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FUTURE SKILLS: APPROACHES FOR TEACHING DATA LITERACY IN HIGHER EDUCATION

Study on behalf of the working group “Curriculum 4.0” of the “Hochschulforum Digitalisierung”

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Bildung. Wissenschaft. Innovation.

CHE
Centrum für Hochschulentwicklung

HRK Hochschulrektorenkonferenz
Die Stimme der Hochschulen

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Objective and focus

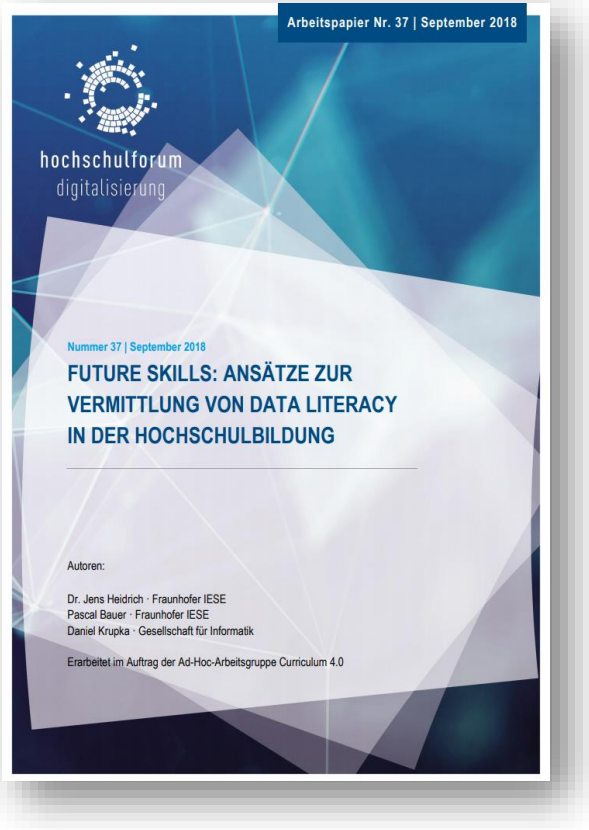
- **Objective:** Compile actionable knowledge for the implementation of curricula for data literacy
- **Focus:** European and international best practice examples of offers for cross-disciplinary education of data literacy
- **Scope:** Scope was on the education of data literacy in different application domains and not on data science education

Key questions:

1. What is meant by data literacy and what is the main focus?
2. How is data literacy integrated into disciplines and curricula and how do you create incentives for teachers?
3. What is a transdisciplinary set of basic competencies and what are special competences?
4. What are requirements on graduates for the society, job market and research?
5. What are factors of success and failure of the curricular implementation?

Overview

1. Desk Research
   - Research und classification of **89 courses (of studies)**
   - Summary of 17 state-of-the-art literature sources
2. Interviews and Survey
   - Selection and **detailed classification of 15 cases**
   - **Interviews with representatives of 6 cases** (21 questions)
   - **Survey with 69 participants** (16 questions)
3. Workshop
   - Conduction of an international **workshop with 19 experts**
4. Documentation
   - Stan-of-the-art handout
   - 100-page final report



Key question 1: What is meant by data literacy and what is the main focus?

