NEPS
National Educational Panel Study

Research Data

Information on Competence Testing

NEPS Starting Cohort 4 — Grade 9

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

Wave 14: 26 years

LIfBi
LEIBNIZ INSTITUTE FOR
EDUCATIONAL TRAJECTORIES

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Bamberg; September 11, 2023

Information on testing	
Sample	Study B157, Starting Cohort 4 und 6, Year 2021. The study was conducted as a Computer Assisted Personal Interview (CAPI).
Test situation	CAPI field with computer-based testing (CBT)
Test sequence	*Computer-assisted face-to-face interviews (CAPI) with integrated task processing on the computer (TBT):* The participants completed computer-based tasks in the technology-based testing (TBT) module in their own households. A biographical interview was conducted subsequently.
	Rotations
	The tests were given in different rotations (test sequences). Rotation 1: Scientific Literacy + procedural metacognition – ICT Literacy + procedural metacognition Rotation 2: ICT Literacy + procedural metacognition – Scientific Literacy + procedural metacognition
Test duration (net test time)	60 minutes
Administration time (incl. survey)	Starting Cohort 4: 100 minutes (60 minutes testing; 40 minutes biographical interview) Starting Cohort 6: 90 minutes (60 minutes testing; 30 minutes biographical interview)

Information on constructs				
Constructs	Number of Items	Allowed Processing Time	Survey Mode	Next Measurement (expected)
ICT Literacy	20	28 min	CAPI (TBT)	
Scientific Literacy	23	28 min	CAPI (TBT)	
Stage-specific procedural metacognition Regarding the ICT Literacy domain	2	2 min	CAPI (TBT)	
Stage-specific procedural metacognition Regarding the Scientific Literacy domain	1	1 min	CAPI (TBT)	

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.

Main study B157, 2021

ICT Literacy

The ability to effectively use ICT (information and communication technologies) plays an important role in schools, many workplaces and in people's everyday lives (Fraillon, Alnley, Schulz, Friedman, & Duckworth, 2019). Therefore, researchers as well as organizations (e.g., European Commission, International Society for Technology in Education) have developed frameworks to promote ICT literacy by describing competencies and skills that are considered important for the knowledge society (Siddiq, Hatlevik, Olsen, Throndsen, & Scherer, 2016). More recent conceptualizations of ICT literacy integrate technologial and cognitive aspects to define this competence. Technological aspects encompass the knowledge of hardware and software applications and understanding technological concepts. Cognitive aspects, labeled as information literacy, encompass the ability to use digital media to access, create, manage and critically evaluate information and to use it effectively for one's own purposes, also plays an important role (ETS, 2002).

Thus, ICT literacy is understood as a meta-competence that helps people to acquire important competencies and skills for educational and work situations and to achieve private goals over the entire life span (van Laar, van Deursen, van Dijk, & de Haan, 2017). Furthermore, since people need to acquire new knowledge and skills in a self-regulated way over the life span that are increasingly mediated through digital media, ICT literacy is a necessary prerequisite for successfully keeping pace with recent developments in the area of digital media (Goldhammer, Gniewosz, & Zylka, 2017).

One widely used definition of ICT literacy to which we also refer was formulated by the *ICT Literacy Panel*: „ICT literacy is the ability to appropriately use digital technology, communication tools, and/or networks to solve information problems in order to function in an information society. This includes having the ability to use technology as a tool to research, organize, and communicate information" (ETS, 2002, p. 16).

In the context of NEPS, *ICT Literacy* is conceptualized as a unidimensional construct comprising the facets of process components and software applications (see Figure 1; Senkbeil & Ihme, 2020; Senkbeil, Ihme & Wittwer, 2013a, b). As a basis for constructing the instrument assessing computer literacy in NEPS, we use a framework that identifies four process components of computer literacy representing the knowledge and skills needed for a problem-oriented use of modern information and communication technology. Each process component integrates technological and cognitive aspects of the construct. The process components are defined as follows:

Access: knowledge of basic operations used to retrieve information (e.g., entering a search term in an internet browser, opening and saving a document);

Create: the ability to create and edit documents and files (e.g., setting up tables, creating formulas);

Manage: the ability to find information within a program (e.g., retrieving information from tables, processing the hits returned by a search engine);

Evaluate: the ability to assess information and to use it as the basis for informed decisions (e.g., assessing the credibility of the information retrieved).

Apart from the process components, the construction of the NEPS tests for ICT Literacy is guided by a categorization of software applications that are used to locate, process, present, and communicate information: (a) word processing and operating systems, (b) spreadsheet and presentation software,

(c) e-mail and other communication applications, and (d) internet and internet-based search engines. Each item in the test refers to one process component and one software application.

