so that in the last step (5) competence stages and minimum, regulation and optimal standards can be defined.

Project data

Project management	Koch-Priewe, Barbara Prof. Dr., Bielefeld University, Faculty of Educational Science, AG 4 School Development and School Research
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Time frame	01/05/2012-30/04/2015

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Modeling and Measuring Competencies in Higher Education: Competence in German as a Second Language (*Deutsch als Zweitsprache*)

BMBF-Project DaZKom "Professional Competencies of Pre-Service Teachers (secondary education) in the field of German as a Second Language (DaZ)"

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Aim of the Project

The focus of the interdisciplinary project DaZKom lies on the theoretical modeling and empirical validation of competencies in the field of German as a Second Language (DaZ). Prospective teachers of mathematics need these competencies in addition to their disciplinary expertise, in order to adequately facilitate students' language development in the mainstream classroom within the subject areas, especially for those students whose first language is another than German. Building upon the preliminary studies on the professionalization of teachers (Blömeke et al. 2008; Kunter et al. 2011), the project aims to develop a test instrument for the assessment of pre-service (mathematics) teachers' DaZ-Competencies which are relevant for the subject area (mathematics). This instrument is to give empirically based insight on how learning opportunities in academic teacher training must be designed for enabling the acquisition of substantiated and standardized DaZ-Competencies.

DaZ-Competence

(Working) definition of DaZ-Competence:

DaZ-Competence (in education) describes the skill of a teacher to know **linguistic** as well as **cultural** particularities of the German language. On the basis of **theoretical knowledge of second language acquisition**, the teachers must have the ability to **didactically and methodically adapt and utilize** subject relevant material for the **facilitation** of students with German as a Second Language. Furthermore, they are aware of **their task as a language facilitator in the subject areas** and do not allow their actions to be influenced by prejudices.

Framework for DaZ-Competence und item construction

1. Exemplary unit: word problem

Peter wants to buy sweets at the school kiosk during break. He buys 10 pieces of candy for 20 cents each. His friend Max cannot resist and also buys 5 treats for 50 cents each.

(Source: Bezirksregierung Münster (2008): Sprachförderung als Aufgabe aller Fächer – Mathematik – Gesamtschulen- nur für den internen Gebrauch, p. 13)

1.1 The usage of which terms could create confusion for second language learners?

1.2 Which connections between the first and second sentence do learners need to make? Two answers are correct.

	yes	no
Connection between sweets and each.	<input type="radio"/>	<input type="radio"/>
Connection between Peter and he.	<input type="radio"/>	<input type="radio"/>
Connection between sweets and pieces of candy.	<input type="radio"/>	<input type="radio"/>
Connection between break and pieces of candy.	<input type="radio"/>	<input type="radio"/>

1.3 How could you modify the word problem in order to present a more precise problem? Name one possibility.

Linguistics

- Morphology
- Syntax
- Semantics
- Pragmatics
- ...

Didactics/ Teaching methods

- Vocabulary instruction
- Didactic preparation of teaching materials
- ...

Dimensions of Multilingualism

- Second language acquisition
- Migration and Multilingualism
- ...

2. Exemplary unit: classroom situation

Today's lesson is on area calculation. A math problem depicts the task of installing impact sound insulation. While the students are solving the problem, the following situation occurs:

Enok: I don't get it.
Teacher: OK, so you've got a hint here, right?
Enok: Which...but look what it says. The door has a clearance width of ...
Teacher: Yes, why don't you make a sketch of the room.
Enok: But that's what I don't know.
Teacher: But it says so right here.
Enok: But it says something about the door...
Teacher: Yes, but there's a door in there and it has to be installed. Now solve the problem!

2.1 What could be Enok's linguistic problem in this situation?

2.2 Enok doesn't receive an adequate response from the teacher. What could an alternative feedback look like? Give two possibilities.

3. Exemplary unit: case study

You have been observing two of your students in 7th grade and have made these findings: Kamilla is from Poland and has been in Germany for nine months. Even though she has been receiving special tuition in German as a Second Language twice a week, she still produces utterances such as "Yesterday I not do homework", but writes answers to word problems such as "Mr. Smith will receive 530€ interest after 3 years". Her fellow student Ivan, who grew up in Germany with an Ukrainian immigrant background, seems to speak German fluently. However he writes answers such as "The interest rate is that a customer gets ar 5,7%".

3.1 Which factors could cause the variation between Kamilla's oral speech and her written answers? Please tick the appropriate boxes.

	yes	no
The variation is caused by her not being conscious of having to conjugate 'do'.	<input type="radio"/>	<input type="radio"/>
The variation is caused by increased planning time during writing tasks.	<input type="radio"/>	<input type="radio"/>
The variation is caused by her being able to transfer the phrasing from the word problem into her answer.	<input type="radio"/>	<input type="radio"/>
The variation is caused by her visual learning style, through which she is able to memorize written sentences more easily.	<input type="radio"/>	<input type="radio"/>
The variation is caused by her not having integrated the grammatical forms into her learner language yet.	<input type="radio"/>	<input type="radio"/>

3.2 Why does Ivan – in contrast to Kamilla – not have difficulties in oral speech, but in his written work? Give two reasons.

3.3 What would you do to scaffold both students' language proficiency in your subject teaching? Please make two suggestions.

Further Procedure



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BilWiss-Beruf – The Relevance of Theoretical Broad Pedagogical Knowledge for Young Teachers' Transition to Practice

Kunina-Habenicht, O., Kunter, M., Leutner, D., Seidel, T., Terhart, E.

Objectives

The project BilWiss-Beruf examines the relevance of theoretical broad pedagogical knowledge for the successful transition of newly qualified teachers into work life. We assume that broad pedagogical knowledge, as a part of teachers' professional competence (Baumert & Kunter, 2013), provides a necessary conceptual framework that enables teachers to properly interpret and reflect on instructional and classroom events and thus informs their professional development.

Theoretical background

Discussions about the quality of academic teacher education often concern its practical relevance and the arbitrariness of its contents (Veenman, 1984). To improve the quality of teacher education in Germany the Standing Conference of the Ministers of Education and Cultural Affairs of the German federal states has adopted standards for teacher education (KMK, 2004). These standards include guidelines which contents should be addressed during teacher education and define requirements regarding the four domains instruction, education, assessment, and innovation. Unfortunately, these standards confound individual qualifications and professional behavior.

Several approaches modeling teachers' professional development throughout their career have been proposed in the literature. This project refers to the model of professional teacher competence, its determinants and outcomes proposed by Kunter, Kleickmann, Klusmann, and Richter (2013). This model, in particular, addresses the impact of learning opportunities in teacher education programs (e.g. formal courses, discussions with peers or own-held lessons) as well as individual differences in their usage for the development of professional competence comprising professional knowledge, motivation, beliefs, and self-regulation (Baumert & Kunter, 2013). These aspects of professional competence are assumed to influence teachers' behavior in education-related settings.

Professional knowledge as a central aspect of professional competence has been widely examined. More specifically, Shulman (1986) distinguishes between content knowledge, pedagogical content knowledge, and pedagogical knowledge. For subject-specific knowledge several researchers have put forward taxonomies of content and pedagogical content knowledge showing their practical relevance in teaching situations (Baumert et al., 2010; Hill, Rowan, & Loewenberg Ball, 2005). However, comparable results have not yet been obtained for non-subject specific parts of teacher knowledge. Current approaches tapping general pedagogical knowledge cover only selected aspects of relevant theoretical educational foundations (König & Blömeke, 2010; Seifert, Hilligus, & Schaper, 2009; Voss, Kunter, & Baumert, 2011).

First results indicate the usefulness of non-subject specific knowledge for the professional behavior of teachers (Voss et al., 2009) and on student outcomes (Pfanzi, Thomas, & Matischek-Jauk, in press). This body of research, however, has to be expanded. We therefore conduct a longitudinal study with teacher candidates to assess the construction of knowledge during the induction phase, the influence of individual and institutional variables on this construction process, and finally the relation to teachers' professional behavior.

Research questions

This project will address two research questions:

- 1) How does theoretical broad pedagogical knowledge contribute to young teachers' transition to practice?
- 2) Which formal learning opportunities facilitate young teachers' transition to practice?

Research methods

This research is based on a knowledge test that was developed in the first funding period of that project from 2009 to 2012 (Terhart et al., 2012). This knowledge test covers broad pedagogical topics from educational science, educational psychology, educational law, and the sociology of education (Kunina-Habenicht et al., 2012). The long version of the test consists out of approx. 290 items, whereas a short version includes 56 items. In spring 2011 the long version of the test was applied in a sample of 3300 teacher candidates at the beginning of their induction phase in a selected German federal state North Rhine-Westphalia (first results can be found in Kunina-Habenicht et al., 2013).

