NEPS
National Educational Panel Study

Research Data

Starting Cohort 2: Kindergarten (SC2)
Wave 3
Information on the Competence Test

A STUDY BY

LIfBi

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Information on testing					
Test situation	Group testing (N<15), 1 test instructor				
Test sequence	The tests are held on two test days.				
	Sequence on test day 1: picture-based tests: Listening comprehension at sentence level : receptive grammatical competence + Listening comprehension at word level : receptive vocabulary + procedural metacognition				
	Sequence on test day 2: picture-based tests: scientific competence + mathematical competence + declarative metacognition + procedural metacognition				
Test duration (net processing time)	105 min				
Breaks	Test day 1: 10-minute break before test to listening comprehension at word level; 15-minute break before test to procedural metacognition; Test day 2: 10-minute break before test to mathematical competence				
Information on the individual tests					
Construct		**Number of Items**	**Allowed Processing Time**	**Survey Method**	**Next Measurement**
Test day 1					
Listening comprehension					
Listening comprehension at sentence level : receptive grammatical competence		40	15 min	Picture-based answer format	Class 3
Listening comprehension at word level : receptive vocabulary		66	20 min	Picture-based answer format	Class 3
Domain-specific procedural metacognition					
Regarding the receptive grammatical competences		1	1 min	Picture-based answer format	
Regarding the receptive vocabulary domain		1	1 min	Picture-based answer format	Class 3
Test day 2					
Scientific competence		26	30 min	Picture-based answer format	Class 3
Mathematical competence		22	ca. 30 min	Picture-based answer	Class 2

			format	
Declarative metacognition	10	ca. 15 min	Picture-based answer format	Class 3
Domain-specific procedural metacognition				
Regarding the scientific domain	1	1 min	Picture-based answer format	Class 3
Regarding the mathematical domain	1	1 min	Picture-based answer format	Class 2

Preliminary note

The development of the individual tests is based on framework concepts. They constitute overarching concepts on the basis of which education-relevant competences are to be shown consistently and coherently over the entire personal history. Therefore, the following framework concepts that served as a basis for the development of the test tools to measure the above mentioned constructs are identical in the different studies.

The stage-specific measures are collected at certain points of time in the life course. Usually a repetition of measurement does not take place. They are also underlaid by superior concepts and on this basis the educationally relevant competencies are depicted.

Mathematical competence

In the National Education Panel Study, the construct of mathematical competence is based on the idea of mathematical literacy as was defined, for example, in PISA. Thus, the construct describes "[…] an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded mathematical judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen." (OECD, 2003, 24). Regarding younger children, this idea refers to competent handling of mathematical problems in age-specific contexts. Accordingly, mathematical competence in NEPS is operationalized by items assessing more than pure mathematical knowledge; instead, solving the items requires recognizing and flexibly applying mathematics in realistic, mainly extra-mathematical situations.

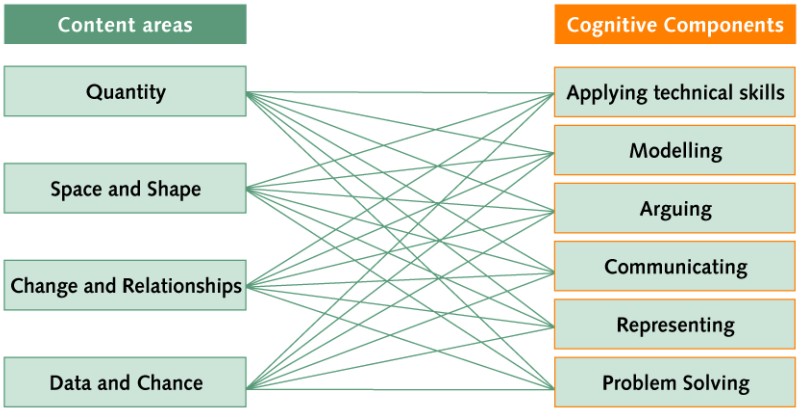

Fig. 1: Framework of mathematical competence in NEPS

The NEPS framework of mathematical competence distinguishes between content-related and process-related components (cf. Fig. 1). In detail, the content areas are characterized as follows:

- **Quantity** comprises all kinds of quantifications when numbers are used to organize and describe situations.
- **Space and Shape** includes all types of planar and spatial configurations, shapes or patterns.
- **Change and Relationships** includes all kinds of (functional) relationships and patterns.
- **Data and Chance** comprises all situations involving statistical data or chance.

