NEPS
National Educational Panel Study

Research Data

Information on Competence Testing

NEPS Starting Cohort 2 — Kindergarten

From Kindergarten to Elementary School

Wave 5: Grade 3

LIfBi
LEIBNIZ INSTITUTE FOR
EDUCATIONAL TRAJECTORIES

Information in testing	
Test situation	Paper-based group testing (N <20) at school, 1 test instructor
Test sequence	The tests are held on two test days. **Test day 1**: Scientific literacy und ICT literacy (computer knowledge) **Test day 2**: Listening comprehension on word level and declarative metacognition
Test duration (net processing time)	**Test day 1**: 62 minutes **Test day 2**: 36 minutes (+ 30 min for student questionnaire)
Breaks	**Test day 1**: 15-minute break between scientific literacy and ICT literacy **Test day 2**: 5-minute break between listening comprehension on word level and declarative metacognition; 10-minute break between declarative metacognition and student questionnaire

Information on the individual tests

Construct	**Number of items**	**Allowed processing time**	**Survey mode**	**Next measure-ment**
1. Test day				
Scientific literacy	23	30 min	multiple-choice answer format true/false answer format open answer format	grade 7
Domain-specific procedural metacognition				
regarding the domain of scientific literacy	1	1 min	picture-based answer format	grade 7
ICT literacy (computer knowledge)	30	30 min	multiple-choice answer format true/false answer format open answer format	--
Domain-specific procedural metacognition				
regarding the domain of ICT literacy	1	1 min	picture-based answer format	--
2. Test day				
Listening comprehension on word level: receptive vocab-ulary				
Word-picture-matching	72	20 min	picture-based answer format	--

Domain-specific procedural metacognition				
regarding the domain of listening comprehension on word level	1	1 min	picture-based answer format	--
Declarative metacognition	10	15 min	picture-based answer format	--

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.

Scientific literacy

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.

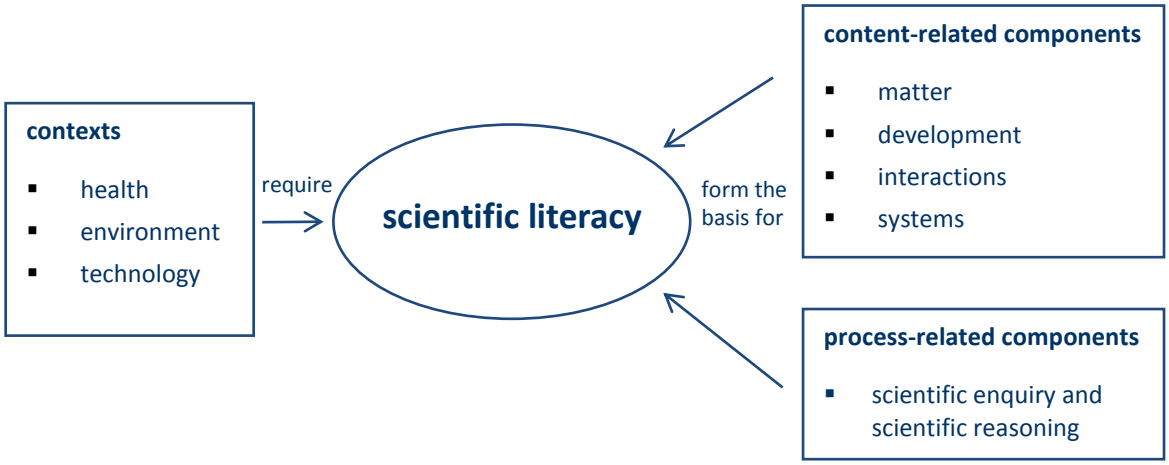

Figure 1: Implementation contexts as well as the content-related and process-related components scientific competence test of the NEPS-science tests

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

Bibliography

American Association for the Advancement of Science (AAAS). (2009). *Benchmarks for science literacy. Project 206*. Retrieved from http://www.project2061.org/publications/bsl/online/index.php

Bybee, R. W. (1997). Towards an understanding of scientific literacy. In W. Gräber & C. Bolte (Eds.), *Scientific literacy – An international symposium* (pp. 37–68). Kiel: Institut für die Pädagogik der Naturwissenschaften (IPN).

Gräber, W., Nentwig, P., Koballa, T. & Evans, R. (Eds.). (2002). *Scientific Literacy. Der Beitrag der Naturwissenschaften zur Allgemeinen Bildung*. Opladen: Leske + Budrich.

KMK (2005a). *Beschlüsse der Kultusministerkonferenz: Bildungsstandards im Fach Biologie für den Mittleren Schulabschluss*. Beschluss vom 16.12.2004. München: Luchterhand.