Approximately 400 of these teacher candidates will be reassessed in three follow-up studies: (1) after the first year in the teacher induction program, (2) at the end of the teacher induction program, and (3) approximately 1.5 years after entering the profession. At the third time of assessment besides the theoretical broad pedagogical knowledge – measured via the previously described knowledge test – further aspects of professional competence motivation, beliefs, self-regulation will be assessed via self-reports.

For the assessment of the professional behaviour in education-related settings, multiple criteria will be used. Apart from self-report measures, we will rely on student ratings and standardized video- and computer-based tests assessing professional vision and diagnostic abilities. The self-report measures were developed following the standards of the KMK and comprise instruction, education, assessment, and innovation. Moreover, students will evaluate teachers' professional competence, assessing their instructional quality (such as cognitive activation, classroom management, individual learning support) as well as teachers' education, assessment, and innovation skills. In order to capture different aspects of professional behavior, computer-based methods are additionally applied. While teachers' perceptions of learning environments (noticing, knowledge-based reasoning) will be assessed via the "Observer" (Seidel, Blomberg, & Stürmer, 2010), teachers' diagnostic competence will be measured via the "Schülerinventar" method.

Individual differences in teachers' competence may be partly explained by varying learning opportunities during the teacher induction phase. Therefore, duration, quantity, and perceived quality of the courses at the teacher education institute (*Studienseminar*) and additional elements implemented in the induction phase (e.g. coaching, peer learning groups) will be considered in the longitudinal study. To be more precise, the impact of these different aspects in the induction phase on teachers' professional development is investigated by a comparison of two cohorts of teacher candidates within the recent reform of teacher induction phase in North Rhine-Westphalia.

These findings can inform about the long-term outcomes of the first, university-based, phase of teacher education and may allow conclusions regarding the optimization of curricula in academic teacher education programs in Germany.

Project data

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Time frame	10/2012 – 09/2015

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BilWiss-Beruf: The Relevance of Theoretical Broad Pedagogical Knowledge for Young Teachers' Transition to Practice

Theoretical Background and Modeling Approach

Standards of teacher education

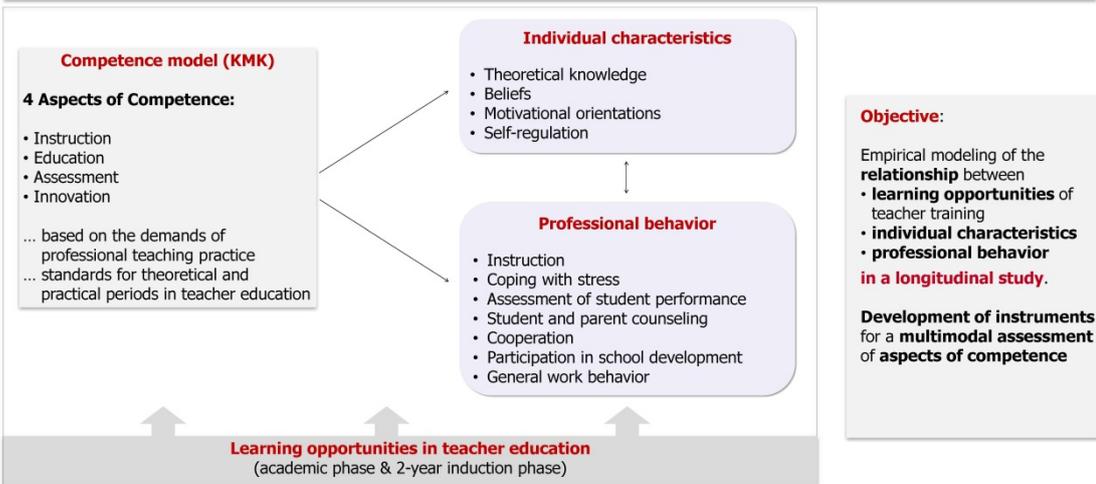
- Constituted by the Conference of the Ministers for Education and Cultural Affairs of German federal states (KMK, 2004)
- To date only few studies on operationalization or modeling of professional competence

Criticism on KMK standards:

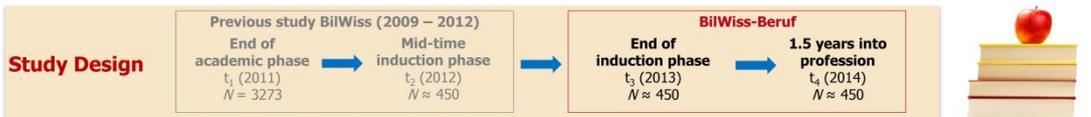
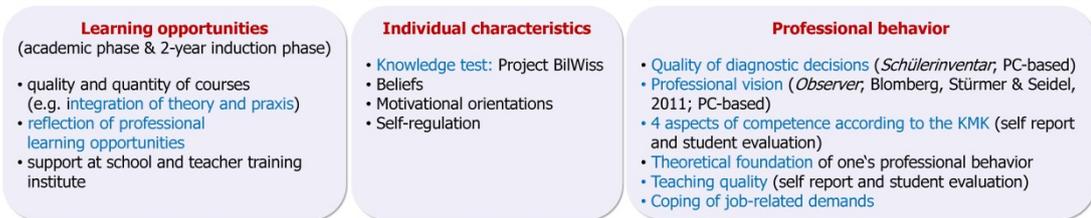
- **Individual characteristics**
- **Professional behavior** are confounded

Modeling the development of professional competence

- Development of competence is an active process (Cochran-Smith & Zeichner, 2005; Timperley, Wilson, Barrar & Fung, 2007)
- Considering the institutional **learning opportunities** and their **active usage** as instruments for professional development (Blömeke, Kaiser & Lehmann, 2008; König & Siefert, 2012; Kunter, 2011)



Modeling of Relevant Domains (procedures to be developed or to be revised are printed in blue)



Implications & Objectives

- **Development** of innovative, partly computer-based, instruments for the assessment of professional competence
- Understanding the **relevance** of academic broad pedagogical knowledge for a successful development of professional competence (considering the complex relationships between learning opportunities and their individual usage)
- Guidelines for future improvements of academic **teacher training programs**

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KomPaed – Task-Related Competencies in Fields of Educational Activities

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Objectives and theoretical framework

Generally, higher education focuses on scientific, research-oriented education. However, it is also the universities' responsibility to teach students skills that are required in occupational fields beyond research and which help to promote the employability of their graduates. This can be achieved in particular by strategic acquirement of interdisciplinary generic competencies (Weinert, 2001a; 2001b). This project focuses on generic competencies which are essential for the professional activities of university graduates and the identification of these fields of competencies. The study's sample covers university graduates of educational science studies.

Research shows that apart from genuine educational activities such as educating, mentoring, and attending, the job activities of educational scientists primarily include organizing, planning, and coordinating (Fuchs, 2003). Fuchs systematizes educational, interdisciplinary, and non-educational activities as job activities of educational scientists. In addition, she distinguishes educational from non-educational fields of work as well as educational from non-educational activities, leading to a systematization of four occupational fields. The activities which are related to these four fields will be analyzed by an instrument based on the *Job Requirements Approach* (JRA) which is the background of a number of international surveys on job activities such as the PIAAC Questionnaire (OECD, 2009). The JRA allows to measure indirectly generic competencies required in professional practices.

Research questions

- Can interdisciplinary generic job activities be identified for academic professions? (“occupational field survey”)
- Derived from these generic job activities, can interdisciplinary competence models as well as instruments for their measurement be developed? (“graduates survey”)

Study design and methodology

Our research questions will be examined with two scopes: First, in the “Occupational Field Survey” (University of Hamburg) potential employers of educational science graduates will be interviewed about the duties and tasks their employees are engaged in. The methodological approach will primarily consist of a content analysis to identify fields of competencies. As a follow-up, heterogeneous types of job requirements for educational science graduates will be generated in dependence of the Grounded Theory.

Second, the “Graduates Survey” (HIS Institute for Research on Higher Education) analyzes fields of activity, job requirements, and self-rated competencies of highly skilled personnel, using data from the *HIS Graduate Panels 2001, 2005, and 2009* (focusing on university graduates of educational science studies). Additionally, a survey instrument for the acquisition and analysis of job characteristics, generic job activities and requirements will be developed. This instrument will be based on the *Job Requirements Approach* (JRA) and will be implemented in the online survey with approximately 17250 graduates from the *HIS Graduate Panels* (thereof approximately 2800 graduates of educational science studies).

