NEPS
National Educational Panel Study

Research Data

Information on Competence Testing

NEPS Starting Cohort 3 — Grade 5

Paths Through Lower Secondary School — Educational Pathways of Students in Grade 5 and Higher

Wave 1: Grade 5

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Information on testing	
Test situation	Group testing, normally taking place in the classroom, individual tests, single seats, 1 test instructor, normally 1 supervisory teaching staff
Test sequence	The tests are predetermined in two different sequences (random order of the test booklets for the study participants): **Test order test booklet 1**: reading speed, reading competence + procedural metacognition, mathematical competence + procedural metacognition, cognitive basic skills: perceptual speed + reasoning, orthography + procedural metacognition **Test order test booklet 2**: reading speed, mathematical competence + procedural metacognition, reading competence + procedural metacognition, cognitive basic skills: perceptual speed + reasoning, orthography + procedural metacognition
Test duration (net processing time)	100.5 minutes
Breaks	1 15-minute break before the test to measure cognitive basic skills

Information on the individual tests

Construct	**Number of Items**	**Allowed Processing Time**	**Survey Mode**	**Next Measurement (until 2013)**
Reading-related measures				
Reading speed	51	2 min	paper-pencil	
Reading competence	33	28 min	paper-pencil	After 2 years
Mathematical competence	25	28 min	paper-pencil	After 2 years
Cognitive basic skills (non-verbal)				
Perceptual speed	3 x 31 = 93	3 x 30 sec	paper-pencil	-
Reasoning	3 x 4 = 12	3 x 3 min	paper-pencil	-
Stage-specific measures				
Orthography	74	25 min	paper-pencil; Dictation from CD	After 2 years

Construct	Number of Items	Allowed Processing Time	Survey Mode	Next Measurement (until 2013)
Domain-specific procedural metacognition				Corresponding to the respective domains
Regarding the reading competence domain	6	3 min	paper-pencil	See above
Regarding the mathematical competence domain	4	3 min	paper-pencil	See above
Regarding the orthography domain	2	1 min	paper-pencil	See above

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.

Reading speed

In addition to the reading competence test which focuses on reading comprehension, an indicator of the reading speed is collected where primarily basal reading processes and/or their automation are given priority. The test which is processed by the study participants within two minutes is based on the test design principles of the two Salzburg reading screenings (e.g. Auer, Gruber, Mayringer & Wimmer, 2005). The test material, however, was newly designed for use by the National Education Panel. The study participants are given a total of 51 sentences which can normally be answered with the aid of general world knowledge, in other words no specific content-related previous knowledge is required (e.g. ”mice can fly”). After each sentence, the participant has to check whether the sentence is correct in terms of content (“true“) or not (”false“). When taking the test, participants mainly differ from each other by the number of sentences they are able to process within the given time limit. As a result of the less demanding material in terms of content, differences between participants with proportionately falsely processed sentences are to be neglected. The measure of the reading speed is determined by the number of sentences correctly judged during the two-minute processing limit.

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Reading competence

The ability to understand and use written texts is an important precondition for further developing personal knowledge and personal skills, and a prerequisite for participating in cultural and social life. Manifold areas of knowledge and life are made accessible through reading. The range of reading occasions is very wide, and reading fulfills many different functions (cf. Groeben & Hurrelmann, 2004). They range from reading for expanding knowledge which is crucial to further education and lifelong learning to literary-esthetic reading. Not only do texts convey information and facts, but they also transport ideas, moral concepts and cultural contents. Accordingly, the concept of reading competence in the National Education Panel takes functional understanding as a basis for reading competence, as is also reflected in the Anglo-Saxon *Literacy* Concept (also see OECD, 2009), with the focus on competent handling of texts in different typical everyday situations.

In order to represent the concept of reading competence over the entire life span as coherent as possible, three characteristic features were specified in the framework concepts for the NEPS reading competence test. They are considered in the following age and stage-specific test forms:

1. Text functions, text types respectively,
2. Comprehension requirements,
3. Task formats.

1. Text functions/text types

NEPS distinguishes between five text functions and associated text types which are represented in each version of the test: a) factual texts, b) commenting texts, c) literary texts, d) instructions and e) advertising texts. This selection is based on the assumption that these five text functions are of practical relevance to the study participants of various ages. The text functions and/or text types can be characterized as follows:

