

## The NEPS ICT Literacy Framework and Item Examples

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# The NEPS ICT Literacy Framework and Item Examples

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*National Educational Panel Study*

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## The NEPS ICT Literacy Framework

The ability to effectively use information and communication technologies (ICT) not only plays an important role in many workplace settings, but is also becoming increasingly important in people's everyday lives (ETS, 2002; Wittwer & Senkbeil, 2008). Because of the rapidly changing technological environment, self-regulated and continuous life-long learning is a key or meta competence for successfully keeping pace with recent developments in the area of ICT (e.g., Blossfeld, Doll, & Schneider, 2008).

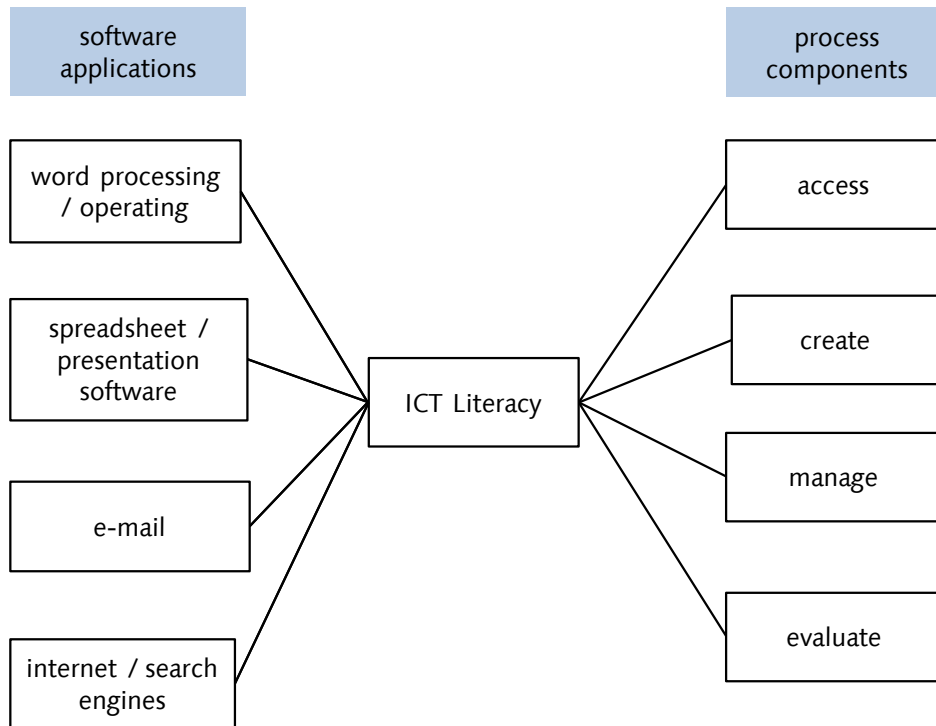
More recent conceptualizations are not exclusively confined to technological literacy, that is, knowledge of hardware and software applications and understanding technological concepts. Instead, information literacy, that is, the ability to use digital media to access, create, manage and critically evaluate information and to use it effectively for one's own purposes, also plays an important role (ETS, 2002). Thus, ICT literacy is to be understood as a functional literacy that helps people to acquire other important competencies and skills for professional success (educational and work settings) and to achieve private goals across the lifespan. 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” (Katz, 2007, p. 6).

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 & 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:

- 1) *Access*: knowledge of basic operations used to retrieve information (e.g., entering a search term in an internet browser, opening and saving a document);
- 2) *Create*: the ability to create and edit documents and files (e.g., setting up tables, creating formulas);
- 3) *Manage*: the ability to find information within a program (e.g., retrieving information from tables, processing the hits returned by a search engine);
- 4) *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.



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

Each item in the tests refers to one process component and one software application. With the exception of a few items addressing factual knowledge (e.g., computer terminology), the items ask students to accomplish computer-based tasks. To do so, students were presented with realistic problems embedded in a range of authentic situations. Most items use screenshots—for example, an internet browser, an electronic database, or a spreadsheet—as prompts.

This framework can be applied to constructing ICT literacy tests for all age cohorts tested (i.e., students attending Grades 3, 6, 9, and 12; students in the vocational track; university students; and adults). It is also applicable to computer-based simulation tasks that was used in NEPS for testing ICT literacy in 2017 for the first time.

## Item format

In the first stage of NEPS (2010 – 2017) the measurement of ICT literacy was based on multiple-choice tests (from 2018: computer-based and interactive items are additionally used).

The majority of the NEPS ICT literacy items are constructed as simple multiple choice (MC) items. These kinds of items display an item stem giving the test persons background information on the item topic. Most items contain a screenshot with given relations between text and screenshot. The test question is followed by four to eight different answer options. One of the response options is correct, whereas the other response options function as distractors (Senkbeil & Ihme, 2014). NEPS ICT literacy tests also use the multiple true false (MTF) format. Structurally similar to the MC format, they also feature an item stem containing background information and often a screenshot, a test question, and three to ten answers. Unlike the MC items, the test person here must decide whether each MTF answer is either true or false. For MTF items, summaries are made, if necessary, thus creating answers with fully correct solutions (full credit) and partly correct solutions (partial credit).