Both, the occupational field and the graduates survey are closely linked. The quantitative results from the graduates survey will be used for the selection of the qualitative sample (methodological link for the sample selection). Likewise, the survey instrument development will be based on existing instruments as well as on results of the qualitative occupational field survey. Furthermore, the

typology from the first survey will be combined with the cluster analysis results from the second. Moreover, both approaches have a common theoretical framework. Linking the qualitative and quantitative scope closely allows strong synergies between the two partners which is particularly important taking into account the complexity of the research object.

Perspectives

In the context of *KomPaed*, an instrument for the analysis of job requirements will be developed, validated, and will be made freely accessible for the scientific community. Moreover, important competence domains, based on the graduates survey of job requirements, will be identified for a variety of occupational fields. Subsequently suitable testing instruments should be developed.

Finally, basic knowledge about the structure of the fields of educational activities will be generated by the occupational field survey, which is essential for additional processes of professionalization in this area.

Project data

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Time frame

01/07/2012 – 30/06/2015

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– KomPaed –
Task-related competences in fields of educational activities

**Edith Braun, Knut Schwippert, Doren Prinz, Hilde Schaeper,
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Objectives

- Identification of fields of activity of highly skilled personnel
- Identification and typification of generic job activities and requirements
- Development and validation of a German-speaking, internationally compatible survey instrument for the analysis of generic job activities and requirements
- Focusing on university graduates of educational science studies

Research Questions

- Can interdisciplinary generic job activities be identified for academic professions?
- Derived from these generic job activities, can interdisciplinary competence models as well as instruments for their measurement be developed?

Work Packages

Occupational Field Survey (University of Hamburg)

- Theoretical and empirical selection of relevant fields of activity of university graduates of educational science studies
- Questioning of relevant employers of university graduates of educational science studies about current and future job tasks and requirements
- 16 exploratory semi-structured interviews with responsible persons of relevant social institutions:

	Educational Activity	Non-Educational Activity
Educational Field Of Work	6	4
Non-Educational Field Of Work	4	4

Graduates Survey (HIS-Institute for Research on Higher Education)

- Secondary analysis of graduates' fields of activity, job requirements, and self-rated competences, using data from the *HIS Graduate Panels 2001, 2005, and 2009* (focusing on university graduates of educational science studies)
- Development of a survey instrument, based on the *Job Requirements Approach (JRA)*, for the acquisition and analysis of job characteristics, generic job activities and requirements
- Conduction of an online survey with approximately 17250 graduates from the *HIS Graduate Panels* (thereof approximately 2800 graduates of educational science studies)
- Analysis of generic job activities and requirements as well as derived competences at different stages of the professional biography

Milestones

Work Step	2012				2013				2014				2015							
	7	8	9	10	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
Work Package 1: Professional Field Survey																				
Sample selection and contacting																				
Interviews																				
Interview transcriptions																				
Content analyses																				
Quantitative analyses (balance) and publication																				
Qualitative content analysis for typification																				
Publication of findings																				
Work Package 2: Graduates Survey																				
Secondary analyses for sample selection in WP 1																				
Literature research																				
Development of survey instrument																				
Secondary analyses for interview evaluation in WP																				
Contacting and address actualization																				
Survey programming and expert pretest																				
Field period																				
Coding, data edition and data set compilation																				
Methodology report and documentation																				
Data analysis																				
Publication of findings																				

Synergies

Methodology

- Methodological link for the sample selection
- Integrated development of the survey instrument
- Combination of qualitative typologies (University of Hamburg) and cluster analysis results (HIS-Institute for Research on Higher Education)
- Reciprocal validation of instruments and results

Content

- Shared theoretical framework
- Interpretation of qualitative typologies (University of Hamburg) against the background of quantitative analyses (HIS-Institute for Research on Higher Education)
- Shared coverage of a complex research object



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Cluster 4: Generic Skills of Higher Education Students

KOSWO

Students' Competencies when Dealing with Scientific Primary Literature

AkaTex

Academic Text Competencies of First-Year and Advanced Teacher Education Students with Particular Reference to their Pre-Conditions

KOMPARE

Competent Argumentation with Evidences: Measurement and Modeling in Educational Sciences and Transfer from Medical Studies

LeScEd

Learning the Science of Education Research Competence in Educational Sciences

PRO-SRL

Product- and Process oriented Modeling and Assessment of Self-Regulation Competencies in Tertiary Education

SEKO

Teachers' Self-Regulation as a Generic Aspect of Professional Competence: Development and Change in Teacher Education as well as Predictive Validity

KOSWO – Students' Competencies when Dealing with Scientific Primary Literature

Schmid, S., Richter, T., Berthold, K., Bruns, K., von der Mühlen, S.

Theoretical Background

Students entering tertiary education must adjust to the new learning environment, including advancing from a reliance on secondary literature (e.g., text-books), to the use of primary literature (e.g., peer-reviewed articles). The scientific primary literature genre differs to that of other genres in various structural, semantic, and syntactic aspects, while having different goals, conventions, and audiences, and being built on different epistemic premises (Swales, 1990). Thus, to deal with primary literature within their studies effectively, students not only need domain knowledge of their subject, but also require sufficient knowledge of the scientific literature genre, and need to be armed with a range of competencies in order to process the literature effectively. Generally, such competencies are not formally taught to students.

We view the competency to deal with scientific primary literature as a generic competency that is important when handling texts from different domains; it is scientific literacy in its fundamental sense (cf. Norris & Phillips, 2003). In line with the theory that text processing is both strategic and goal-driven (van Dijk & Kintsch, 1983), we propose that highly competent readers have command over a wide range of processing strategies that they are able to choose from appropriately and successfully implement, in order to serve the reader's specific goal.

As a primary distinction of possible sub-competencies that may be of importance when dealing with scientific texts we distinguish between two types of processing goals (receptive and epistemic) and processing strategies (heuristic and systematic). The differentiation between receptive and epistemic processing goals targets whether a reader aims to process a text in terms of simple knowledge accumulation, for instance, learning the content of a text to remember it later, or in terms of knowledge validation, that is gleaning the most truthful and knowledgeable picture of the themes discussed in the text (Richter, 2003; Richter, Schroeder, & Wöhrmann, 2009). Distinguishing between heuristic and systematic processing strategies focuses on whether a reader chooses to process a text in more superficial way, using surface markers of the text, or whether they use a more structured deep processing of the text content (Petty & Wegener, 1999). In combining these processing goals and strategies a schema of four competency areas emerges (receptive-systematic, receptive-heuristic, epistemic-systematic and epistemic-heuristic) which, together with the scientific literature genre knowledge, serve as a framework in which to investigate students' competencies when dealing with primary scientific literature (see Table 1 in poster).

Receptive-systematic competencies enable readers to structure and enrich information effectively to understand it and remember it later. These include elaboration, organization, and metacognitive fix-up-strategies that are useful when comprehension difficulties occur when reading. These processes are important for the focussed processing of texts (cf. Berthold & Renkl, 2010) and build the cornerstone of educational psychological research on reading strategies (e.g., Wild & Schiefele, 1994).

Receptive-heuristic competencies are used to gain a quick preliminary overview of a text when strategically selecting a text or "skimming" a text for particular information. Such competencies are essential when encountering a text for the first time during a literature search, and are often used by scientists in such situations (Bazerman, 1985).

Epistemic-systematic competencies are used by readers to test a text's consistency, cogency, and relevancy of claim (Richter & Schmid, 2010). Such processes include firstly, the identification of

argumentative features in a text, such as claims and reasons (Toulmin, 1958; Britt & Larson, 2003) and secondly, the testing of such claims and reasoning for relevancy and validity (Larson, Britt, & Kurby, 2009). Thus, epistemic-systematic competencies are though imperative in order to form a rationally justified appraisal of scientific texts (Maier & Richter, 2013).

Epistemic-heuristic competencies are used to make a quick preliminary judgement of the plausibility of the content of a text and its credibility. These include, the ability to judge a text's plausibility through its reference information such as the publisher, journal, or association (Korpan, Bisanz, Bisanz, & Henderson, 1997; Zimmerman, Bisanz, Bizanz, Klein, & Klein, 2001). Such competencies are of utmost importance when systematic competencies cannot be used, for instance, in the case of a lack of domain specific knowledge, or when motivational and cognitive resources needed for an epistemic-systematic processing of the text are not available (Richter, Schroeder, & Wöhrmann, 2009; Schroeder, Richter, & Hoever, 2008).

Research Questions and Studies

The overarching goal of this project is to develop and empirically test an integrative competency model of the effective handling of scientific primary literature. To this end, we developed and adapted a range of items that capture the competency levels of psychology students in all four competency areas, as well as testing their knowledge of the scientific primary literature genre. We applied a combination of well-established, and newly developed computer software (Inquisit 3, SLED) for the test battery. This is currently being piloted on students at five large Universities in Germany, and will be implemented in an intensive study with an expert-novice comparison, a longitudinal study, and in a training experiment.