Texts conveying factual information represent basic texts for learning, fundamental acquisition of knowledge and extraction of information; examples are: articles, reports, reportages and announcements. Texts with a commenting function are texts in which a stand is taken or a controversial question is discussed and in whicha reflecting level is integrated. This is where, for the study and adult cohorts, for example, ingenious essays or humorous comments are found; and where, in the student cohorts, the blessing and curse of smoking could be discussed. The literary-esthetic function of texts was included in the third category; here short stories and extracts from novels or stories can be found. As a result of their specific reception that is presumably strongly dependent on educational track and curriculum, specific literary text types such as stage plays, satires or poems were excluded. The fourth category comprises text types conveying product inserts such as engineering and operating instructions, package inserts for medication, work instructions, cooking recipes etc. The fifth category (appeals, advertising) includes text types such as job advertisements, recreation programs etc. The five selected text functions and, thus, associated text types are realized as a longitudinal concept in each test booklet over the life

span, which means that each test/each test booklet, for measuring the reading competence, contains a total of five texts corresponding to the five text functions.

Unlike the PISA studies, NEPS does not include discontinuous texts such as graphics, tables, road maps etc. Discontinuous texts are not contained in the NEPS concept as they pose high demands on readers and, in addition, are not significant for every age group for which reading competence is tested in NEPS.

Age-specific selection (text complexity, topic selection/task requirements):

For each age cohort, texts were and are selected according to thematic orientation and lexical, semantic and grammatical properties that have to be appropriate for the respective group of readers. By increasing text complexity (larger vocabulary, longer words, foreign words), increased complexity of the sentence structures) as well as the basic length of texts, the test design takes into account the increasing reading competence from childhood to early adulthood. In addition, texts are selected in order to ensure that topics correspond to the environment of the respective age group. This covers a wide spectrum of topics ranging from animals (for children) to social and philosophical questions relating to the meaning of life for adults. Additionally, the test material is adjusted to the respective age group through age-adapted phrasing of the questions, answering options and the comprehension requirements of the tasks.

2. Comprehension requirements / task types

From the literature on reading competence and text comprehension (e.g. Kintsch, 1998; Richter & Christmann, 2002), it is possible to derive different types of comprehension requirements reflected in the NEPS concept in three specific requirement types of the tasks (task types). The variants are called *types* as there is no explicit assumption that tasks of one type are necessarily more difficult or easier than tasks of another type.

For tasks of the first type ("finding information in the text"), detailed information must be identified at sentence level, in other words deciphering and recognizing statements or propositions. For tasks on this requirement cluster, the information needed to solve the respective tasks is, in terms of the wording, either contained in the text and identical with the task itself, or phrasing varies slightly.

In the case of the second task type ("drawing text-related conclusions"), conclusions have to be drawn from several sentences to be related to each other in order to extract local or global coherence. In some cases, this takes place between sentences located closely together, in others, several sentences are spread over entire sections. In another form of this type, the task is to understand the thoughts expressed in the entire text, which requires the comprehension and integration of larger and more complex text portions.

For the third type, the requirements of "reflecting and assessing" are in the foreground, which in the literature is often linked to the mental representation of the text in the form of a situation model. In one version of this task type, the task is to understand the central idea, the main events or the core message of text, whereas in another version, the purpose and intention of a text has to be recognized and the readers are asked to assess the credibility of a text.

The different comprehension requirements occur in all text functions and are considered in the respective test versions in a well-proportioned ratio. (cf. Fig. 1.).

