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## **Assessing competencies across the lifespan within the German National Educational Panel Study (NEPS) – Editorial**

### **Abstract**

*The eight articles of this Special Issue describe the assessment of competencies within the German National Education Panel Study (NEPS) for major educational-stage-comprehensive assessment domains of the NEPS. The Editorial outlines the overall framework for the selection and conceptualization of the assessment of competencies against the background of existing models and approaches in national and international large-scale assessments and panel studies. The functional-integrative perspective on competencies is introduced and briefly described with reference to the competence domains integrated into the NEPS assessments. Moreover, the assessment design implemented within the first five years is presented to illustrate the scientific potential of this unique pattern of competence assessments within the NEPS.*

### **Keywords**

*Models of competencies; NEPS framework; Literacy; Large-scale assessment*

## **Diagnose von Kompetenzen über die Lebensspanne im Rahmen des Nationalen Bildungspanels (NEPS) – Editorial**

### **Zusammenfassung**

*Die acht Artikel dieses Special Issues beschreiben die Konzeption der Messung von Kompetenzen im Nationalen Bildungspanel (NEPS) für die Kompetenzbereiche,*

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*die etappenübergreifend und kohärent gemessen werden sollen. Das Editorial skizziert die Rahmenkonzeption für die Auswahl und Konzeption der Kompetenzmessungen im NEPS vor dem Hintergrund bestehender theoretischer Modelle und Konzeptionen in nationalen und internationalen large-scale assessments und Längsschnittstudien. Die funktional-integrative Perspektive auf Kompetenzen wird vorgestellt und mit Bezug auf die Kompetenzdomänen des NEPS beschrieben. Zudem wird das Erhebungsdesign der ersten fünf Jahre vorgestellt, um das spezifische wissenschaftliche Potenzial zu illustrieren, das sich über die Implementation dieser Rahmenkonzeption zur Messung von Kompetenzen im NEPS ergibt.*

## **Schlagworte**

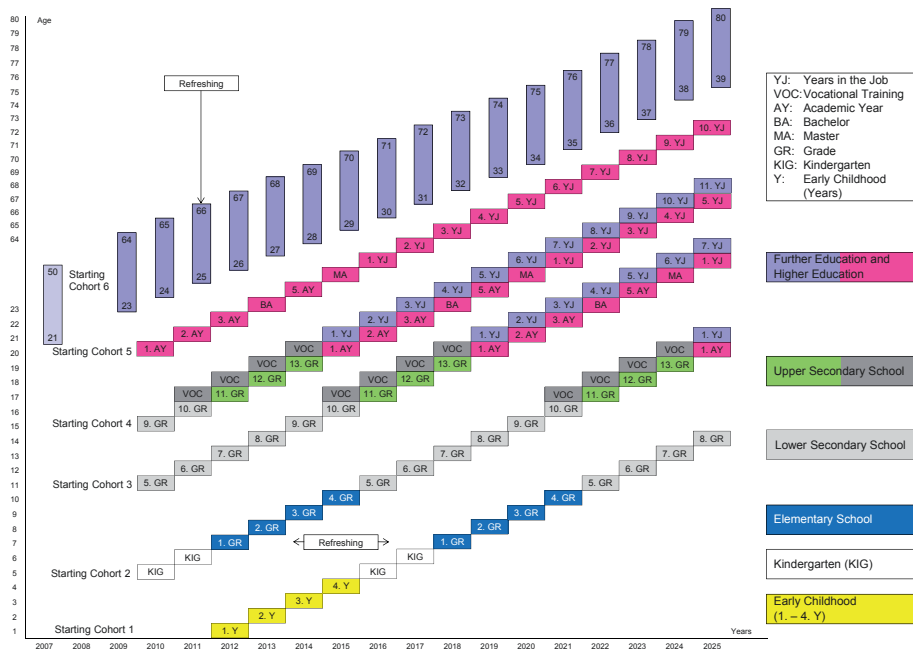
*Kompetenzmodell; NEPS Rahmenkonzeption; Literacy; Large-Scale Assessment*