In a qualitative intensive study with an expert-novice comparison we will examine which declarative and procedural knowledge is linked to successful competency use. For instance, we postulate that a fully developed epistemic belief system is needed to deal successfully with the higher epistemic-systematic sub-competencies. Possible correlates to the sub-competencies will be tested using online-indicators (e.g., cognitive interviews and reaction times), and offline-indicators (e.g., short interviews and questionnaire items). To pinpoint any deficits in specific areas that students display, the intensive study will include an expert-novice comparison, where we will compare the processing goals and strategies of established scientists to those of first year students. In this way we hope to identify differences in the quality of the choice of strategy used for particular processing goals.

A longitudinal study will be used to investigate the development of each competency area and genre knowledge in students over time, and explore the relative contribution of each competency area in explaining students' academic success. Further research questions consider the relationships between sub-competencies within the same, and between different competency areas. The longitudinal study will have three data collection points (one every six months) and will include data from students in each of the six undergraduate semesters.

In a third study we will carry out a training experiment with a randomised two-group pre-post-test design, tailored to foster those specific sub-competencies that emerged as being problematic for students in the expert-novice comparison. When developing the training material we will refer to the results of the intensive study, paying special attention to the correlates that promote the effective choice of suitable processing strategies. This experimental study will support the data reaped in the previous studies by investigating the causality aspect of the correlates uncovered. It is hoped that the results gleaned from this training study will serve as a basis to a comprehensive intervention programme that will boost the competencies of students at a tertiary educational level in dealing effectively with scientific primary literature and thus, fostering their academic success.

Project data

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Time frame	01/03/2012 – 28/02/2015

Students' Competencies when Dealing with Primary Scientific Literature

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Aim

To develop and empirically test an integrative competency model for dealing with scientific primary literature

Introduction

- Challenge for university students → Dealing with scientific primary literature.
- Scientific primary literature vs. secondary literature: different structure, goals, and epistemic premises
- To handle primary literature proficiently → need range of sub-competencies (see Table 1)
- Sub-competencies → not generally formally taught
- Psychological reading strategy research → focus on receptive-systematic competencies
- Other competency areas neglected → research gap
- This project → attempts to fill research gap

Table 1 : Competency areas

Processing strategy	Processing goal	
	Receptive	Epistemic
Systematic	Receptive-systematic competencies - Organisation - Fix-up-strategies	Epistemic-systematic competencies - Identify argument - Test for consistency
Heuristic	Receptive-heuristic competencies - Skimming - Text selection	Epistemic-heuristic strategies. - Judge credibility by reference material

Overview of Project Studies

Intensive Study with Expert-Novice Comparison

Aims

- To investigate the declarative and procedural knowledge associated with sub-competencies
- To identify differences in the quality of the choice of strategy

Design

- Qualitative intensive study design
- Expert-novice comparison
- Online- and offline-indicators
- Novices $n=80$; Experts $n=40$

Longitudinal Study

Aims

- To investigate developmental trends
- To pinpoint relationships between sub-competencies

Design

- Longitudinal 3-wave design
- Data points every six months
- Computerised test battery (Inquisit 3 and SLED)
- $n=200$

Training Experiment

Aims

- To foster sub-competencies that are problematic to students
- To investigate causality between sub-competencies and correlates

Design

- Randomised two-group pre-post-test experimental design
- Experimental group
- Waiting control group
- $n = 100$

AkaTex – Academic Text Competencies of First-Year and Advanced Teacher Education Students with Particular Reference to their Pre-Conditions

Kaplan, I., Decker, L., Siebert-Ott, G., Schindler, K.

Theoretical framework, research objectives and research questions

Basic reforms in secondary and higher education (e.g. reduction of school years in secondary schools from 9 to 8 years; conversion of teacher education into Bachelor and Master) require a systematic research of academic text competencies, which focuses on the changing conditions. AkaTex, which is located at the University of Cologne and the University of Siegen, applies itself to the task of modeling and measuring these competencies.

First of all, it is necessary to clarify what kind of text competencies elementary (Bachelor) and advanced (Master) teacher education students need in order to master the demands, placed by university and school (as the field of work), successfully. In order to do justice to both institutions, we distinguish academic text competencies in both a narrower and broader sense: *Academic text competencies in a narrower sense* refer to the capability of receiving scientific texts, locating them in scientific discourse as well as developing an own position supported by reasonable arguments. These competencies will be measured indirectly by the text form “discourse presentation” (which serves as foundation stone for the text type “academic paper”). *Academic text competencies in a broader sense* refer to the capability of receiving texts of pupils scientifically and educational-didactically, evaluating, supportingly assessing and grading them. These competencies will be measured indirectly by the text type “teacher’s comment”.

The modeling of the academic text competencies is based on research of literature, analysis of curricula and interviews with members of the scientific and professional community (universities and schools). Both sub-projects will collect and analyze full texts (discourse presentations and teacher’s comments). The competence measurement works with a triangulation of different survey and evaluation methods: a survey of full texts which will be analyzed by using rating procedures, corpus linguistic studies and testing of competencies utilizing the Item-Response-Theory.

Study design

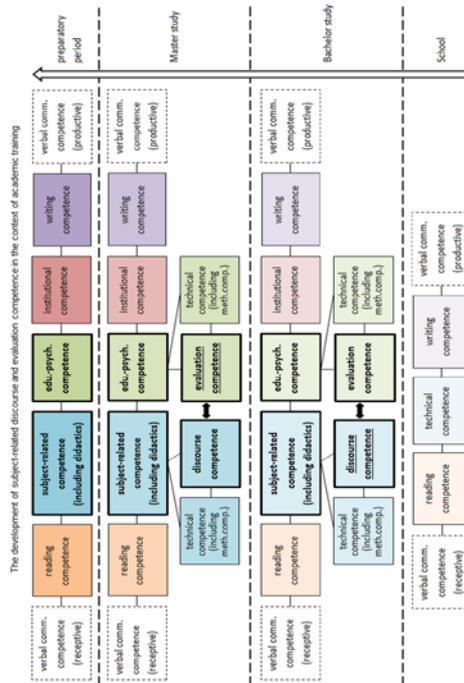
Academic text competencies in a narrower sense will be measured on the one hand by full texts. The data will be collected at different measuring times during the course of study: To find out the initial requirements of the students an exercise format for writing tasks was developed, which is geared towards the competence expectations of writing argumentative texts at the end of the senior high school. This writing task will be set at the beginning of the first study semester. Furthermore an exercise format for writing tasks was developed, which is geared towards the competence expectations for the first academic degree (BA). For this the text form discourse presentation (which serves as foundation stone for the text type bachelor thesis) was selected. These writing tasks combine two goals for academic writing: *writing to learn* with the aim of developing scientific and didactical competencies and *learning to write* with the aim of developing disciplinary and cross-disciplinary, generic writing competencies. Writing tasks of this type will be set to students at different time points during the course of the bachelor study. Afterwards the collected texts will be assessed by trained raters using a criteria catalogue. Furthermore the full texts will be analyzed by applying corpus linguistic methods using the program MaxQdA.

Academic text competencies in a broader sense will be measured by a formal test and analyzed by using the Item-Response-Theory. The test includes half-open and open items regarding a pupil’s text (result report of a pupil in the fourth school year), which has to be described, revised and assessed by

students focusing on various characteristics, such as text grammar, orthography, coherence and others. After the analysis the students evaluate the pupil's text by writing a teacher's comment. Therefore relevant competencies to assess pupil's texts, scientific and didactical competencies as well as educational-psychological competencies will be gathered. The teacher's comments as full texts, which will be collected in the sub-project, will be analyzed with the help of corpus linguistic methods. As in the sub-project "academic text competencies in a narrower sense" the program MaxQdA will be used.

