[NEPS
National Educational Panel Study

Information on Competence Testing

NEPS Starting Cohort 4 — Grade 9

School and Vocational Training — Educational Pathways of Students in Grade 9 and Higher

Wave 1: Grade 9

LⁱfBi

LEIBNIZ INSTITUTE FOR EDUCATIONAL TRAJECTORIES

Information on testing

Test situation	Group testing, normally taking place in the classroom, 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**: ICT literacy, scientific competence, reading speed, mathematical competence, listening comprehension at word level: receptive vocabulary **Test order test booklet 2**: scientific competence, ICT literacy, reading speed, mathematical competence, listening comprehension at word level, receptive vocabulary
Test duration (net processing time)	112 min
Breaks	1 15-minute break before the test to measure the reading speed

Information on the individual tests

Construct	Number of Items	Allowed Processing Time	Survey Mode	Next Measurement (until 2013)
ICT Literacy	40	29 min	paper-pencil	After 3 years
Scientific competence	28	29 min	paper-pencil	
Reading speed	51	2 min	paper-pencil	After 3 years
Mathematical competence	22	28 min	paper-pencil	After 2 years
Listening comprehension at word level: receptive vocabulary	89	20 min	paper-pencil	
Domain-specific procedural metacognition				Corresponding to the respective domains
Regarding the ICT Literacy domain	1	1 min	paper-pencil	See above
Regarding the scientific competence domain	1	1 min	paper-pencil	See above
Regarding the mathematical competence domain	1	1 min	paper-pencil	See above
Regarding the receptive vocabulary domain	1	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.

ICT Literacy

New conceptions for computer literacy increasingly emphasize aspects of information literacy in addition to technological literacy (basic declarative and procedural functional knowledge about hardware and software applications). Computer literacy is the ability to create, access, manage, integrate, and evaluate information using digital media. It can thus be seen as a combination of technological and information literacy. Therefore, explicit technological and informational tasks in specific contexts are represented in the tests. Different process components and content areas are taken into account for a content valid test construction. The process components were either allocated to technological literacy (e.g. create) or information literacy (e.g. evaluate) (see Fig. 1). Various software applications (e.g. operating system, internet search engines) were included for the content areas. All test items were constructed in such a way that they could be allocated to either of the two subscales as well as to a process component and a field of content.
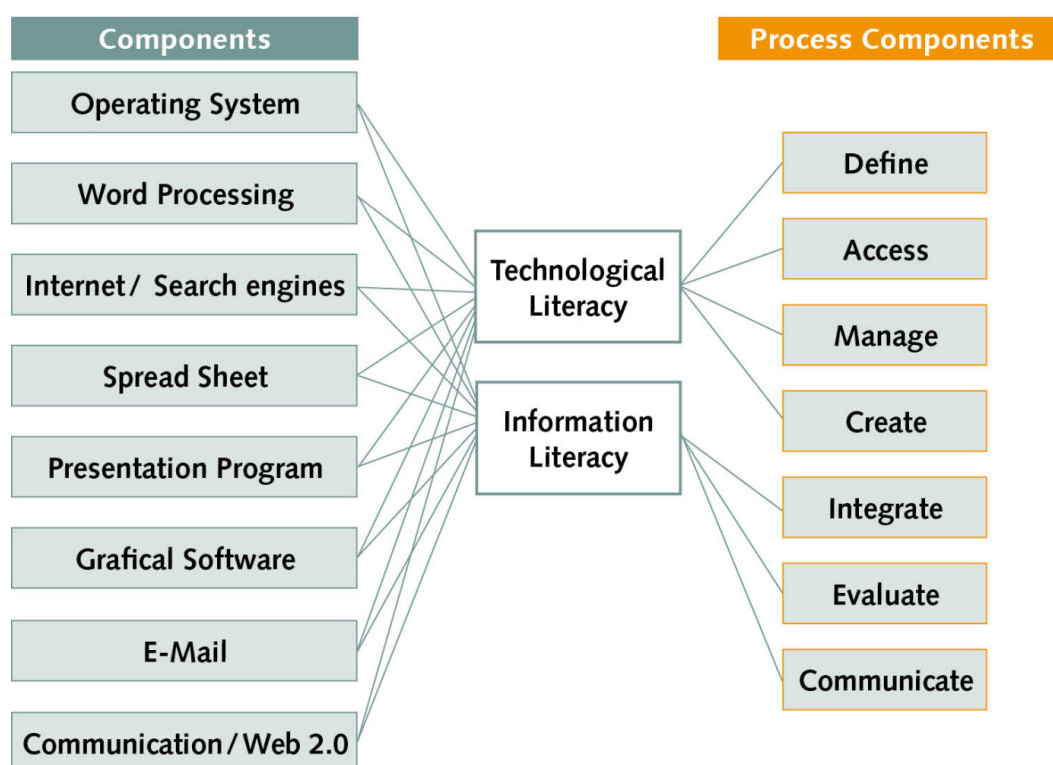

Fig. 1: ICT Literacy Outline Concept in NEPS

Scientific competence

Scientific competence is the precondition for participating in world affairs marked by science and technology (Prenzel, 2000; Prenzel et al., 2001; Rost et al., 2004) and is viewed as a predictor for an economically, socially and culturally successful life. Many problems and issues we encounter in our daily life require an understanding of natural sciences and technology. Scientific topics and problems affect all. Therefore, the current discussions of the goals of scientific education focus on the concept of scientific literacy for all people (Osborne & Dillon, 2008). Such literacy is the basis for lifelong learning, serves as a connection for further learning (OECD, 2006; Prenzel et al., 2007) and, thus, also influences professional careers.