## **1. The National Educational Panel Study (NEPS)**

The National Educational Panel Study (NEPS) aims at analyzing educational and developmental processes and outcomes in Germany from early childhood to late adulthood. In order to be able to examine educational careers, their preconditions, and consequences, NEPS is implementing a large-scale multicohort sequence design (see Figure 1). On the basis of NEPS data that will be made available to the scientific community, it will be possible to trace the consequences of education for individual biographies and developments and to describe important educational processes and career stages throughout the entire lifespan. NEPS is thus contributing highly relevant knowledge to areas of comparatively little research, particularly on educationally relevant competencies in adulthood, and the cumulative development of competencies across educational stages. Therefore, important empirical questions in the NEPS relate to the development and relevance of these competencies beyond school, their importance for future job careers, and their impact on general life satisfaction.

The NEPS assessment framework is built on five perspectives (named “pillars”) that enable the comparability of operationalizations as well as consistent approaches across and within the six different starting cohorts of the NEPS (cf. Blossfeld, Roßbach, & von Maurice, 2011). The five pillars focus on the development of competencies (Pillar 1), family education, education in and outside institutions (Pillar 2), educational decisions and their distal and proximal determinants (Pillar 3), issues of migration (Pillar 4), and educational returns (Pillar 5). Not surprisingly, measures of educationally relevant competencies serve as a central reference point because the interrelation between competence development and the themes of the other four “pillars” is of particular importance within the Educational Panel Study NEPS.

Figure 1: The NEPS multi-cohort-sequence-design



## 2. Selection and conceptualization of competencies within the NEPS

The selection of competence domains that are assessed within the NEPS (as part of Pillar 1) aims at improving the analytic potential of studies on the role of education (for a detailed overview, see Weinert et al., 2011). NEPS thus places special emphasis on educationally relevant, domain-specific, functional competencies that are subject to educational influence and are thought to be especially relevant to educational careers, to a successful and autonomous individual life, and a well-functioning society. However, in order to be able to disentangle effects of schools, families, and other relevant factors throughout the life course it seems necessary to also take into account the effects of relevant precursors and/or covariates. Educationally relevant competencies are often referred to as functional, context-bound, domain- and demand-specific (cognitive) achievement dispositions that are subject to educational influence and interventions (e.g., reading literacy, mathematical literacy) (cf. Rychen & Salganik, 2001, 2003; Weinert, 2001). These domain- and demand-specific competencies are distinguished from (a) (primary) domain-general and rather context-free cognitive capacities (e.g., fluid intelligence or working memory capacity) as well as from (b) specialized content-specific knowl-

edge structures and procedural skills. Furthermore, educationally relevant competencies are often conceptualized as either curricular (i.e., subject-bound) or cross-curricular (i.e., cross-subject) (Weinert et al., 2011). In order to adequately address the research questions with respect to the five pillars of the NEPS, educationally relevant domain-specific competencies such as mathematical, natural science, and reading competence, need to be supplemented by some of the other facets of individual abilities and capacities mentioned above, such as domain-general cognitive functions. Moreover, recent discussions about the relevance of competencies across the lifespan also place special emphasis on various social skills, motivational dispositions, attitudes, and expectations (see, e.g., the Definition and Selection of Competencies, DeSeCo). Therefore, it seems important to add cross-curricular and not exclusively cognitive aspects of individual functioning, such as metacognition (i.e., cognition about cognition), and cognitive and noncognitive aspects of self-regulated learning, as well as aspects of socioemotional development to the NEPS assessment. However, although cognitive and noncognitive components obviously do interact in everyday applications, it seems reasonable to systematically distinguish between cognitive and noncognitive components from both an analytical point of view as well as from the perspective of a longitudinal reconstruction of the development of educationally relevant competencies.