Project data

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Time frame	01/04/2012 – 31/03/2015



University course of training (incl. occupational area)

University course of training (incl. occupational area)	Prevailing concepts of didactics of written words
Master (4 Semester) Studies in the discipline Practical semester	Writing in the disciplines- Writing to learn Teaching writing – assessing writing
Bachelor (6 Semester) Studies in the disciplines Internship in the occupational area Orientation internship	Writing in the disciplines- Writing to learn Internship in the occupational area Orientation internship
School	Writing across the disciplines Learning to write

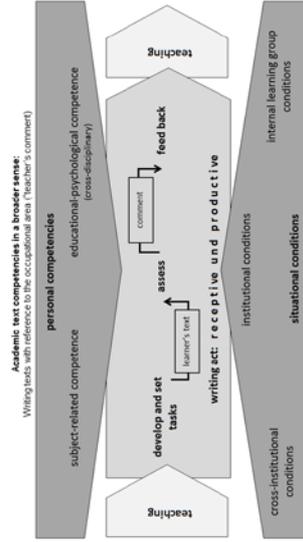
Modeling and Measurement of Academic Text Competencies

Research objectives

The project especially pursues two different goals:
 First of all it aims to develop a competency model, which represents academic text competencies of teacher trainees in a way that achievable standards and stages of development can be described, in particular the transition between school and university (academic text competencies in a narrower sense) will be taken into account as well as the transition between university and occupation (academic text competencies in a broader sense).
 The second goal of the project is to establish a set of tools with which academic text competencies can be located, i.e. identified on appropriate text products or text tasks and predicted in their development. Proceeding from the new modular courses of teaching study the project will integrate the results into teaching in the course of study.

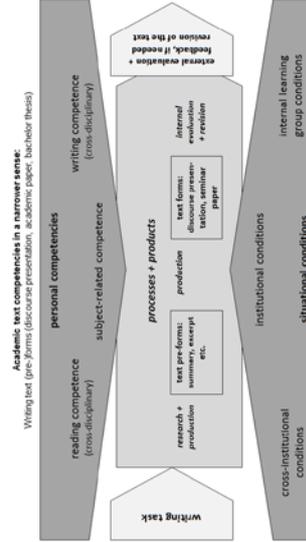
Methods

The modeling of the academic text competencies is based on research of literature, analysis of curricula and interviews with members of the scientific and professional community (universities and schools). Both sub-projects will collect and analyze full texts (discourse presentations and teacher's comments). The competence measurement works with a triangulation of different survey and evaluation methods: a survey of full texts which will be analyzed by using rating procedures (focus corpus discourse presentation), corpus linguistic studies (corpus discourse presentations as well as corpus teacher's comment) and testing of competence utilizing the Item-Response-Theory (with a focus on academic text competencies in a broader sense).



Academic text competencies in a broader sense
 Texts of children have to be scientifically and educational-didactically received, evaluated, supportingly assessed and graded. The competence will be measured indirectly by the text type "teacher's comment".

Academic text competencies in a narrower sense
 Scientific texts have to be received and productively located in a scientific discourse. Furthermore you have to develop an own position for it supported by reasonable arguments. The competence will be measured indirectly by the text form "discourse presentation" (which serves as foundation stone for the text type "bachelor thesis").



KOMPARE – Competent Argumentation with Evidences: Measurement and Modeling in Educational Sciences and Transfer from Medical Studies

Trempler, K.

Aims and research questions

The research project examines (sub-)competencies that refer to argumentation with scientific evidence in the context of medicine and education. The research project is divided into three main parts: The first study focuses on the development and validation of a competence model of argumentation as well as on the differences between groups of expertise. The second study deals with the competence development of evidence-based argumentation within a period of two years and in the third study cognitive conditions such as skills and knowledge and their relation to (sub-)competencies of scientific argumentation are analyzed. The central research questions are: (1) Which dimensions and levels of competence of evidence-based argumentation can empirically be verified, (2) which dimensions and levels of this competence can be identified between different groups of expertise, (3) how does the competence develop over a period of two years, and (4) in what way are cognitive prerequisites such as intelligence and scientific thinking related to the competence of evidence-based argumentation?

Theoretical Background

Evidence-based pedagogical practice has been a controversially discussed topic in educational sciences for some time. Evidence-based practice may relate to different levels of education such as the level of educational governance that is concerned in how empirical results of educational sciences can be made applicable. However, in order to improve the educational system, the KOMPARE-project aims at the individual level of evidence-based pedagogical practice, that is, on individual evidence-based decisions and practices of teachers. The application of empirical results in the context of pedagogical practice requires complex and specific competencies on the part of teachers. The research project KOMPARE focusses on the competencies of student teachers as well as active teachers that are necessary to use empirical evidence in pedagogical practice. One context in which evidence-based practice has been in use for a longer period of time is medicine, where evidence-based practice is defined as “(...) conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients” (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996, p. 71). Evidence-based practice includes searching and assessing relevant research findings and the application of information in professional decision making. Within the framework of medical education elaborate approaches to the utilization of scientific findings for the best possible education already exist (Best Evidence Medical Education, Harden, Grant, Buckley, & Hart, 1999). However, when comparing the contexts of medicine and education the question arises why empirical findings of educational research have little relevance for the educational practice (Gräsel & Parchmann, 2004), while medical research results have a high relevance for medical practice. Within educational science there are numerous discussions on the transfer of theoretical findings to practice (Fischer, Waibel, & Wecker, 2005; Stark, 2004; Stokes, 1997; The Design-Based Research Collective, 2003). One reason identified for the low relevance of empirical findings for educational practice is a lack of skills of the teachers for the identification and application of relevant research findings. The competence of evidence-based argumentation consists of sub-competencies that include the *Sourcing of Information*, *Evaluation of Scientific Evidence* as well as *Scientific Argumentation* (Harden & Lilley, 2000). The sub-competence *Sourcing Information* in turn includes cognitive abilities that relate to the identification of information needs, using information sources and extraction of relevant information to solve an information problem (Brand-Gruwel, Wopereis, & Walraven, 2009). The *Evaluation of Evidence* as second sub-competence builds a precondition for the identification of relevant empirical results that may be of practical use. The appraisal of empirical

results is already applied in medicine by means of so-called QUESTS-Ratings (Harden et al., 1999) and requires competencies related to scientific thinking. In order to evaluate evidence, the criteria *quality, utility, extend, target, strength* and *setting* are important indicators of internal and external validity (Harden et al., 1999). The third sub-competence *Scientific Argumentation* embraces competencies related to decision making on the basis of evidence as well as the justification of this decisions (Brown, Furtak, Timms, Nagashima, & Wilson, 2010).

Design of the study

The KOMPARE-project consists of several studies. Before starting the three main studies we conducted a pre-test in the form of an interview study with teachers (N=25) with different professional experience, from different school forms, and with different teaching subjects. The aim of the pre-test was to clarify which resources are important for teachers in order to make decisions that are related to their pedagogical practice.

The first main study focusses on the operationalization and validation of a competence-model of evidence-based argumentation on the basis of the aforementioned theoretically assumed (sub)-competencies. In order to achieve this aim we developed a case study scenario in which a problem is presented that refers to everyday school life. In order to solve that problem test persons have to make several pedagogical and didactical decisions, e.g. whether to use group or single work during instruction. Within this scenario participants first have to search for information to the problem via a simulated setting that is similar to conventional online search engines. More precisely, they have to type in several search items and keywords that may help finding the needed information. After this searching process the results are presented in two lists, first in the form of bibliographic information and then in a list that contains short abstracts of journal articles. Based on those lists the participants have to draw up a shortlist of possibly relevant empirical results that could be relevant to problem solving (based on the Information Problem Solving-Model, IPS, Brand-Gruwel et al., 2009).

After searching for information the test participants are presented scientific evidence in the form of structured abstracts, that is, one to two-paged summaries of original journal articles that have to be evaluated systematically by QUESTS-Ratings. Those ratings are based on already existing evaluation instruments of the medicine (Harden et al., 1999) and on validity criteria by Cronbach (1982) and Cook & Campbell (1979). For the QUESTS ratings ten items were operationalized that help participants to rate scientific evidence according to external and internal validity; that is, to decide whether actual findings are important in order to solve the given problem of the case study. After rating the structured abstracts participants have to make a decision to solve the problem and justify their decision on the basis of evidence in written form. The first study is a cross-sectional study with groups of different expertise levels. The sample consists of students of the bachelor with a focus on education (N=200), students of the Master of Education program (N=200), PhD-students of the educational sciences (N=50) as well as teachers (N=50). Parallel to the first study we conduct an expert study with thinking aloud protocols that serves as sample solution for the analysis of the competence model as well as for the modification of the test items. Experts of that study are PhD's and Professors of the educational sciences (N=24) with expertise in the area of scientific thinking. The second study is a longitudinal study that analyses the development of the competence on evidence-based argumentation over a period of two years with two points of measurement. The sample of this study consists of students of the Bachelor (N=200) and students of the Master of Education (N=200).

The third study focuses on cognitive skills which are necessary to show the competence of evidence-based argumentation. Those skills are (1) domain-specific basic knowledge, (2) use of case-based evidence, (3) the ability of scientific thinking, (4) epistemological beliefs and understanding of the nature of science, and (5) general intelligence. In a quasi-experimental design students of medicine (N=120) and students of educational sciences (N=120) either work on (1) cases that are derived from their domain and with case-based information, (2) cases that are derived from their domain and without case-based information, and (3) cases that are derived from another domain and with case-

based information. Here, domain-specific knowledge (derived from the course of studies) and case-based information form independent variables and the competence of evidence-based argumentation forms the dependent variable. The variables general intelligence, scientific thinking, epistemological beliefs and the understanding of sciences are control variables.