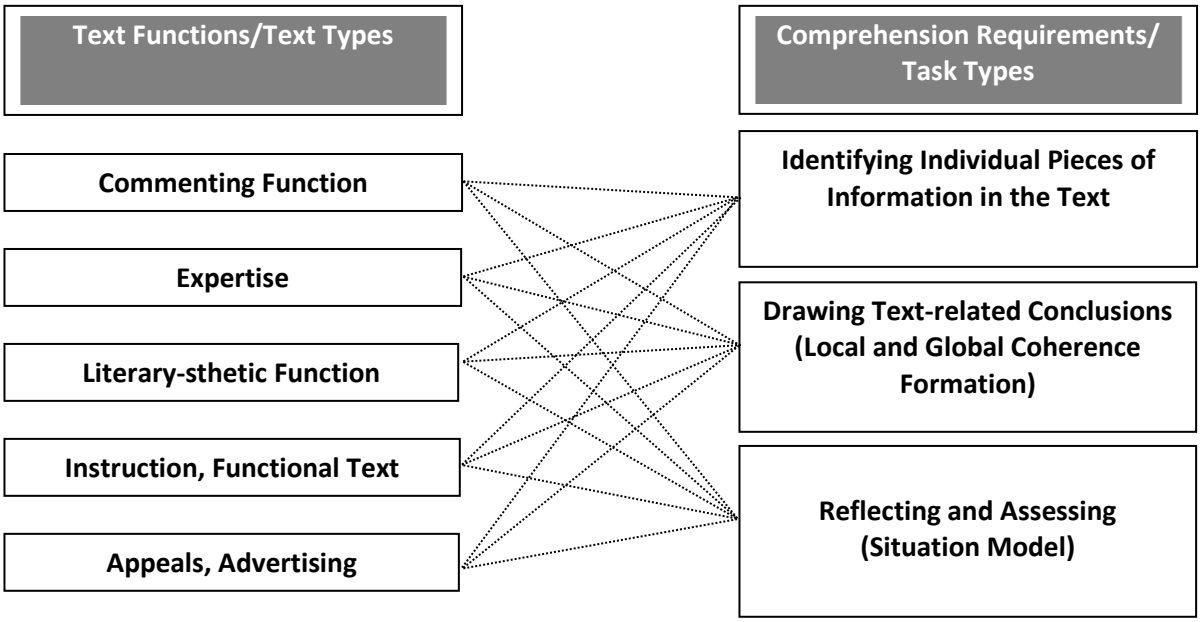

Fig. 1: Text functions and comprehension requirements

3. Task formats

The majority of tasks match the multiple choice format. Tasks of this type consist of a question/assignment on a text for which four different answers are offered, one of which is the correct answer. As another task format, decision-making tasks are used where individual statements have to be judged on whether they are right or wrong according to the text. The so-called correlation tasks represent a third format where, for example, a partial title must be chosen and assigned to different sections of a text. For tasks of the second and third type, summaries are made, if necessary, thus creating answers with partly correct solutions (partial credit items).

By systematically considering different text functions, which are implemented in different age groups in realistic and age-related texts, text themes and different comprehension requirements of the related tasks, it is possible to operationalize reading competence as a comprehensive ability construct.

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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.

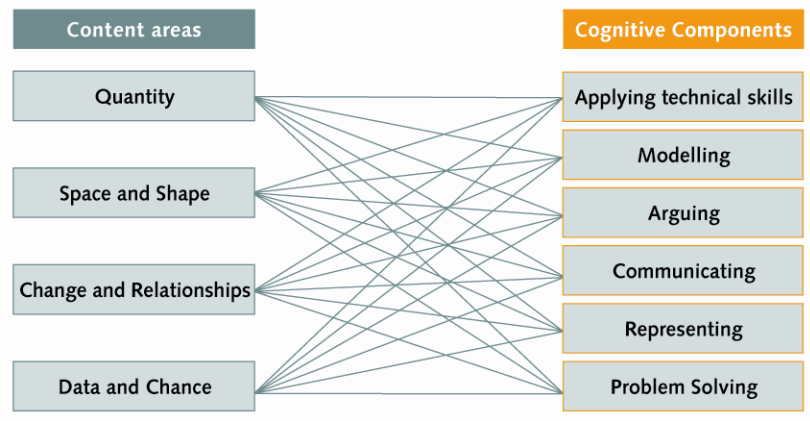

Fig. 1: Framework of mathematical competence in NEPS

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.
  Examples from the *elementary sector*: comparisons of sets, counting (ordinal/cardinal aspects of numbers), simple operations (e.g., adding)
  Examples from the *adult sector*: calculations of percentages and interests, calculations of area and volume, use of different units, simple equation systems
- **Space and Shape** includes all types of planar and spatial configurations, shapes or patterns.
  Examples from the *elementary sector*: recognizing geometric shapes, simple properties of shapes, perspective
  Examples from the *adult sector*: three-dimensional mathematical objects, geometric mappings, elementary geometric theorems
- **Change and Relationships** includes all kinds of (functional) relationships and patterns.
  Examples from the *elementary sector*: recognizing and continuing patterns, relationships among numbers, proportionality

Examples from the *adult sector*: interpreting curves or function graphs, properties of linear, quadratic, and exponential functions, extremum problems

- **Data and Chance** comprises all situations involving statistical data or chance.
  Examples from the *elementary sector*: intuitively assessing probabilities, collecting and structuring data
  Examples from the *adult sector*: interpreting statistics, basic statistical methods, calculating probabilities

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.

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Cognitive basic skills (non-verbal) – Perceptual speed and reasoning

In NEPS, cognitive basic skills are measured based on the differentiation between "cognitive mechanics" and "cognitive pragmatics" following Baltes, Staudinger and Lindenberger (1999). While the former is measured using task contents as education-independent, new and domain-unspecific as possible, the tasks for measuring cognitive pragmatics are based on acquired skills and knowledge (Ackerman, 1987). Consequently, some of the domain-specific performance tests used within the framework of NEPS may serve as indicators of pragmatics.