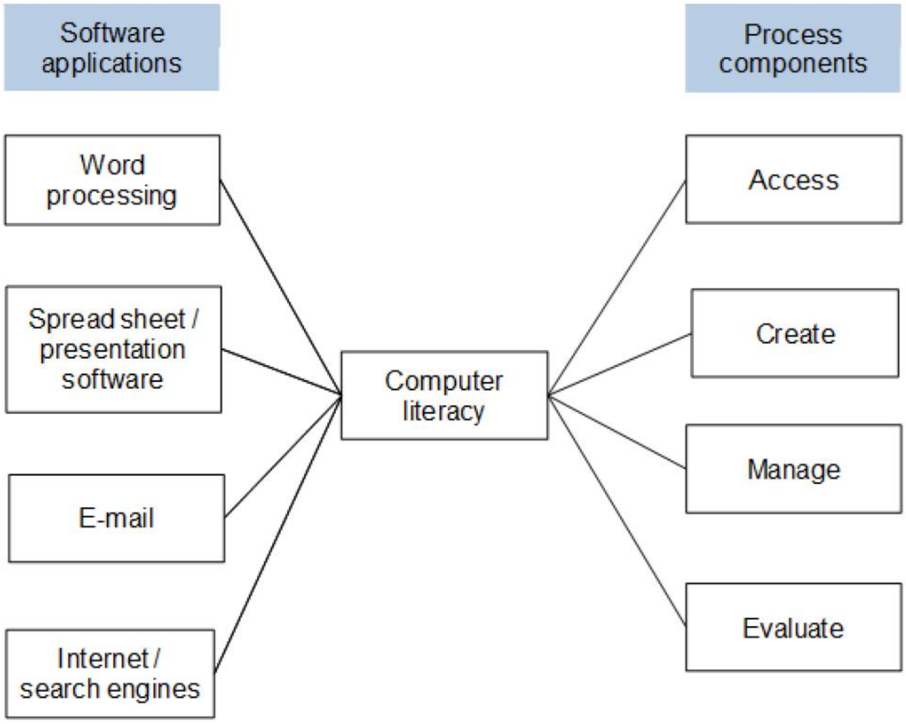

Figure. 1: Assessment framework for ICT Literacy in the German National Educational Panel Study

Item format

The assessment of computer literacy contains two types of tasks.

The first type of tasks, knowledge-based and *static items*, which account for about half of the tasks, were pencil-and-paper questions. These task addressed factual (e.g., computer terminology) and conceptual knowledge (classifications, and principles), whether the test subjects can deal appropriately with certain computer-based tasks (e.g. saving a file on a specific drive). To do so, participants were presented with realistic problems embedded in a range of authentic situations. About half of the items used screenshots, for example, of an internet browser, an electronic database, or a spreadsheet as prompts (see Senkbeil et al., 2013). The static items included two types of response formats: simple multiple choice (MC) and complex multiple choice (CMC) items. In MC items the test taker had to identify the correct answer out of four to six response options with one option being correct and three to five response items functioning as distractors (i.e., they were incorrect). In CMC items several subtasks with two response options each (true / false) were presented.

The second type of tasks were *interactive items* of simulations of generic software or universal applications to complete an action. These interactive items additionally addressed procedural and strategic knowledge (e.g., planning, executing, and monitoring the problem-solving process). Respondents were required to solve specific tasks and problems by using and interacting with these simulations: These may be single-action tasks (such as opening a web-browser) or may contain a sequence of steps (such as “Save As” with a specific file name, sorting or filtering a web-based database according to one or more criteria). The interactive items contained linear and nonlinear tasks. Linear tasks required the execution of at least two commands executed in a necessary prescribed sequence (e.g., opening a file from the desktop, “Save As” with a specific file name, and moving the file to another drive). Nonlinear tasks required respondents to reach a desired outcome by executing various subcommands, with the order of the commands variable.

Scaling of the tests

For estimating item and person parameters for ICT literacy a Rasch model is used. In order to compare competencies across different measurement occasions and examine competence development over time the different measurements are linked (Fischer, Rohm, Gnambs & Carstensen, 2016). The psychometric quality and the scaling results of the tests and items are described in the technical reports of each starting cohort.

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Scientific literacy

Scientific literacy 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 literacy 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 literacy is understood as the use of scientific knowledge in the environmental, technological and health contexts (Hahn et al., 2013). In addition, the concept distinguishes between content-related and process-related elements (see Fig. 1).