Project data

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Time frame	01/02/2012 – 31/01/2015

LeScEd – Learning the Science of Education Research. Competence in Educational Sciences

Schladitz, S., Rott, B., Winter, A., Wischgoll, A., Groß Ophoff, J., Hosenfeld, I., Leuders, T., Nückles, M., Renkl, A., Stahl, E., Watermann, R., Wirtz, M., Wittwer, J.

With the growing importance of evidence-based education it is crucial for both students and postgraduates to acquire and develop research competence. Such research orientation goes beyond the mere reception of scientific knowledge (so-called research literacy), but also comprises the ability to think and work scientifically. Even though research has begun to measure such competencies, a comprehensive model of research competence in the field of Educational Science remains a challenge. The project LeScEd aims at the theory-based development and empirical verification of models of educational research competence.

The project is guided by the following research questions:

Is it possible to conceptualize essential facets of a research competence model? What structure and levels of research competence can be empirically assessed and described? Do certain subgroups (e.g. courses of studies) differ in the amount of research competence? How does the amount or the structure of research competence change over time? What predictor variables on the different facets of research competence can be identified?

These main research questions are addressed in several sub-studies using samples of students and doctoral candidates in the educational sciences (a. o. teacher education, pedagogy, psychology). The data are analyzed by applying (multidimensional) IRT methods that are the current standard in competence modeling. Each study aims at different aspects of gaining a comprehensive understanding of research competence.

Research literacy as the ability to understand and use research knowledge was assessed in a large scale study with $N = 1,343$. To identify structures and levels of research competence, different competence facets (e.g. statistical literacy) as part of the research cycle were taken into account. Furthermore, we included potential predictors such as cognitive ability and motivation. To do so, we used a Youden Square booklet design to minimize strain for the participants while allowing the testing of 150 items of varying complexity.

In a second study, we are currently developing and testing a model of scientific writing competence based on genre knowledge. The model is supposed to describe different dimensions and levels of genre knowledge as they are reflected in and contribute to students' competence in scientific writing. The test includes items assessing declarative knowledge about rhetoric principles as well as abilities in applying genre knowledge, such as the ability to identify typical rhetorical problems. Accordingly, test items about text structure and rhetorical function and task formats for capturing procedural abilities are offered. Until now, 259 pre-service teachers of different semesters completed the test that comprises 32 items. We are currently collecting further data in order to obtain a total sample of $N = 600$. The Partial Credit Model and confirmatory factor analyses will be used in analyzing the data.

In another study we aim at testing the construct validity and change sensitivity of research competence scales over time and its sensitivity to instruction. We evaluate different methods to deal with expected scale structure changes over time. In cooperation with the other sub-projects we selected two content areas of academic competence (i.e., statistical literacy and research-related critical thinking) and tested their relation to academic writing which is an essential skill for beginning

scientists. Against this background, we constructed items for a competence test to assess learning in academic writing. We divided the field of academic writing into two related but separate areas to make the content areas for the planned experiments comparable with regard to several aspects: Macro structure and micro structure of scientific texts. Up to now, we have tested the learning environments in a pilot study ($N = 5$) and in a larger empirical study ($N = 60$). Subsequently, in two main experiments we will analyze how the psychometric properties are affected by training in the previously mentioned content areas.

A further study deals with epistemological beliefs and pursues two aims: (a) to identify epistemological beliefs about mathematics as a science, and (b) to develop instruments that allow for a valid and reliable but also economic assessment of epistemological beliefs in math (e.g., about the ontology of mathematical objects, or about the certainty of mathematical knowledge). To assess these beliefs we are currently developing a web-based questionnaire. As a first step, we conducted a series of interviews to record possible positions and arguments regarding the investigated epistemological beliefs. Our sample for the interviews so far consists of ten students, five professional mathematicians and two professors of mathematics.

With the data of these studies, we can analyze the research literacy of students in the Educational Sciences from different angles. These insights provide a reliable basis for improving the curricula. This is necessary to ensure the quality of study programs in higher education so that alumni working in research as well as in practice can make appropriate use of research in their respective fields.

Project data

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Homepage	http://www.kebu-freiburg.de/english-version/projects.htm#LeScEd
Time frame	02/2012 – 01/2015



Research Competence in Educational Sciences

Project LeScEd Learning the Science of Education

BMBF-funded Research Program "Modeling and Measuring Competences in Higher Education"



Background

Study programs in educational science qualify for research and practice as well. Graduates of educational science need a profound research orientation and related competencies. Thus, a central aim of higher education is the development of competencies in scientific reasoning and science-based or rather evidence-based professional activities (e.g. Tippelt & Reich-Claassen, 2010). The interdisciplinary cross-university project LeScEd is devoted to the investigation of this competence area.

The topic **Research Competence** comprises academic skills, which are basically acquired in the course of primary and secondary education (a.o. Brown et al., 2010), but are developed comprehensively only in higher education (e.g. Barchfeld & Sodian, 2009). However, since various disciplines contribute to the current state of knowledge about research competence, it is discussed and investigated in various ways (e.g. Statistical Literacy, Ben-Zvi & Garfield, 2004; Evidence-based-Practice, Davies, 1999).

Following Borg (2010), two levels of research competence can be distinguished:

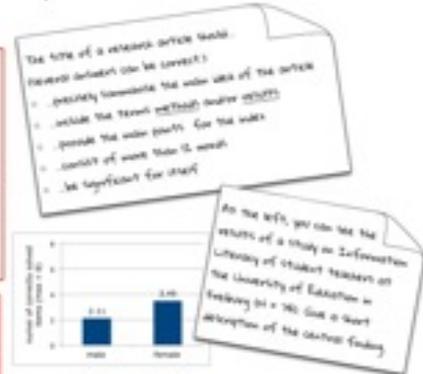
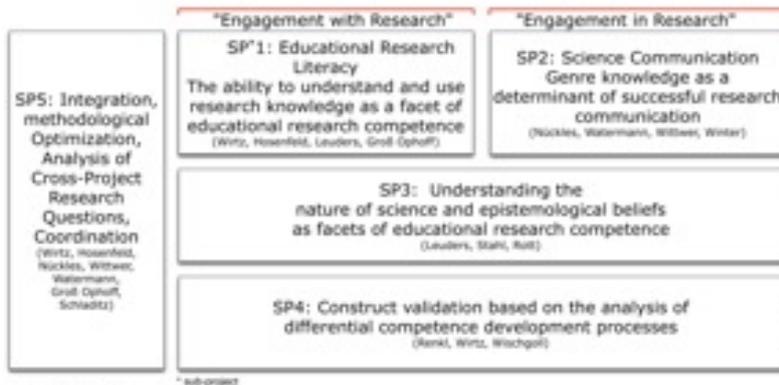
- **Engagement with Research:** pursuit of research knowledge to learn further (problem- or case-oriented)
- **Engagement in Research:** generation of research knowledge as part of a scientific community.

Research Questions

1. Is it possible to conceptualize essential facets of a research competence model? What structure/levels of research competence can be empirically assessed and described? Which predictor or moderator variables on the facets of research competence can be identified?
2. Is it possible to draw cross-sectional/longitudinal conclusions about the structure of research competence and its development? For example, do certain subgroups differ in their research competence? How does research competence change in the course of study?

Methods

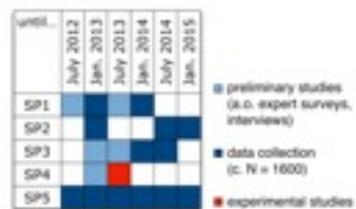
- Multidimensional IRT analysis and scaling
- Experimentally induced differential item functioning
- Latent class analysis, mixture distribution models
- Growth curve modelling, latent change score analysis



Objectives

- Development of a comprehensive multidimensional structure model of research competence in educational science and specification of competence levels in due consideration of moderating variables
- Empirically validated, IRT-based tests for the assessment of various facets of research competence
- Comparative empirical analysis of the development of research competence (structure and levels)
- Empirically substantiated recommendations for the assessment of research competence: advantages and disadvantages of the pursued approach
- Identification of discipline-specific competence aspects, construct definitions, characteristics of competences

Schedule



Prospects

LeScEd is an innovative research project in the field of Higher Education: Basing on the theory-based development of assessment instruments, a comprehensive understanding of research competence in educational science is endeavored. On that basis, it will be possible to approach the various facets of research competence empirically. These insights provide a reliable basis for improving the curricula and thus for evidence-based professionalization – especially in educational practice.