Since 2018, the ICT literacy tests have been conducted in a computer-based setting. These tests include MC and MTF tasks as described above, as well as simulation-based items in which software environments are simulated and test takers often have to solve multi-step problems.

## **Assessment conditions**

The NEPS ICT literacy tests of the main studies takes 28 min, leaving 2 min of half an hour to the metacognition question where test persons are asked to judge how many items they answered correctly. In NEPS, ICT literacy is tested in school students attending Grades 3, 6, 9, and 12; in young adults in the vocational track; in university students; and in adults. In school, the tests are applied in a group context. It is only in Grade 3 that all questions and response options are read out. Adults are tested at home in a one-on-one setting.

## **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, Gnamb & Carstensen, 2016). The psychometric quality and the scaling results of the tests and items are described in the technical reports of each starting cohort.

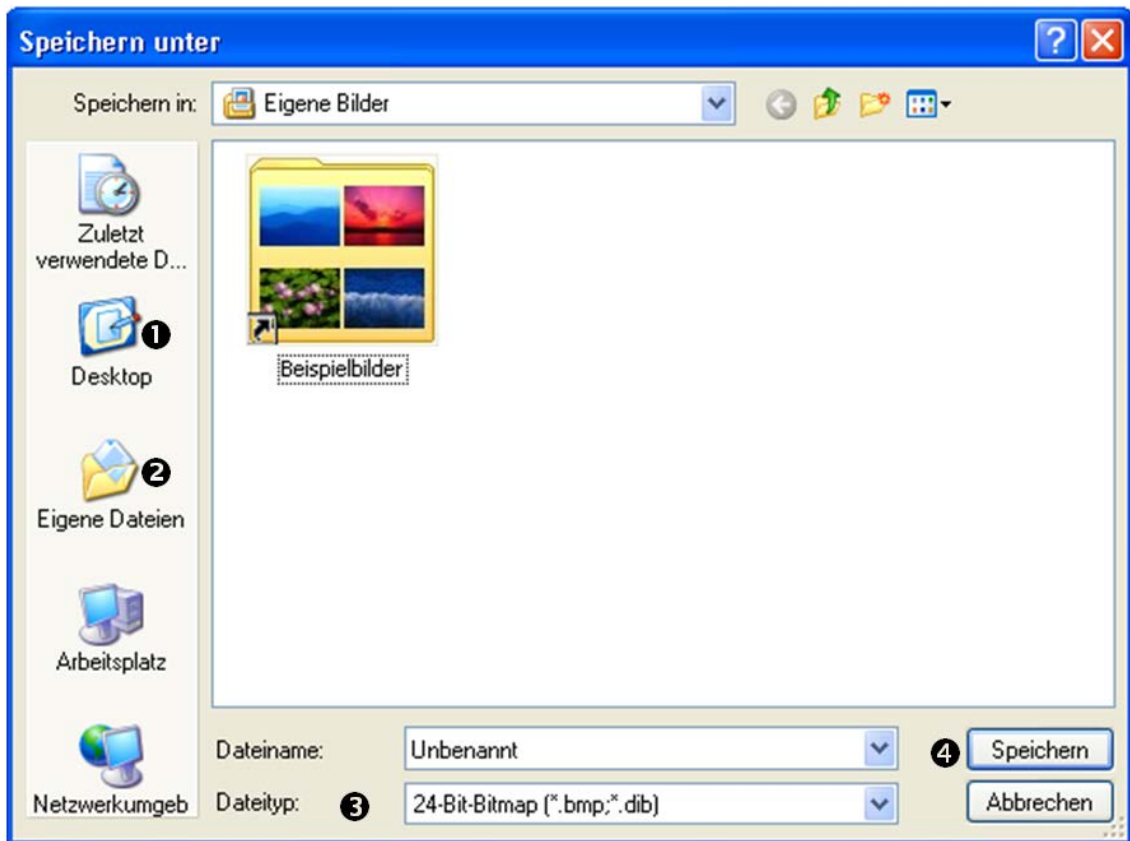
## The NEPS ICT Literacy Test – Item Examples

The ICT literacy items aim to measure the ability to handle specific tasks and problems. To construct realistic tasks, most of the items contain screenshots—for example, of an internet browser, an electronic database, or a spreadsheet. Realistic answer alternatives, which were taken from the screenshots (e.g., menu buttons), usually serve as distractors in the tasks for technological literacy. In the items for information literacy—for example, authentic search masks—were used to construct distractors.

Figure 2 contains an example item for *technological literacy*, process component *access*, within *word processing/operating systems*. The item in Figure 3 is an example of an *information literacy* item, process component *manage*, software application *internet/search engines*. The item in Figure 4 is another example of a technological literacy item with the process component *create*, software application *spread sheet*.

## Question 1:

Peter wants to save a picture in this image processing application in the TIFF format. How does he do that?



© Microsoft

Please check the right answer! Please check one box only!