In contrast to this, the tests of basic cognitive skills aim at assessing individual differences of fluid cognitive abilities. While these are subject to age-related changes, in comparison to the education- and knowledge-related competences they prove to be less culture-, experience- and language-dependent and more strongly biologically determined. In this context, these tests provide an individual basis and differentiating basic function for the acquisition of education-dependent competences.

Among the facets of cognitive mechanics, two common marker variables stand out: perceptual speed (WG) and reasoning (SF).

Perceptual speed marks the basal speed of information processing (*"speed"*). In NEPS, this is measured by the Picture Symbol Test (NEPS-BZT). This is based on an improved version of the Digit-Symbol Test (DST) from the intelligence tests of the Wechsler family by Lang, Weiss, Stocker and von Rosenbladt (2007). Analogously to this improved version, the NEPS-BZT requires the reverse performance: to enter the correct figures for the preset symbols according to an answer key.

Reasoning serves as key marker of fluid intelligence (Gottfredson, 1997). The NEPS reasoning test (NEPS-MAT) is designed as a matrices test in the tradition of the RAVEN Test. Each item of the matrices test consists of several horizontally and vertically arranged fields in which different geometrical elements are shown – with only one field remaining free. The logical rules on which the pattern of the geometrical elements is based have to be deduced in order to be able to select the right complement for the free field from the offered solutions.

Both tests have been designed in such a way that they can be effectively used without changes to the item sets across as many age groups as possible and relatively independent from the subjects' mother tongue. Currently, they are administered as paper-and-pencil tests, while computer-aided administration is generally possible.

The results of both tests provide an estimator of basic cognitive skills which, however, is not directly comparable to the overall result of a traditional intelligence test (IQ). It rather permits controlling for differential initial capacities in the competence acquisition process.

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Orthography

As empirical results at the end of elementary school reveal, some of the fourth graders still show serious orthography problems (cf. Löffler & Meyer-Schepers, 2005). Those verifiably extend across the entire secondary school period and increase even more (Schneider et al., 2008:149). However, orthographic performance is seen as a reliable predictor for the educational path of students (Schneider et al., ebd.). For these reasons, orthographic competence is tested as a stage-specific complement at secondary level in grade 5, 7 and 9.

For testing orthographic competence in NEPS, a language-systematic testing tool was developed. It is based on a differential competence model (Blatt et al. in print) empirically founded in the "Orthography" complementary studies to PIRLS-2006 (International Elementary School Reading Survey) and HeLp-2007/8 (Hamburg Reading Promotion Project). This competence model is based on research results of the linguistic field of graphemics (Eisenberg 2006). Oriented towards the principles of German orthography shown by Eisenberg, five sub skills are differentiated (Tab. 1):

Tab. 1: Differential orthographic competence model according to the Eisenberg principles (2006)

Orientation Towards Principles	**Sub skill**
Phonographic and syllabic principle in the core area	Establish relationship between graphic and phonological structure with reference to the information on syllable structure (onset, coda, syllable cut)
Morphological principle in the core area	Derive inherited syllable-written information in inflected and derived forms, know and use inflectional morphemes
Peripheral area	Put irregular markings in open syllables, i.e. in inherited spellings; foreign word spelling
Principles of word formation	Know different parts of speech and word formation morphemes and productively use them in derivations and compounds
syntactic principle	Know syntax structures and apply to capitalization, writing as separate words or as one word, "dass" spelling and punctuation

Approx. 75 percent of the test words used for the NEPS spelling test in fifth grade originate from the test material of the "Orthography" complementary study to HeLp 2007/08 and has thus already been checked for test quality criteria. About one fourth of the test words was newly developed and piloted in smaller testis. The test words are evaluated both as a whole and in terms of the included sub skills, and are broken down into structural units according to the sub skills. The test material is selected so that it provides an adequate number of structural units for testing all five sub skills. In fifth grade, the testing focuses on the core area of spelling, in other words on regular spellings. Therefore, the number of the structural units is comparably smaller in the peripheral area. Regarding the further development in terms of content of the systematic language tests for grades seven and nine, the peripheral area will be extended in accordance with the framework plans, i.e. more words will be

included that cannot be derived regularly as is the case with foreign word or words with an “h” with a lengthening effect on the preceding vowel. In addition, the number of structural units is increased to the sytanctic principle; punctuation will be supplemented as well.

In grade level five, as a test format, a gap test combined with three complete sentences was selected, which proved to be particularly time-efficient. In order to be able to adequately test the use of commas, sentence-related capitalization and the use of small initial letters as well as writing as separate words or as one word, the test format in grade level nine will probably be a whole text.

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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.

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 the study 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.

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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