With respect to the cognitive domains, discussions about the relevance of competencies for future prospects are strongly influenced by international large-scale assessments of students' and adults' performance – for example, the Programme for International Student Assessment (PISA), the Third International Mathematics and Science Study (TIMSS), the Adult Literacy and Life Skills Study (ALL), the Programme for the International Assessment of Adult Competencies (PIAAC). The frameworks of these assessments place a special emphasis on basic school-related and demand-specific cognitive competencies. There is overall consensus on the relevance of the following competencies: language competencies (including reading literacy and foreign-language competencies), mathematical literacy, and scientific literacy (see, e.g., Bynner, 2004; Forum Bildung, 2002; Autorengruppe Bildungsberichterstattung, 2012; OECD, 2013; Rychen & Salganik, 2001, 2003; Tenorth, 2004). Especially the OECD's PISA raised the claim that competencies such as reading, mathematical, and scientific literacy were not only school-related competencies in a narrow sense but also highly relevant for success in later life.

Without a doubt, NEPS can be described as serving multiple purposes. It is intended to serve as a long-running data resource for system monitoring and to offer opportunities for in-depth research. At the same time, different national (e.g., National Standard Setting) as well as international developments (International Large-Scale Assessments) in the field of competence assessment and monitoring have to be taken into account. Furthermore, the blueprint for the selection of competence domains (including assessment) must consider that the relevance of competencies may change across the lifespan, and that competencies are subject to a more or less stage-specific dynamic. At the same time, it has to be noted that there are almost no comprehensive models of competence development in the field of

the social sciences describing the development and (possibly age- or educational-stage-specific) structure of competencies across the lifespan. Hence, the selection and relative weighting of competencies that are included in the NEPS are to be located between a) a normative – and pragmatically necessary – commitment to a set of competencies analyzed and described across the lifespan which is based on theoretically justifiable assumptions about their internal structure and b) the necessity of staying flexible in terms of additions and changes and of incorporating age- and educational-stage-specific analyses on the structure of relevant competencies within educational stages and their structural changes across stages. Taken together, the process of selecting competencies for the assessment within the NEPS was driven by the following intended characteristics for the assessments: The competence assessment should produce relevant results for monitoring, describing, and optimizing educational processes (relevant to the panel pillars and to system monitoring in general), they should be linkable to national (e.g., educational standards) and international (e.g., PISA) studies, and they should follow a comprehensive taxonomy (and not purely an additive list). Moreover, these competencies should be adequately convertible into tests and instruments (assessment), allow for measuring change (instruments that are sensitive to change and allow for tracking cumulative developmental progress), and enable an in-depth understanding of developmental trajectories and, if possible, underlying processes. With these considerations in mind and also paying attention to the restricted number of competencies that can be included from a research-practical point of view, the following competencies were selected for the assessment within the NEPS:

- Domain-general cognitive functions (e.g., indicators of nonverbal reasoning and information-processing speed).
- Domain-specific cognitive competencies:
  - German-language competencies, specifically, reading competence and listening comprehension (i.e., measures of written and oral language comprehension),
  - mathematical competence,
  - scientific literacy.

(In addition, indicators of foreign and first-language competencies are assessed)

- Metacompetencies and social competencies:
  - indicators of procedural and declarative metacognition (i.e., indicators of control and knowledge of one’s own cognitive functioning) and self-regulation,
  - Information and Communication Technologies (ICT) literacy,
  - social competencies and additional noncognitive measures and indicators of subject-specific interests, motivation, and the self-system are treated in more depth in Pillar 3 of the NEPS.
- Educational stage-specific (curriculum- or job-related) competencies as well as precursor and outcome measures.

The assessment design of the first five years of the NEPS with respect to the above-mentioned competence domains is depicted in Table 1 (see also Figure 1 for the multi-cohort-sequence design implemented in the NEPS). Whereas the assessment of educationally relevant domain-specific competencies was intended to take place rather frequently (especially in the younger cohorts) and with a fixed pattern of simultaneously assessed domains, domain-general functions as well as English-language competence (foreign language) and first-language competence (in the case of persons with a migration background) are assessed less often (in some cases only once) within each cohort/institution. Note that stage-specific assessments can also vary within a particular stage.