Based on this, the NEPS definition of scientific competence follows the Anglo-Saxon literacy concept (Bybee, 1997; Gräber, Nentwig, Koballa & Evans, 2002; OECD, 2006) that does not regard scientific competence as a simple reproduction but rather as flexible use of acquired knowledge in different situations and contexts of daily life.

In NEPS, scientific competence is understood as the use of scientific knowledge in the environmental, technological and health contexts. In addition, the concept distinguishes between content-related and process-related elements (see Fig. 1). In selecting its contexts as well as the content-related and process-related elements, NEPS uses the education standards of the Conference of Ministers of Education for the medium-level school-leaving qualification (KMK, 2005) and the *Benchmarks for Scientific Literacy* of the *American Association for the Advancement of Science* (AAAS, 1989, 2009) as a guideline. The selected contexts are of personal, social and global relevance. Considering the current scientific research and the general events of the day, it is assumed that they will remain important across the entire life span.
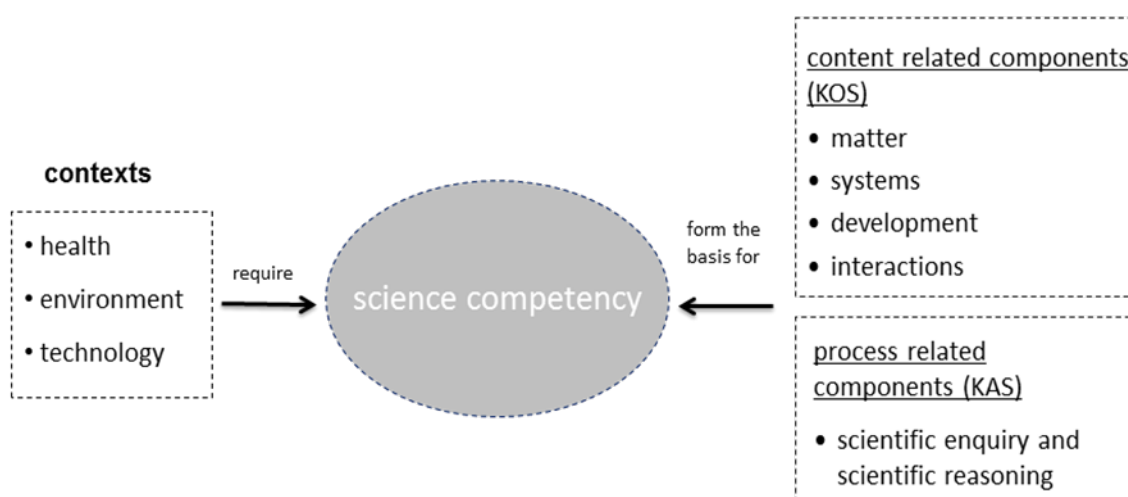

Fig.1: Application contexts as well as content-related and process-related elements of scientific competence of the NEPS scientific test.

The selected content-related and process-related elements cover central concepts of all scientific disciplines. The scientific knowledge domain comprises the content-related matter, *systems*, *development* and *interactions*. The knowledge of natural sciences includes *inquiry*

and scientific reasoning that deal, among other things, with checking hypotheses, interpreting findings as well as measuring principles and measuring error control.

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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 new 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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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.
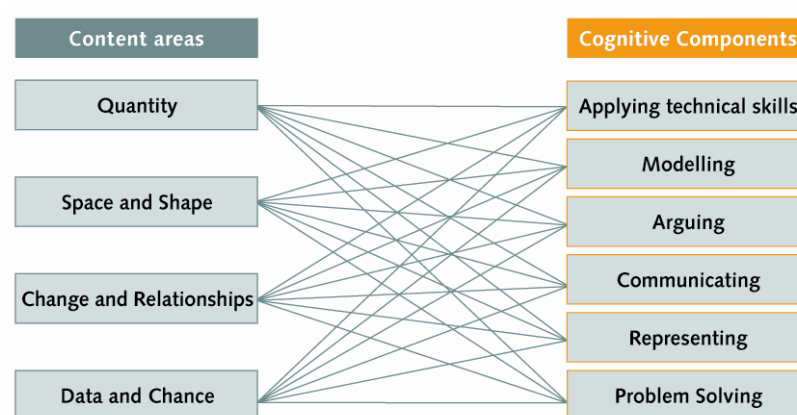

Fig. 1:   Framework of mathematical competence in NEPS

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 *adult 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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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 favourable, 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.

A German version of the PPVT was published in 2004 (Dunn & Dunn, 2004) based on the PPVT-III (Dunn & Dunn, 1997). It is suitable for older children from the age of 13 years. 89 items were selected from the 204 of the PPVT-III.

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

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

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Metacognition

Metacognition is the knowledge about and control of the own cognitive system. According to Flavell (1979) und Brown (1987), the NEPS distinguishes declarative and procedural aspects of metacognition.

Procedural metacognition

Procedural metacognition includes the regulation of the learning process through activities of planning, monitoring and control. Within NEPS the procedural aspect of metacognition is not assessed as a direct measure of such planning, monitoring and control activities but as a metacognitive judgement along with the domain-specific competence tests (judgment of performance during/shortly after the learning phase; see also Nelson & Narens, 1990). After the participants have completed all items of the respective competence tests, they are asked to estimate their own performance in the domain-specific competence test.

In general, one judgment about the portion of correctly given answers is inquired per competence domain. For competence domains divided into coherent individual parts (e.g. reading competence assessed by providing items referring to several texts), the assessment of procedural metacognition is referred to these parts as well, resulting in a longer assessment time.

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