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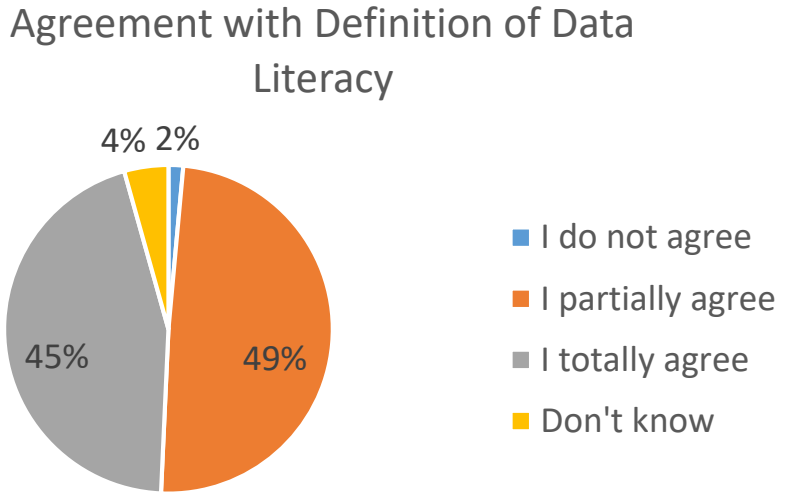
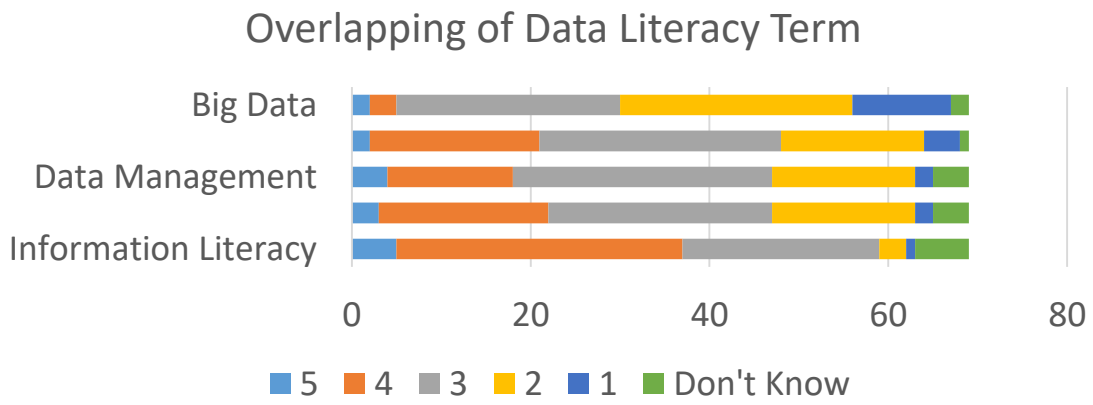
“Data Literacy is defined as the ability to collect, manage, evaluate and apply data in a critical manner” [Ridsdale et al.]

- Expert interviews as well as survey fully or partially agreed to that definition (100% and 94%, respectively)
- The missing aspects usually affect and emphasize individual competence areas of data literacy
- There is a significant overlapping with the terms “Information Literacy” as well as with adjacent terms such as “Data Information Literacy”, “Science Data Literacy”, or “Statistical Literacy”





Key question 2: How is data literacy integrated into disciplines and curricula and how do you create incentives for teachers

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1. Acquisition of competences in the field of data literacy should start as early as possible (for example at post-secondary institutions)
2. Awareness of the importance has to be raised for students as well as organizations (universities, institutes)
3. Any offer must be adapted to different educational levels and to specifics of disciplines, such as the general context, terminology, workflows, and problems
4. It is recommended to establish an independent institution/unit, which involves experts from different disciplines for developing educational programs
5. A national research, education and training agenda is required as well as the development of national infrastructures
6. Different models of integration imaginable: Online offers, a central introductory course with advanced modules, or approaches fully integrated in existing courses (of studies)
7. Successful offers modular and make use of modern teaching formats (such as hands-on and project-based learning)
8. Motivation of teachers to participate in joint offers mostly based on personal interest and broadening their own skills

Key question 3: What is a multidisciplinary set of basic competencies and what are special competencies?

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Conceptual Framework	Introduction to Data	Conceptual
Data Collection	Data Discovery and Collection	
	Evaluating and Ensuring Quality of Data and Sources	
Data Management	Data Organization	
	Data Manipulation	
	Data Conversion (from format to format)	
	Metadata Creation and Use	
	Data Curation, Security, and Re-Use	
	Data Preservation	
Data Evaluation	Data Tools	Core
	Basic Data Analysis	
	Data Interpretation (Understanding Data)	
	Identifying Problems Using Data	
	Data Visualization	
	Presenting Data (Verbally)	
	Data Driven Decisions Making (DDM) (Making decisions based on data)	
Data Application	Critical Thinking	Advanced
	Data Culture	
	Data Ethics	
	Data Citation	
	Data Sharing	
	Evaluating Decisions Based on Data	

- Basic and advanced competences depend on purpose of data literacy education
- Within the workshop to different main purposes were discussed:
  1. Teaching of mature educated citizens: requires a cross-disciplinary, generic, basic, broad set of competences
  2. Teaching data literacy competence for a specific discipline: requires more specialized, in-depth competences with adaptations

[C. Ridsdale et al., „Strategies and Best Practices for Data Literacy Education: Knowledge Synthesis Report“, Report, 2015.]