Literature: Barchfeld, R. & Sodian, B. (2009). Differentiating Theories from Evidence: The Development of Argument Evaluation Abilities in Adolescence and Early Adulthood. *Journal of Research in Personality*, 43(1), 246-270. Ben-Zvi, D. & Garfield, D. (Eds.). (2004). *The Challenge of Developing Statistical Literacy: Reasoning and Thinking*. New York, NY: Kluwer Academic Publishers. Borg, S. (2010). Language Teacher Research Engagement. *Language Teaching*, 43(4), 391-426. Brown, N. J. S., Furlan, E. M., Torro, M., Nagayama, S. G. & Wilson, M. (2010). The Evidence-Based Reasoning Framework: Assessing Scientific Reasoning. *Educational Assessment*, 15(1/4), 129-141. Davies, B. (1999). What is evidence-based education? *British Journal of Educational Studies*, 47(1), 106. Kultusministerkonferenz. (2004). *Standards für die Lehrerbildung: Standards der Lehrerbildung für die Sekundarstufe I und II*. Bonn: Kultusministerkonferenz. http://www.kmk.org/Dateien/Lehrerbildung/Standards/Standards2004-2004_12_04-Standards-Lehrerbildung.pdf (13.09.2011). Tippelt, R. & Reich-Claassen, J. (2010). *Stichtwort: Evidenzbasierung*. DIE – Zeitschrift für Erwachsenenbildung, 4, 5, 12-13.

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PRO-SRL – Product- and Process Oriented Modeling and Assessment of Self-Regulation Competencies in Tertiary Education

Dresel, M., Spiel, C., Schober, B., Schmitz, B., Ziegler, A.,
Jöstl, G., Roth, A., Wimmer, B., Steuer, G.

The project “Product- and process oriented modeling and assessment of self-regulation competencies in tertiary education” (PRO-SRL) is a joint research project of the University Augsburg, the University Vienna, the Technical University Darmstadt and the Friedrich-Alexander-University Nuremberg-Erlangen.

Objectives and research questions

Superior objectives of the project are to model competencies of self-regulated learning (SRL) of undergraduate students and their development in the course of their studies and to develop measuring instruments to assess them. Thereby general competencies as well as domain-specific competencies are focused and will be assessed by both utilizing product oriented (situational judgments, questionnaires) and process oriented measuring approaches (standardized diaries, portfolios). Specific sub-goals are the development and testing of a structural model of SRL competencies, the development and validation of product- and process-oriented measuring instruments for the assessment of SRL competencies, as well as the generation of hints for the development of competencies during studies. Further sub-goals are the analysis of differences between students of different fields of studies and between students with different educational backgrounds.

Theoretical background

The relevance of self-regulated learning (SRL) becomes apparent in an increasing number of scholarly publications on this topic and further in evidence pointing on relations between SRL and measures of achievement. The latter was, for example, shown in the PISA-2000 study: SRL allowed a notable prognosis of achievement (Artelt, Demrich, & Baumert, 2001). The increasing significance of SRL, however stands in sharp contrast with clear deficits in its assessment.

The literature of SRL comprises of two different approaches: the component-oriented approach and the process-oriented approach (cf. Boekaerts et al., 2000; Zimmerman & Schunk, 2011).

The component-oriented approach focuses on identifying relevant components of SRL. There are three major types of strategies which can be identified as the **dimension of strategy**: cognitive strategies, metacognitive strategies and resource management. Whereas a huge body of literature exists for cognitive and metacognitive strategies (cf. Zimmerman & Schunk, 2011), the research concerning resource management is rather sparse. However, in particular there are findings that point to the relevance of the regulation of achievement motivation and regulation of emotion (e.g. Pekrun, Goetz, Titz, & Perry, 2002; Wolters, 2003). Furthermore the strategies can be differentiated according to the **dimensions of knowledge**: declarative knowledge, procedural knowledge and conditional knowledge about strategies.

The process-oriented approach emphasizes the coordination and regulation of the different components within the different phases of the learning process. Most adequately, learning processes are conceptualized as recursive learning cycles (cf. Schmitz & Wiese, 2006; Winne & Hadwin, 1998; Ziegler, Stoeger, & Dresel, 2004; Zimmerman, 2000). At least, three phases have to be discriminated: preaction phase, action phase and postaction phase. This temporal dimension on the learning process is the **dimension of process**.

The combination of the three dimensions leads to our structural model of SRL competencies:

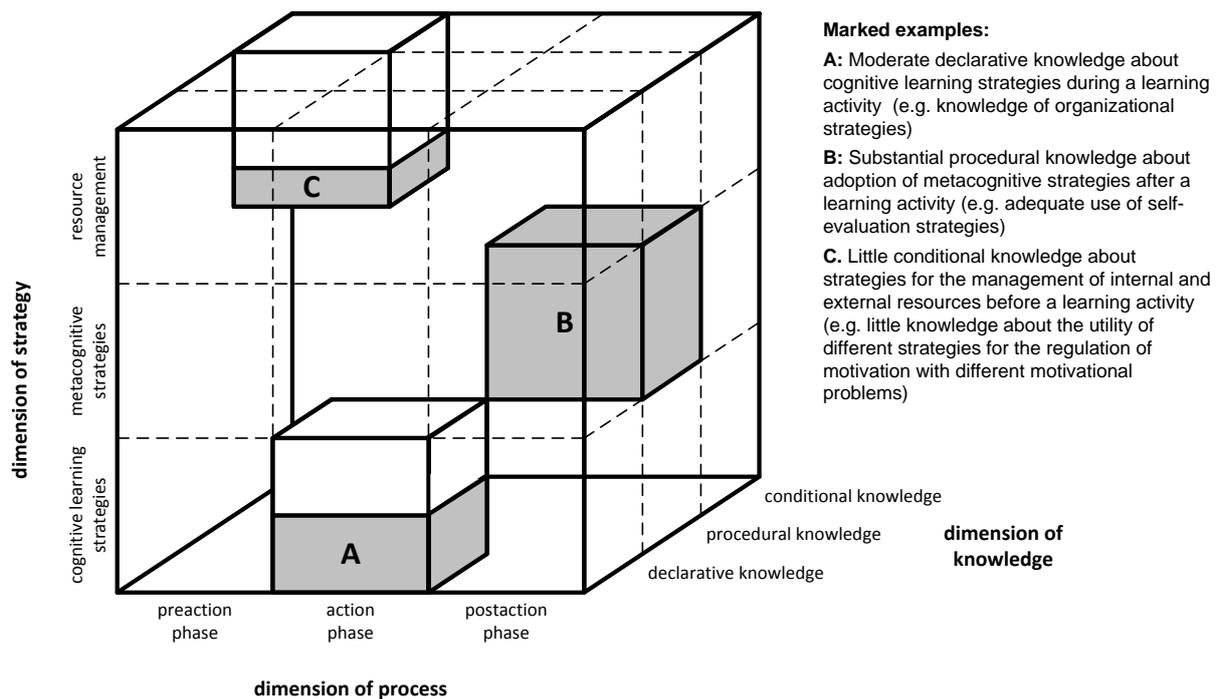


Figure 1. Assumed structural model of SRL competencies.

Design of the study

Altogether the joint research project includes six stages of inquiry, which are closely integrated over the subprojects. The stages address the identification of prototypical events and adequate strategies of SRL, the piloting and validation of measurement instruments, the development of final assessments and test of hypotheses with regard to the structure, the development and the levels of SRL competencies through a representative study. In order to receive an adequate theoretical model of SRL competencies as well as to foster the generalizability of the results obtained, the project is settled in different fields of study. The following fields of studies are investigated at two universities at a time: (a) electrical engineering (Darmstadt and Nuremberg-Erlangen), (b) teacher education in the STEM disciplines (Augsburg and Nuremberg), (c) psychology (Darmstadt and Vienna) and (d) economic sciences (Augsburg and Vienna).

Altogether there will be three innovative approaches for the assessment of competencies of SRL (situational judgment, standardized diaries, portfolios) and one established approach for assessing the amount of utilized SRL-strategies (questionnaires). The product-oriented assessments (situational judgment, questionnaires) are utilized in Augsburg and Vienna and the process-oriented assessments (standardized diaries, portfolios) in Darmstadt and Nuremberg-Erlangen. During the project, measuring instruments will be developed and validated, following these approaches. For every measuring approach, computerized e-assessments will be developed.