KMK (2005b). *Beschlüsse der Kultusministerkonferenz: Bildungsstandards im Fach Chemie für den Mittleren Schulabschluss*. Beschluss vom 16.12.2004. München: Luchterhand.

KMK (2005c). *Beschlüsse der Kultusministerkonferenz: Bildungsstandards im Fach Physik für den Mittleren Schulabschluss*. Beschluss vom 16.12.2004. München: Luchterhand.

OECD (2006). *Assessing scientific, reading and mathematical literacy: A framework for PISA 2006.* Paris: OECD.

Prenzel, M. (2000). Lernen über die Lebensspanne aus einer domänenspezifischen Perspektive: Naturwissenschaften als Beispiel. In F. Achtenhagen & W. Lempert (Eds.), *Lebenslanges Lernen im Beruf - seine Grundlegung im Kindes- und Jugendalter. Band IV. Formen und Inhalte von Lernprozessen* (pp. 175-192). Opladen: Leske + Budrich.

Prenzel, M. (2001). Voraussetzungen und Beispiel zu PUS. In M.-D. Weitze (Ed.), *Public Understanding of Science: Theorie und Praxis. Public Understanding of Science im deutschsprachigen Raum. Die Rolle der Museen* (pp. 49–61).

Rost, J. (2004). *Lehrbuch Testtheorie – Testkonstruktion*. Bern: Verlag Hans Huber.

Prenzel, M., Schöps, K., Rönnebeck, S., Senkbeil, M., Walter, O., Carstensen, C. & Hammann, M. (2007). Naturwissenschaftliche Kompetenz im internationalen Vergleich. In M. Prenzel, C. Artelt, J. Baumert, W. Blum, M. Hammann, E. Klieme & R. Pekrun (Eds.), *PISA 2006. Die Ergebnisse der dritten internationalen Vergleichsstudie* (pp. 63-105). Münster: Waxmann.

ICT Literacy

New conceptions for computer literacy (e.g. ETS, 2002; Fraillon, Schulz, & Ainley, 2013) 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. 2). 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.

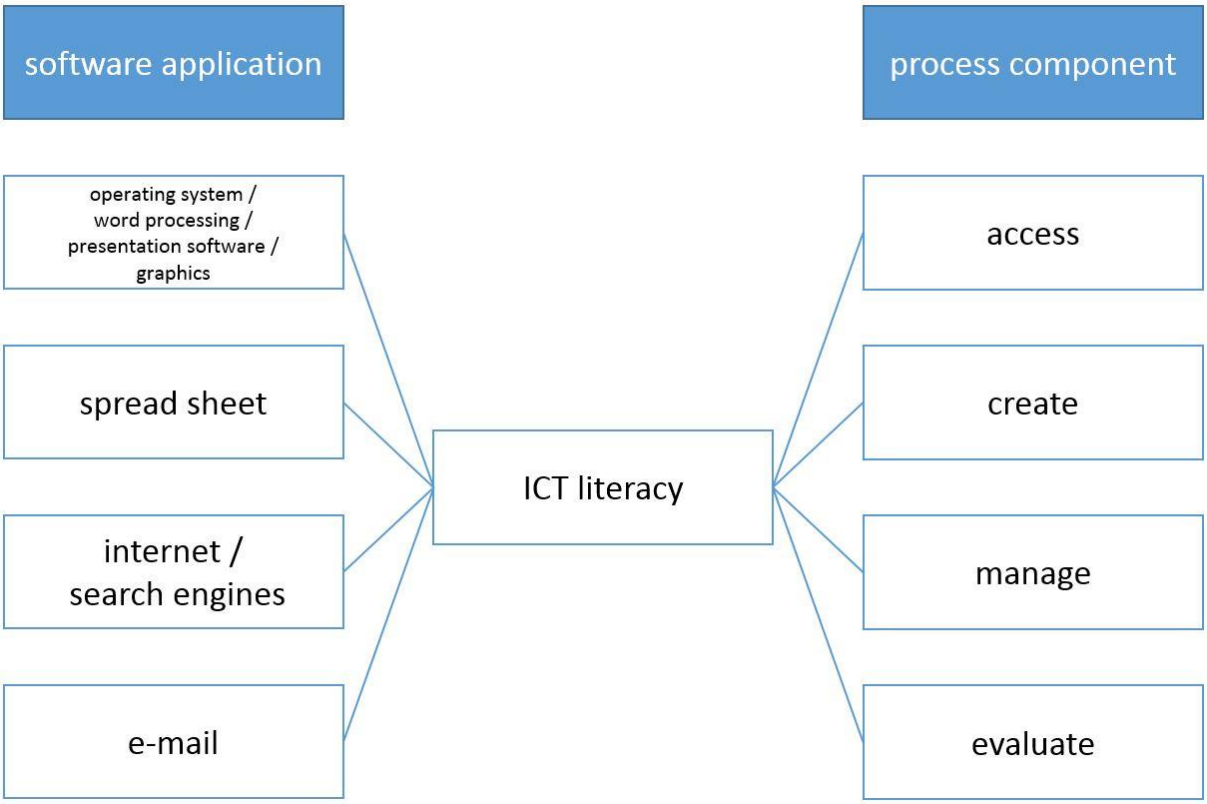

Figure 2: Conceptual framework of ICT literacy in NEPS

Bibliography

ETS (2002). *Digital transformation. A framework for ICT literacy.* Princeton, NJ: ETS.