Key question 3: What is a multidisciplinary set of basic competencies and what are special competencies?

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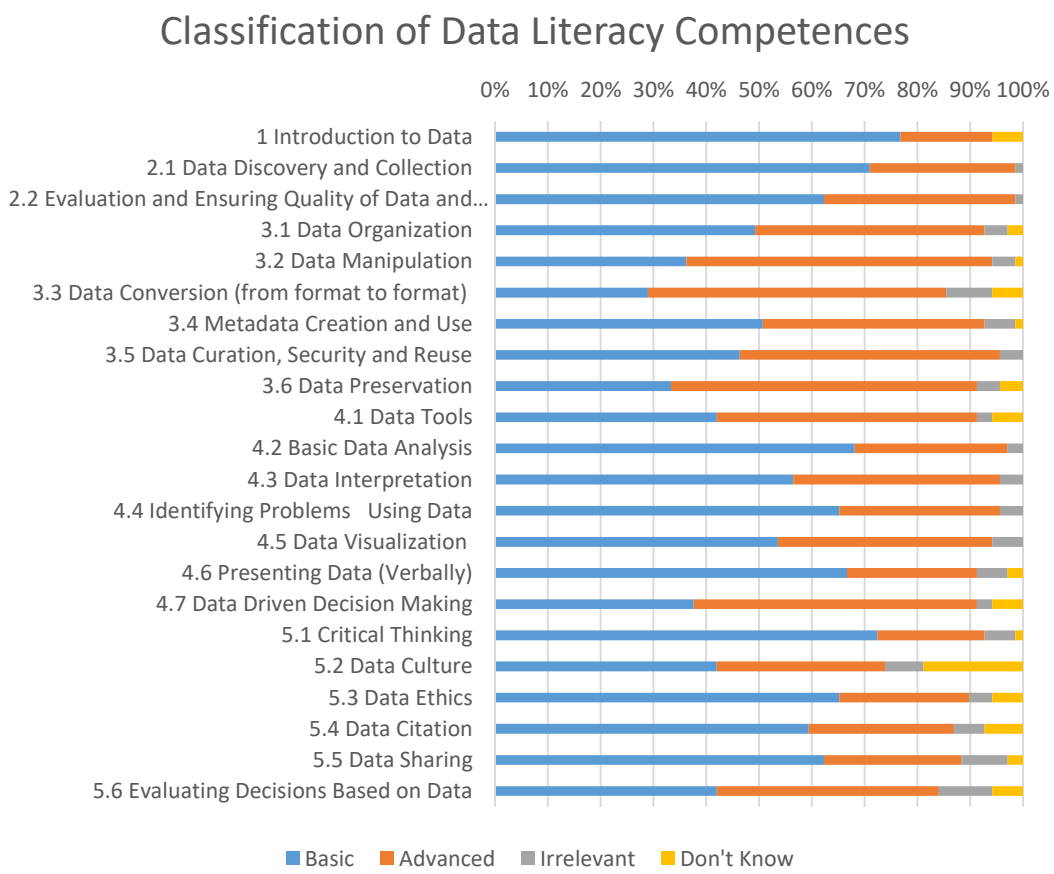
- Opinions regarding the classification of competences differed widely among expert; they only agreed on “introduction to data” and “basic data analysis” for being basic competences
- The survey showed that “introduction to data” is seen by 95% as being a basic competence, followed by “data representation (verbally)” with 90% and “critical thinking” with 85%
- The least basic competences were “data conversion” at 10% and “data preservation” at 15%
- All other areas of competences were rated by at least 35% of respondents as being basic



Key question 4: What are requirements on graduates for the society, job market and research?