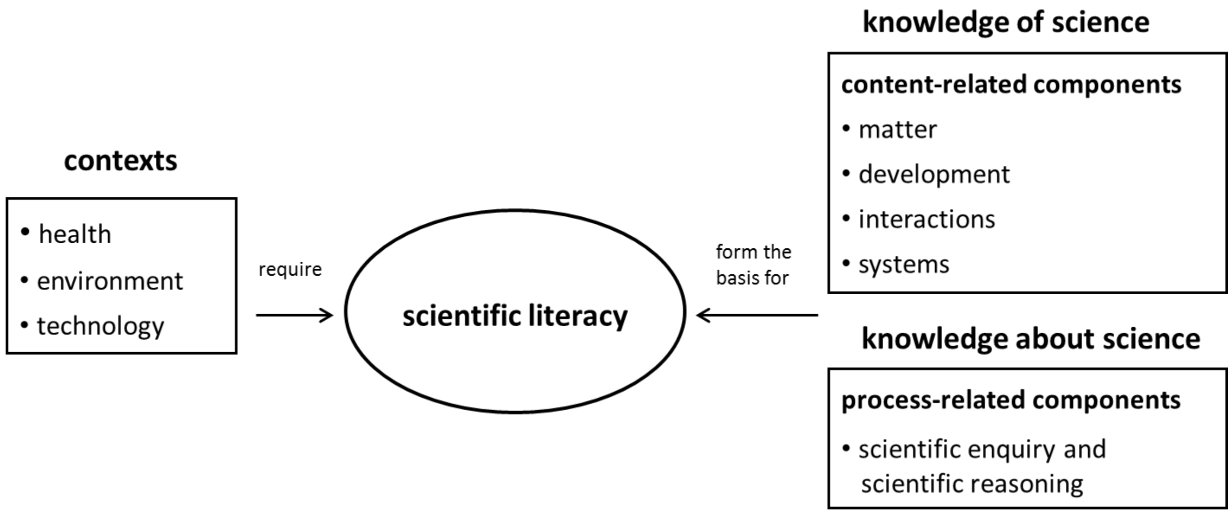

Fig.1. Application contexts as well as content-related and process-related elements of scientific literacy of the NEPS scientific test (Hahn et al., 2013).

In selecting its contexts as well as the content-related and process-related elements, NEPS uses PISA (OECD, 2006), the *Benchmarks for Scientific Literacy* of the *American Association for the Advancement of Science* (AAAS, 2009) and the education standards of the Conference of Ministers of Education for the medium-level school-leaving qualification (KMK, 2005a, 2005b, 2005c) 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. Figure 2 gives an overview of the content related components' overlap between PISA, the German educational standards and NEPS. The selected content-related and process-related elements cover central concepts of all scientific disciplines.

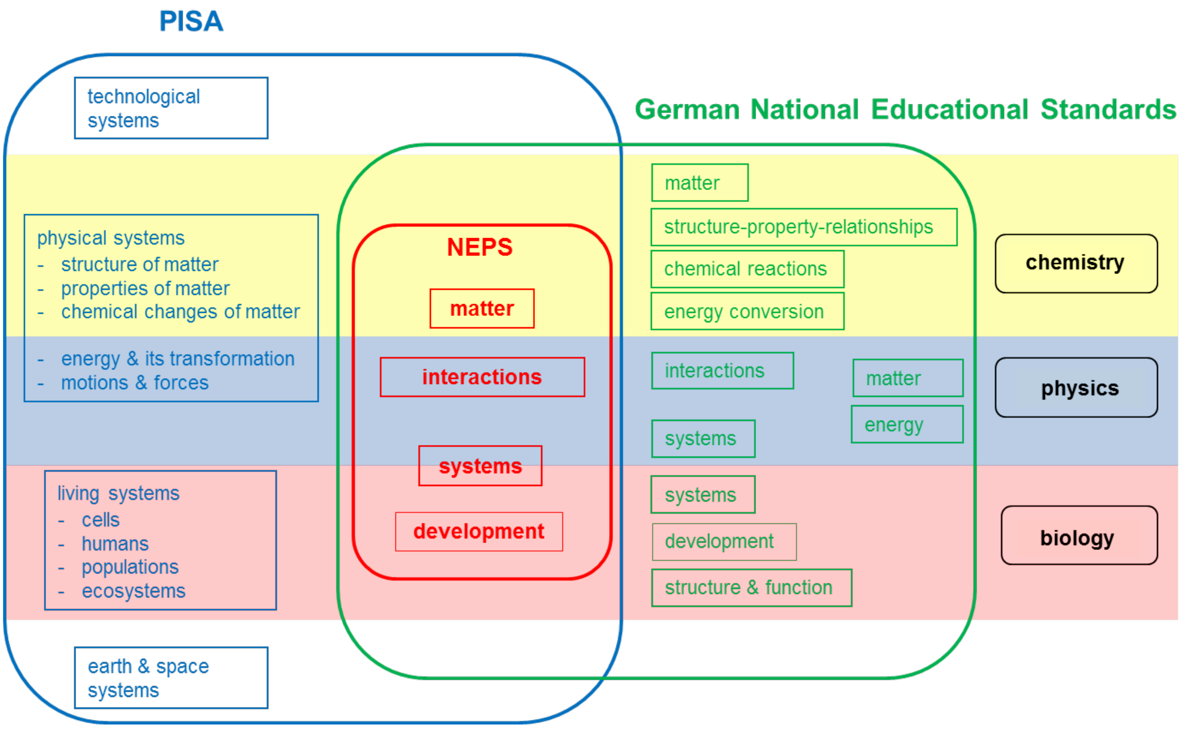

Fig.2. Overview of the content related components' overlap between PISA, the German educational standards and NEPS (Hahn et al., 2013).

The knowledge of science comprises the content-related matter, *systems*, *development* and *interactions*. The knowledge about science includes *inquiry and scientific reasoning* that deal, among other things, with checking hypotheses, interpreting findings as well as measuring principles and measuring error control (see Fig. 1).

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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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