Fraillon, J., Schulz, W. & Ainley, J. (2013). *International computer and information literacy study assessment framework*. Amsterdam, Niederlande: International Association for the Evaluation of Educational Assessment (IEA).

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 hand. However, not all indicators are measured at each survey.

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 only available for older children from an age of 13 years (Dunn & Dunn, 2004), a procedure analogous to PPVT was prepared for NEPS. Based on a NEPS-pilot study with 638 children 72 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. The test in 3rd grade was presented in two different versions, which differed in their order of answer options.

[1] http://www.acf.hhs.gov/programs/opre/hs/faces/

[2] http://www.statcan.ca/english/sdds/4450.htm

Bibliography

Bynner, J. (2004). Participation and progression: use of British Cohort Study data in illuminating the role of basic skills and other factors. *Nuffield Review of 14-19 Education and Training,* Working Paper 9.

Dunn, L. M. (1959). *Peabody Picture Vocabulary Test (PPVT): Manual of directions and forms.* Nashville, TN: American Guidance Service.

Dunn, L. M. & Dunn, L. M. (1981). *Peabody Picture Vocabulary Test-Revised* (PPVT-R). Circle Pines, MN: American Guidance Service.

Dunn, L.M. & Dunn, L.M. (1997). *Peabody Picture Vocabulary Test, Third Edition* (PPVT-III). Circle Pines, MN: American Guidance Service.

Dunn, L. M. & Dunn, L. M. (2004). *Peabody Picture Vocabulary Test* (PPVT) (deutsche Version). Göttingen: Hogrefe.

Dunn, L. M. & Dunn, L. M. (2007). *Peabody Picture Vocabulary Test, Fourth Edition* (PPVT-4). Upper Saddle River, NJ: Pearson.

European Child Care and Education (ECCE)-Study Group (1997). *European Child Care and Education Study. Cross national analyses of the quality and effects of early childhood programmes on children's development*. Berlin: Freie Universität Berlin, Fachbereich Erziehungswissenschaft, Psychologie und Sportwissenschaft, Institut für Sozial- und Kleinkindpädagogik.

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.

When assessing declarative metacognition in 3rd grade the scenarios and proposed strategies are presented orally accompanied by pictures. Contrary to the assessment in first grade, the texts are printed in the test material to enable the children to read along (Lockl, Händel & Artelt, under review). Children are asked to rate three strategies per scenario.

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.

Procedural metacognition

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.

Bibliography

Borkowski, J. G., Milstead, M., & Hale, C. (1988). Components of children's metamemory: Implications for strategy generalization. In F. E. Weinert & M. Perlmutter (Eds.), *Memory development: Universal changes und individual differences* (pp. 73–100). Hillsdale, NJ: Erlbaum.

Brown, A. L. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. In F. E. Weinert and R. H. Kluwe (Eds.), *Metacognition, motivation, and understanding* (pp. 65-116). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Flavell, J. H. (1979). Metacognition and Cognitive Monitoring: A New Area of Cognitive-Developmental Inquiry. *American Psychologist, 34*, 906-911.

Händel, M., Artelt, C., & Weinert, S. (2013). Assessing metacognitive knowledge: Development and evaluation of a test instrument. *Journal of Educational Research Online, 5(2),* 162-188*.*

Lockl, K., Händel, M. & Artelt, C. (under review). Kompetenztestung bei Grundschulkindern: Differenzielle Effekte unterschiedlicher Testbedingungen. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie.*

Nelson, T.O. & Narens, L. (1990). Metamemory: A theoretical framework and new findings. In G.H. Bower (Hrsg.), *The psychology of learning and motivation* (pp. 125-141). New York: Academic Press.

Neuenhaus, N., Artelt, C., Lingel, K., & Schneider, W. (2011). Fifth graders metacognitive knowledge: gerneral or domain specific? *European Journal of Psychology of Education*, *26*, 163–178.

Paris, S. G., Lipson, M. Y., & Wixson, K. K. (1983). Becoming a strategic reader. *Contemporary Educational Psychology*, *8*(3), 293–316.

Schlagmüller, M., & Schneider, W. (2007). *WLST 7-12. Würzburger Lesestrategie-Wissenstest für die Klassen 7 bis 12*. Göttingen: Hogrefe.