The cognitive components of mathematical thinking processes are distinguished as follows:

- **Applying technical skills** includes using known algorithms and remembering mathematical knowledge or calculation methods.
- **Modelling** includes the representation in a situation model and in a mathematical model as well as interpreting and validating results in real-life situations.
- **Arguing** includes assessing explanations and proofs, but also developing own explanations or proofs.
- **Communicating** requires communication on mathematical contents and includes, among other things, the correct and adequate use of mathematical technical terms.

• **Representing** comprises the use and interpretation of mathematical representations such as tables, charts or graphs.

• **Problem Solving** takes place, when there is no obvious approach, and, therefore, includes systematic trying, generalizing or examining special cases.

This differentiation renders the framework concept of mathematical competence in NEPS compatible with both the PISA studies and the German National Mathematics Education Standards. The test items used in NEPS refer to one content area that is mainly addressed by the item, but may well contain several cognitive components.

In order to test mathematical competence independently from reading competence, all items are read aloud by the interviewers. The children answer by choosing either between different pictures or different Arabic numbers, most of which are below 20. As the children are abecedarians, pictures are used instead of page numbers in order to ensure that all students are working on the correct item.

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Scientific competence

NEPS's definition of scientific literacy derives from the Anglo-Saxon concept of literacy (Bybee, 1997; Gräber, Nentwig, Koballa & Evans, 2002; OECD, 2006), viewing scientific competence not sole as the reproduction but rather as the application of knowledge in different situations and contexts of everyday life. Scientific literacy is the prerequisite to participate in a world driven by science and technology (Prenzel, 2000; Prenzel et al., 2001; Rost et al., 2004) and is viewed as a predicator for an economically, socially, and culturally successful life. Scientific literacy is one part of the foundation for lifelong learning (OECD, 2006; Prenzel et al. 2007) thus influencing career choices and career developments.

NEPS defines scientific literacy as the application of science knowledge within the contexts of environment, technology, and health. Additionally the NEPS framework distinguishes between content-related and process-related components (figure 1). It follows the PISA-framework (OECD, 2006), the German Educational Standards for biology, chemistry, and physics at the end of Grade 10 (KMK, 2005a, b ,c), and the Benchmarks for Scientific Literacy of the American Association for the Advancement of Science (AAAS, 2009) thus fulfilling the requirement that the NEPS framework can be linked to international large scale assessments in the field of competence assessment. The chosen contexts of health, environment, and technology are of personal, social, and global significance. New research and the events of the day show that they continue to be relevant throughout a person's life span. The content-related and process-related components cover the central concepts of all of the science disciplines. In the area of knowledge of science this includes matter, development, interactions, and systems. The knowledge about science contains scientific inquiry and reasoning such as to test hypotheses, interpret findings, and the principals of measurement and measurement errors.

The test results of the content-related and process-related components lead to a composite value assessing scientific literacy.

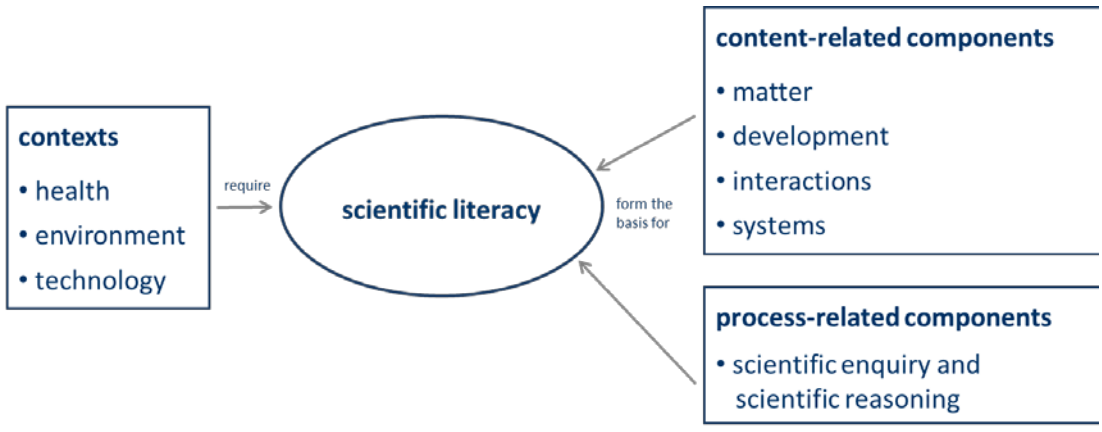

Figure 1: Implementation contexts as well as the content-related and process-related components scientific competence test of the NEPS-science tests