### **3. Challenges of modeling competencies across the lifespan**

The NEPS framework on competence development differentiates between competencies that are measured in a coherent stage-comprehensive way across the entire lifespan (domain-specific cognitive competencies such as reading competence, mathematical competence, and science literacy) and are aimed at a comprehensive reconstruction of their internal dynamics of emergence and developmental change over the life course, and competencies that are assessed with more stage-specific or less age-sensitive instruments. This is because they either serve mainly as covariates (e.g., domain-general cognitive functions), are regarded as stage-specific outcome or precursor variables, or because the internal structure or competence domain is assumed to change considerably across time (e.g., ICT literacy). Competence assessment for the coherently assessed domains (reading competence, mathematical competence, and scientific literacy) is confronted by a number of challenges described below that will also be addressed within the related articles of this Special Issue.

A conceptual/theoretical challenge is surely to be seen in ensuring a common framework of competence assessment within each domain across the different age groups and, thus, also throughout the lifespan. Bearing in mind the lack of comprehensive theoretical models of competence development for relatively long periods of the life course as well as the lack of adequate assessment instruments, setting up a test framework for the individual domains does not seem to be a straightforward endeavor. Although the labels (reading, mathematics, science) remain the same, the corresponding competence domains do change during the lifespan. The school-subject domain obviously offers a different point of reference to that of the scientific discipline. A fixation on school-related competence models implies that further competence development after formal schooling would not be covered appropriately in the NEPS, even though analyzing the extent to which school subject-related competencies (e.g., mathematical) are instrumental for further studies, different jobs, or everyday problem solving would be an interesting task. From this per-

Table 1: Competence assessments of the years 2010–2014 for different starting cohorts of the NEPS

Age	Stage	Assessment	Domain-general competencies		Domain-specific competencies				Metacompetencies			Stage-specific tests
			DGCF	Starting Cohort 2 – Kindergarten	German language				Science	Metacogn.	ICT	
					Reading	Listening	Math					
4	Preschool	2010			x			x				
5	Preschool	2011	x			x						x
6	E: Grade 1	2012			x	x		x			x	
7	E: Grade 2	2013	x		x	x						
8	E: Grade 3	2014			x			x			x	
Starting Cohort 3 – Grade 5												
10	S: Grade 5	2010	x					x				x
11	S: Grade 6	2011			x					x		x
12	S: Grade 7	2012			x							x
13	S: Grade 8	2013										
14	S: Grade 9	2014	x		x	x		x			x	x
Starting Cohort 4 – Grade 9												
14	S: Grade 9	2010	x					x				x
15	S: Grade 10/Voc	2011										
16	S: Grade 11/Voc	2012								x		
17	S: Grade 12/Voc	2013			x							x
Starting Cohort 5 – First-Year Students												
18–24	U: Acad. Y. 1	2010			x							
19–25	U: Acad. Y. 2	2011										
20–26	U: Acad. Y. 3	2012	x							x		
21–27	U: Acad. Y. 4	2013										
22–28	U: Acad. Y. 5	2014								x		
Starting Cohort 6 – Adults												
24–66		2010			x							
25–67		2011										
26–68		2012								x		x
27–69		2013										
28–70		2014	x									

Note. DGCF = domain-general cognitive functions; reading = reading competence; listening = listening comprehension; Math = mathematical competence; Metacogn. = metacognition; ICT = information and communication technologies literacy; E = elementary school; S = secondary school; Voc = vocational training; U = university. Starting Cohort 1 – Early Childhood is not depicted because only stage-specific competence assessments were assessed.



spective, it seemed necessary to consider multiple points of reference. These were organized around life coherences (with corresponding domain-specific demands). One central starting point for the NEPS framework was thus an orientation toward the functionality and everyday relevance of the competencies studied (Weinert et al., 2011). This orientation draws on the concept of *literacy* implemented in international comparative studies with a focus on enabling participation in society (see OECD, 1999). Functional literacy seems to be of special relevance because of its ecological validity across a broad age range. There are many reasons why competencies in the sense of functional literacy should be included in the NEPS – one being the assumed relevance largely agreed upon in educational policies, educational sciences, as well as the general public. Another reason is the importance of linking the NEPS to international large-scale assessments.