<input type="checkbox"/>	❶ He clicks on "Desktop".
<input type="checkbox"/>	❷ He clicks on "My Documents" ("Eigene Dateien").
<input type="checkbox"/>	❸ He searches the list "file-type" ("Dateityp").
<input type="checkbox"/>	❹ He clicks on "Save" ("Speichern").

Figure 2. Example item for Technological Literacy.



## Question 2:

To find information about the American president, you entered the search term “Barack Obama”. Which drop-down menu would you use to get this information in German from Germany?

The screenshot shows a search engine interface with the following elements:

- Ergebnisse finden:** mit allen Wörtern, mit der genauen Wortgruppe, mit irgendeinem der Wörter, ohne die Wörter. The search term "Barack Obama" is entered in the search box. The number of results is set to "10 Ergebnisse".
- Sprache:** Antwortseiten, geschrieben in: beliebige Sprache (1)
- Region:** Gesuchte Seiten befinden sich in: alle Regionen (2)
- Dateiformat:** Ausschließlich (3) Ausgabe von Ergebnissen des Dateiformats: irgendein Format (3)
- Datum:** Suche nach zuerst gesichteten Webseiten: ohne Zeitbegrenzung (4)
- Position:** Antwortseiten, in denen meine Begriffe vorkommen: irgendwo auf der Seite (5)

© Mozilla

Please check the right answer in every line!

	true	false
1 <input type="text" value="beliebige Sprache"/> ("any language")	<input type="checkbox"/>	<input type="checkbox"/>
2 <input type="text" value="alle Regionen"/> ("any region")	<input type="checkbox"/>	<input type="checkbox"/>
3 <input type="text" value="irgendein Format"/> ("any format")	<input type="checkbox"/>	<input type="checkbox"/>
4 <input type="text" value="ohne Zeitbegrenzung"/> ("without time limit")	<input type="checkbox"/>	<input type="checkbox"/>
5 <input type="text" value="irgendwo auf der Seite"/> ("somewhere on the page")	<input type="checkbox"/>	<input type="checkbox"/>

Figure 3. Example item for Information Literacy.

### Question 3:

This table shows the number of tickets that have been sold for a school play. Which formula is needed in the table to calculate the total number of tickets issued on Thursday?

	A	B	C	D	E	F
1	Drama Club Play					
2	Tickets					
3		Tickets sold	Tickets issued free of charge	Total no. of tickets	Total attendance	
4	Monday	28	0	28	26	
5	Tuesday	29	24	53	53	
6	Wednesday	65	16	81	80	
7	Thursday	58	8		64	
8	<i>Total</i>	180	48	228		
9						
10						

© Microsoft

*Please check the right answer! Please check one box only!*

<input type="checkbox"/>	=B7+C7
<input type="checkbox"/>	=D5:D7
<input type="checkbox"/>	=E8-B8
<input type="checkbox"/>	=B8-C8

*Figure 4. Example item for Technological Literacy.*

## References

- Blossfeld, H.-P., Doll, J., & Schneider, T. (2008). Bildungsprozesse im Lebenslauf: Grundzüge der zukünftigen Bildungspanelstudie für die Bundesrepublik Deutschland. *Recht der Jugend und des Bildungswesens*, 3/2008, 321-328.
- ETS [Educational Testing Service] (2002). Digital transformation. A framework for ICT literacy. A report of the International ICT Literacy Panel. Princeton, NJ: ETS.
- Fischer, L., Rohm, T., Gnamb, T., & Carstensen, C. H. (2016). Linking the data of the competence tests (NEPS Survey Paper No. 1). Bamberg, Germany: Leibniz Institute for Educational Trajectories, National Educational Panel Study.
- Katz, I. R. (2007). Testing ICT literacy in digital environments: The ETS iskills Assessment. *Information Technology and Libraries*, 26, 1-19.
- Senkbeil, M., & Ihme, J. M. (2014). Wie valide sind Papier-und-Bleistift-Tests zur Erfassung computerbezogener Kompetenzen? *Diagnostica*, 60, 22-34.
- Senkbeil, M., Ihme, J. M., & Wittwer, J. (2013a). The Test of Technological and Information Literacy (TILT) in the National Educational Panel Study: Development, empirical testing, and evidence for validity. *Journal for Educational Research Online*, 5, 139--161.
- Senkbeil, M., Ihme, J. M., & Wittwer, J. (2013b). Entwicklung und erste Validierung eines Tests zur Erfassung technologischer und informationsbezogener Literacy (TILT) für Jugendliche am Ende der Sekundarstufe I. *Zeitschrift für Erziehungswissenschaft*, 16, 671-691.
- Wittwer, J., & Senkbeil, M. (2008). Is students' computer use at home related to their mathematical performance at school? *Computers & Education*, 50, 1558-1571.
- Weinert, S., Artelt, C., Prenzel, M., Senkbeil, M., Ehmke, T. & Carstensen, C. H. (2010). Development of competencies across the life span. *Zeitschrift für Erziehungswissenschaft*, 14 (suppl. 2), 67-86.