To assess the scientific competence of first-graders independent from their reading skills the test is administered by reading the questions and answer options to the students out loud. The answer

options in the test material are given as pictures which will have to be checked. The test material is one-sided print containing one test question per page as to not overwhelm the children with too much content. For better child appropriate navigation throughout the test material each page is marked with images (animals, plants, etc.) instead of page numbers.

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Metacognition

Metacognition is the knowledge and control of the own cognitive system. According to Flavell (1979) und Brown (1987), declarative and procedural aspects of metacognition are differentiated which are both covered in the National Education Panel.

Declarative Metacognition

Declarative metacognition refers to knowledge about person, task and strategy variables that an individual can verbalize (Flavell, 1979). This includes, for example, knowledge about the strengths and weaknesses of one's own memory and learning, knowledge about cognitive requirements of tasks (i.e., their difficulty), as well as knowledge about strategies of attaining cognitive learning and achievement goals. It is assumed that the declarative aspect of metacognition constitutes a necessary prerequisite for strategic learning. Knowledge about different kinds of strategies can again be divided into declarative, procedural, and conditional strategy knowledge. Declarative strategy knowledge is the awareness of strategies, that is, the awareness that a certain strategy exists. Procedural knowledge describes how a strategy works effectively and conditional knowledge helps to understand which strategies are more useful for solving a certain task than others (Borkowski, Milstead, & Hale, 1988; Paris, Lipson, & Wixson, 1983).

In the National Educational Panel Study (NEPS), the declarative aspect of metacognition is measured by scenario-based knowledge tests. The construction of the tests is based on existing test instruments that refer to domain-specific knowledge (mostly in the domain of reading, e.g., the test on knowledge about reading strategies, Schlagmüller & Schneider, 2007) or to domain-general knowledge (Neuenhaus, Artelt, Lingel, & Schneider, 2011). These test instruments have been proven to be reliable and economic in use, they refer to concrete learning situations, and are interpretable against a clear benchmark.

The tests on declarative metacognition that are administered in the NEPS include several scenarios describing different school and leisure-time activities. For each scenario, a list of approaches of differing strategic quality is presented and participants are asked to rate the usefulness of each alternative. In order to be appropriate for the different age groups some characteristics of the tests (e.g., the number of the presented alternatives or the context in which the scenarios are embedded) are modified.

To assess declarative metacognition in first grade the scenarios and proposed strategies are presented orally accompanied by pictures. Children in first grade are asked to rate three strategies per scenario (cf., Lockl, Händel, Haberkorn, & Weinert, 2013).

Test scoring is done with reference to the relative usefulness of the presented alternatives. Thus, the test instrument can be characterized as a test assessing conditional and relational knowledge about strategies (cf. Händel et al., 2013). The evaluation of the relative usefulness of the strategies is based on the ratings of experts who are scientists in the field of educational psychology and learning strategies. Accordingly, a pair comparison is scored as correct if the judgment on a strategy pair concurs with the expert ratings, and as incorrect if the judgment on a strategy pair contradicts the expert ratings.

Procedural metacognition

Procedural metacognition includes the regulation of the learning process through activities of planning, monitoring and controlling. Within the framework of NEPS in combination with the competence tests of the individual domains, the procedural aspect of metacognition is not assessed as a direct measure of such planning, monitoring and controlling activities but as a metacognitive judgement that refers to the control of the learning performance during (and/or shortly after) the learning phase (also see Nelson & Narens, 1990). After participants have taken their competence tests, they are requested to rate their own performance. They are asked to state the portion of questions presumably answered correctly. Kindergarten and elementary school children are shown a 5-point smiley scale to give their judgments.

