NEPS

National Educational Panel Study

Information on Competence Testing

NEPS Starting Cohort 5 — Students

From Higher Education to the Labor Market

Wave 5: 6th Semester

LIfBi

**LEIBNIZ INSTITUTE FOR
EDUCATIONAL TRAJECTORIES**

Information on Testing

Test situation	for sub sample 1 group testing in rooms at universities (or in external rooms), with 1 test instructor, in case of CBA testing with team of 1 or 2 technical advisors; for sub sample 2 online administered individual testing
Test sequence	Testing was administered wihtin one day. Group testing was done conventionally paper-pencil based or paper-based with e-pen or computer-based with notebooks. The test booklet contained tests on science competency, ICT literacy, domain specific procedural metacognition for science competency and ICT literacy, and cognitive basic skills.
Test duration (net processing time)	70,5 min

Information on the individual tests

Construct	Number of Items	Allowed Processing Time	Survey Mode	Position in version A	Position in version B
Science competency	30	29 min	**paper-pencil** or **e-pen** or **computer-based** or **online**	1	3
Domain specific procedural metacognition on science competency	1	1 min		2	4
ICT literacy	36	29 min		3	1
Domain specific procedural metacognition on ICT literacy	1	1 min		4	2
Cognitive basic skills (non-verbal): Perceptual speed	93	1,5 min		5	5
Cognitive basic skills (non-verbal): Reasoning	12	9 min		6	6

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.

Science competency

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 people. 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.
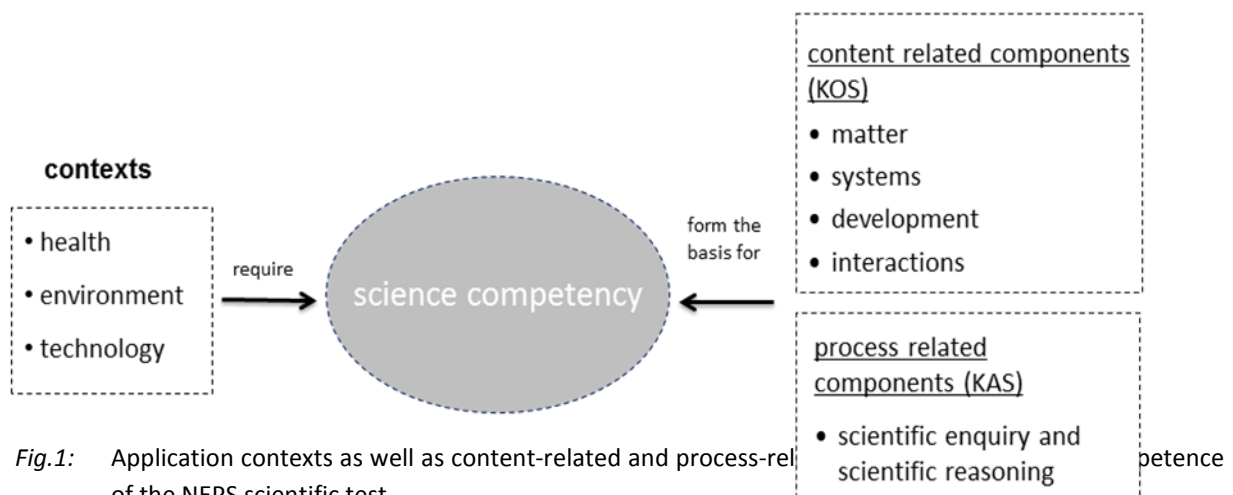

Fig.1: Application contexts as well as content-related and process-rel[...]petence of the NEPS scientific test.

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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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.
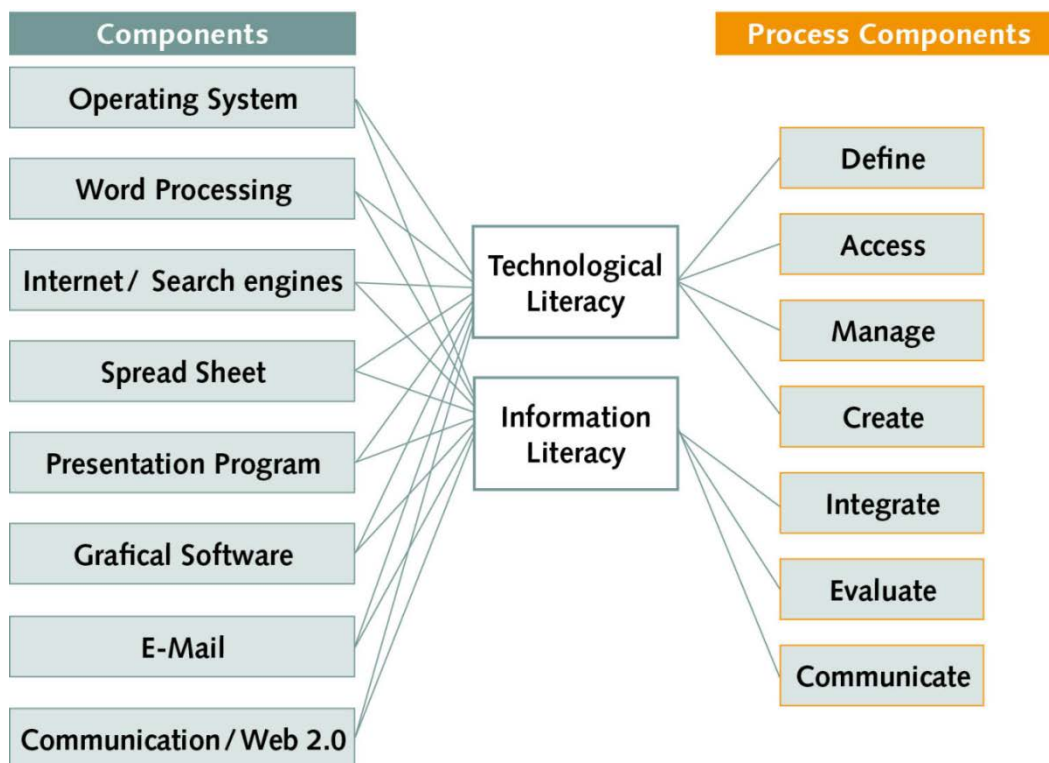

Fig. 1:   ICT Literacy Outline Concept in NEPS

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 the procedural aspect of metacognition – in combination with the competence tests of individual domains – is not assessed as a direct measure of such planning, monitoring, and controlling activities but as a metacognitive judgement that refers to monitoring of 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 number 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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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. 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 and reasoning.

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 tests of the Wechsler family by Lang, Weiss, Stocker and von Rosenbladt (2007). Analogously to this improved version, the NEPS-BZT requires the performance to enter the correct figures for the preset symbols according to an answer key.

Reasoning serves as key marker of mental performance (Baltes et al., 1999). The NEPS reasoning test (NEPS-MAT) is designed as a matrices test in the tradition of the typical reasoning tests. 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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