Project data

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Time frame	09/2012 – 08/2015

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PRO-SRL

Product- and process oriented modeling and assessment of self-regulation competencies in tertiary education

Markus Dresel^a, Christiane Spiel^b, Barbara Schober^b, Bernhard Schmitz^c, Albert Ziegler^d, Gregor Jöstl^b, Anne Roth^c, Bastian Wimmer^d, Gabriele Steuer^a

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I. Objectives

Superior objects of the joint research project are to model competencies of self-regulated learning (SRL) of undergraduate students and their development in the course of their studies as well as to develop measuring instruments to assess them.

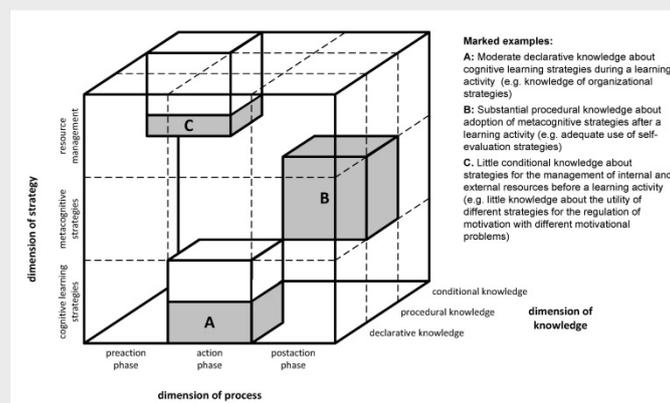
Sub-goals are:

- the development and testing of a structural model of SRL-competencies
- the development and validation of product- and process-oriented measuring instruments for the assessment of SRL-competencies
- the generation of hints for the development of competencies during studies
- the analysis of differences between students of different fields of studies and between students with different educational backgrounds.

II. Challenges

- Procedural character of SRL
- Multi-dimensionality of SRL
- Domain specificity of SRL
- Quantitative vs. qualitative standards to assess SRL
- Low validity of global self-report instruments

III. Assumed structural model of competencies



IV. Measurement approaches

Product oriented assessments (Augsburg & Vienna):

- Situational Judgments
- Questionnaires

Process oriented assessments (Nuremberg & Darmstadt):

- Standardized diaries
- Portfolios

V. Stages of inquiry

qualitative expert interviews

quantitative expert surveys

item development/
pilot phase/
validation 1

item development
pilot phase/
validation 2

development of
the final
measuring
instruments

representative study

VI. Fields of study

- Electrical engineering (Darmstadt & Nuremberg)
- Economic sciences (Augsburg & Vienna)
- Teacher education in the STEM disciplines (Nuremberg & Augsburg)
- Psychology (Vienna & Darmstadt)



Joint project "Product- and process oriented modeling and assessment of self-regulation competencies in tertiary education"
(Funding initiative: "Modeling and measuring competencies in higher education (KoKoHs)")

SEKO – Teachers' Self-Regulation as a Generic Aspect of Professional Competence: Development and Change in Teacher Education as well as Predictive Validity

Roloff Henoeh, J., Klusmann, U., Lüdtke, O., Trautwein, U.

Theoretical Framework and Objectives

The selection and training of qualified teachers is of great public importance. In scientific discourse, the concept of teachers' professional competence describes the skills and knowledge that a teacher needs to have in order to deal successfully with occupational tasks (Baumert & Kunter, 2006). At the current point in time, there is agreement that along with content knowledge, pedagogical content knowledge and generic pedagogical knowledge, generic aspects also characterize a successful teacher. Teachers' self-regulation, which describes the ability to handle one's own resources consciously and in awareness of possible resource losses, appeared to be an important predictor for the quality of instruction, the students' motivation and the teachers' occupational well-being (Klusmann et al., 2008). Less is known about the development of teachers' self-regulation. Up to now, there has been no empirical evidence to indicate whether work-related self-regulation is a stable characteristic over time or alterable throughout teacher education and training. The aim of the present investigation is to examine the individual development of self-regulation and its personal and institutional determinants.

Design of the Study

The present study is attached to a longitudinal study ("Transformation of the Secondary School System and Academic Careers" TOSCA; Köller, Watermann, Trautwein, & Lüdtke, 2004) following two representative student samples from their final year of schooling (Grade 13) into the job. The first cohort included over 5,000 students, the second cohort over 6,000. The study was started in 2002 (2nd cohort: 2006) and the subsequent measurement points were every second year. About 600 students enrolled in teacher education programs. For these students, data on self-regulation, cognitive and psychosocial characteristics, study conditions and academic success are available for three measurement points. To investigate the predictive validity of self-regulation, an additional measurement point is planned with 450 teachers, including self-reports and student ratings of the teachers' instructional quality.

Project data

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Time frame	01/06/2012 – 01/06/2015



Teachers' Self-Regulation as a Generic Aspect of Professional Competence: Development and Change in Teacher Education as well as Predictive Validity

Janina Roloff Henoch, Uta Klusmann, Oliver Lüdtke & Ulrich Trautwein

Theoretical Background

Teachers' professional competence describes cognitive and motivational characteristics that a teacher needs to have in order to deal successfully with occupational tasks (Baumert & Kunter, 2006). At the current point in time, there is agreement that along with content knowledge, pedagogical content knowledge and generic pedagogical knowledge, generic aspects also contribute to teachers' competence. The COACTIV model (Baumert & Kunter, 2006) integrates teachers' self-regulation as a necessary condition for successful teaching.

Teachers' self-regulation describes the ability to handle one's own resources consciously and avoid possible resource losses. It appeared to be an important predictor for the quality of instruction, the students' motivation and the teachers' occupational well-being (Klusmann et al., 2008).

Based on the idea that individuals differ in their patterns of self-regulation and drawing on the work of Schaarschmidt (e.g., Kieschke and Schaarschmidt 2008), four different types of self-regulation have been proposed (see Figure 1; Klusmann et al., 2008).

➤ As part of teachers' professional competence, self-regulation is assumed to be learnable.

➤ The aim of the present investigation is to examine the individual development of self-regulation, its personal and institutional determinants and its predictive validity for teacher's success.

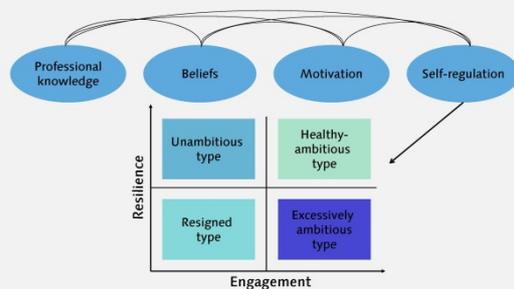


Figure 1: COACTIV model (Baumert & Kunter, 2006; Kunter et al., 2011) and the four self-regulatory types (Kieschke & Schaarschmidt, 2008)

Project Partners

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Janina Roloff Henoch	Leibniz Institute for Science and Mathematics Education, Kiel, Germany
Oliver Lüdtke	Humboldt University, Berlin, Germany
Ulrich Trautwein	Center for Educational Science and Psychology, University of Tübingen, Germany

Research Questions

1. How stable is work-related self-regulation during the transition from preservice teacher education to the profession?
2. What are the personal and institutional determinants for the development of teachers' self-regulation?
3. Is self-regulation predictive for success or difficulties during the transition from preservice teacher education to the profession?

Data and Methods

Present data:

- Data from a longitudinal study ("Transformation of the Secondary School System and Academic Careers" TOSCA; Köller et al., 2004; Trautwein et al., 2007, 2010)
- Starting in the students' final year in secondary school and following them through further education into the profession
- Longitudinal data on work-related self-regulation for three measurement points (collected with AVEM, see Kieschke & Schaarschmidt, 2008)

Further data collection:

- Participants who took part in teacher education programs ($N = 450$)
- Information on the current occupational situation, the occupational well-being and the occupational success, measured with self-assessment and student reports on the teacher's instructional quality

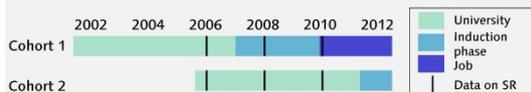
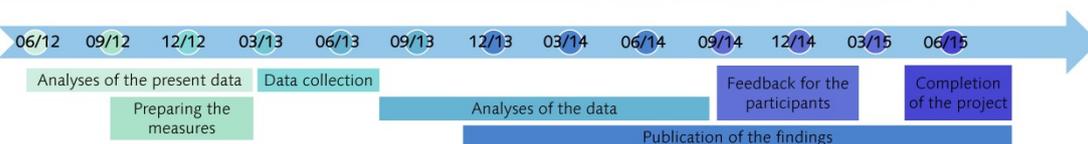


Figure 2: Stages of development in teacher education for both TOSCA-cohorts (applies for the majority of participants), SR = self-regulation

Project schedule



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