Usually, one question is asked per domain. For competence domains that can be divided into coherent individual parts (e.g. reading competence referring to different texts), the inquiry of procedural metacognition is referred to these parts as well, which, of course, leads to a longer processing time.

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Listening comprehension at word, sentence and text/discourse level as indicators of linguistic competence in German

The importance of linguistic competence for learning in school as well as for explaining social disparities during school careers is largely undisputed.

In NEPS, the linguistic competences in German are measured through listening comprehension at word, sentence and text/discourse level on the one hand, and – from 2nd grade elementary school – through reading ability indicators (reading competence, reading speed) on the other where, however, not all indicators are measured at each survey. In nursery school, for the start cohort on the 1st measuring date at the age of about 4 years, listening comprehension is measured at word and sentence level.

Listening comprehension at word level: receptive vocabulary

Measures of the receptive vocabulary represent a favorable, internationally compatible indicator for the acquired language abilities and skills of children and adults. In numerous, comprehensive international, panel studies such as the Head Start Family and Child Experiences Survey – FACES (USA)1, the National Longitudinal Survey of Children and Youth – NLCSY (Kanada; u.a. Lipps & Yiptong-Avila, 1999)2, the British Cohort Study – BCS70 (z.B. Bynner, 2004) or the European Child Care and Education (ECCE) Study carried out in Germany, Austria, Spain and Portugal (e.g. European Child Care and Education (ECCE) Study Group, 1997), the receptive vocabulary is measured as a central and sometimes even sole indicator of the cumulatively acquired linguistic-cognitive abilities against the background of individual basic skills (e.g. working memory capacity, speed variables) and Environmental stimulation.

The internationally most used instrument for measuring the receptive vocabulary certainly is the Peabody Picture Vocabulary Test (PPVT; Dunn, 1959; Dunn & Dunn, 1981, 1997, 2007) which is now available in different versions. Basically, the PPVT can be used over a wide age spectrum and is also easy to carry out and evaluate.

As a published German version of the PPVT is available only for older children from an age of 13 years (Dunn & Dunn, 2004), a procedure analogous to PPVT was prepared for NEPS which is based on data of the ECCE and BiKS studies. Within the framework of the BiKS study, in the longitudinal BiKS-3-10 analysis, a German research version of PPVT (Roßbach u.a., 2005) is used which is based on the data of the ECCE study (European Child Care and Education (ECCE) Study Group, 1997). Based on data of a NEPS developmental study with 566 children a total of 66 items were selected via IRT analyses that are particularly selective for this age range and arranged in one test instrument by complexity.

The task of the children is to select the correct picture for each predetermined individual word from a set of four pictures.

[1] http://www.acf.hhs.gov/programs/opre/hs/faces/
[2] http://www.statcan.ca/english/sdds/4450.htm

Listening comprehension at sentence level: receptive grammatical competences

In view of the so called "erudite language" which, compared to everyday speech, is normally characterized as more decontextualized and grammatically more complex and which is regarded as very significant particularly at school, the grammatical competences of children are viewed as being of special importance to listening comprehension in class.

The "Test for Reception of Grammar" by Bishop (1989) provides an internationally compatible method of which a German translation has been available since 2006 (Fox, 2006). In order to cover the abilities of sentence processing, more exact: of processing/comprehension of linguistic structural forms, sentences of different grammatical structure are given. From a number of pictures, the one has to be assigned to each of these sentences that corresponds to the respective sentence. It is ensured that the words used are known. Suitable distractors are used to selectively test semantic, syntactic or morphological aspects of understanding grammatical structural forms (cf. TROG-D, Fox 2006).

In NEPS, a shortened version of the TROG-D "Tests for Reviewing Grammatical Understanding" (Fox, 2006) is used. In the first testing in Kindergarten it is carried in a playfully arranged individual test situation. In the second testing two years later it is carried out in small groups (N<15 children) in a classroom of elementary school students. The sentences are given by CD to ensure a standardized presentation of the items.

The version applied in elementary school consists of 40 items, with all four original items being predetermined for each of the first three structural forms (Substantives, Verbs, Adjectives) and with two items for each of the other 18 structural forms. The items of the second testing are only partly congruent with those of the first testing. In favor of new items in the more difficult structural forms, items of the particularly easy first three structural forms as well as in five other structural forms have been omitted in the testing in elementary school.

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