A methodological challenge of modeling competencies within the NEPS is to be seen in the attempts to allocate individual competence indicators for the coherently assessed competence domains on a common metric, allowing the description of cumulative developmental progress over time (scale anchoring). As outlined in the paper by Pohl and Carstensen (2013, this issue), this is done via the application of item response theory approach for the scaling of the competence estimates and by either adapting an anchor items design or by using additional calibration samples, resulting in item difficulty estimates for the linking of proximate assessments.

Taking into account the discussions about the selection and calibration of competencies in national studies of other nations (e.g., the NALS in the U.S.; cf. Hauser, Edley, Anderson Koenig, & Elliot, 2005), the need to ensure linkage over time while, at the same time, guaranteeing flexibility for important modifications of tests (e.g., related to concrete requirements of specific jobs or changing everyday demands) can be seen as one of the major challenges of the NEPS assessment of competencies.

#### **4. Outlook on the articles of the Special Issue on Competence Assessment within the NEPS**

The Special Issue on Competence Assessment within the National Educational Panel Study (NEPS) aims at presenting conceptual as well as empirical work related to a coherent assessment of competencies across the lifespan within NEPS. The eight papers present the specific conceptual approaches taken for the various competence domains by relating them to theoretical work as well as existent approaches in international and national large-scale assessments. Furthermore, each of the following competence-domain-related contributions will present results from validation and/or feasibility studies, answering specific questions about psychometric criteria as well as the validity of the approach. This will be followed by a methodological article on the practices and challenges of the scaling approach for competence tests taken within the NEPS. The final article concentrates on a specific group

– students with special educational needs – focusing on the question of whether and to what extent students with special educational needs can be integrated into the general assessment design without compromising on the validity or comparability of data. Specifically, this Special Issue comprises the following articles:

- Assessing language indicators across the lifespan within the German National Educational Panel Study (NEPS) (Karin Berendes, Sabine Weinert, Stefan Zimmermann, and Cordula Artelt);
- NEPS framework for assessing reading competence *and* results from an adult pilot study (Karin Gehrer, Stefan Zimmermann, Cordula Artelt, and Sabine Weinert);
- Modeling and assessing mathematical competence over the lifespan (Irene Neumann, Christoph Duchhardt, Meike Grüßing, Aiso Heinze, Eva Knopp, and Timo Ehmke);
- Assessing scientific literacy over the lifespan – A description of the NEPS science framework and the test development (Inga Hahn, Katrin Schöps, Silke Rönnebeck, Maike Martensen, Sabine Hansen, Steffani Saß, Inger Marie Dalehefte, and Manfred Prenzel);
- The Test of Technological and Information Literacy (TILT) in the National Educational Panel Study: Development, empirical testing, and evidence for validity (Martin Senkbeil, Jan Marten Ihme, and Jörg Wittwer);
- Assessing metacognitive knowledge: Development and evaluation of a test instrument (Marion Händel, Cordula Artelt, and Sabine Weinert);
- Scaling of competence tests in the National Educational Panel Study – Many questions, some answers, and further challenges (Steffi Pohl and Claus H. Carstensen);
- Including students with special educational needs into large-scale assessments of competencies: Challenges and approaches within the German National Educational Panel Study (NEPS) (Jana Heydrich, Sabine Weinert, Lena Nusser, Cordula Artelt, and Claus H. Carstensen).

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