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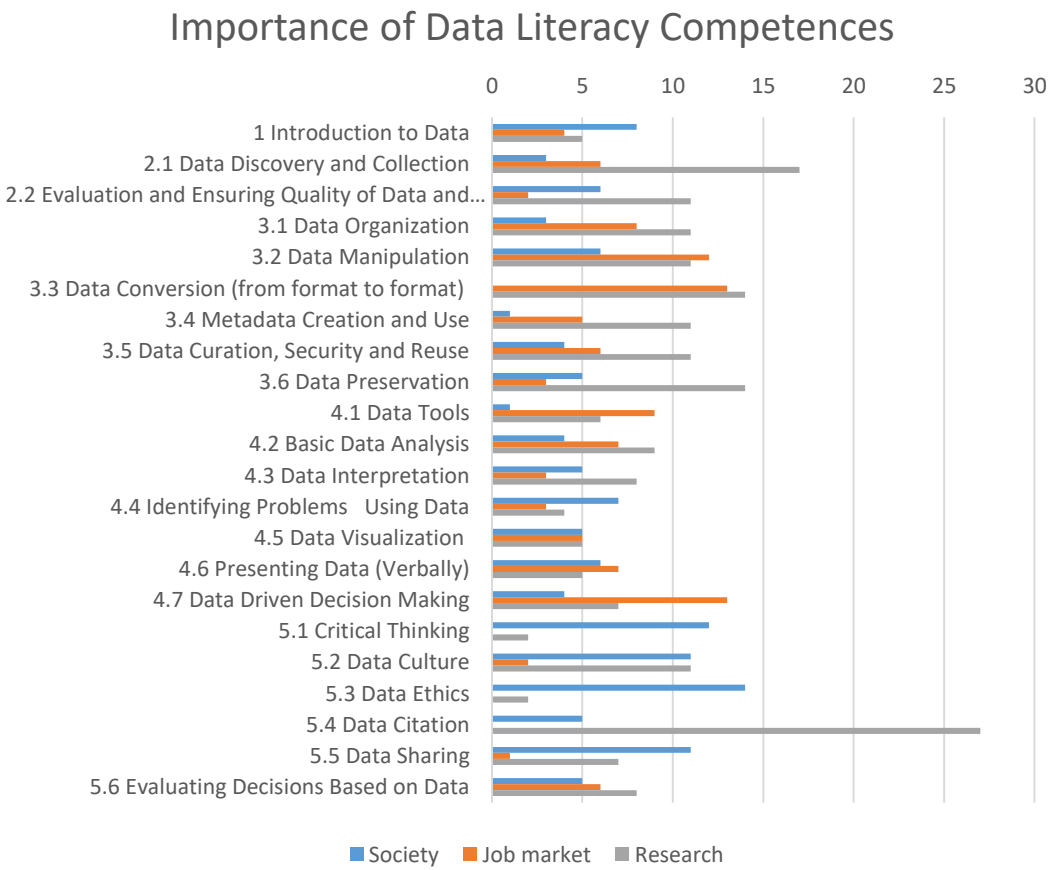
- According to the survey, “critical thinking”, “data ethics”, and “data sharing” plays an important role for society
- For the job market, “data conversion”, “data-driven-decision making” and “data tools” are most relevant
- In the research sector, “data citation” plays a major role alongside “data discovery and collection”
- Expert interviews showed that for the society, competencies related to data ethics, for the job market, skills focusing on technical competencies, and for research, a broader set of competencies is necessary



Key question 5: Challenges and measures from literature and interviews

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	Structures & Collaboration	Competences & Integration	Teaching/Training
Challenges	• Collaborations with others (breaking silos) • Availability of resources • Initial funding	• Create awareness as early as possible • Identifying relevant competencies • Different educational levels	• Attracting enough competent trainers and teachers • Diversity of participants • Application-oriented teaching
Measures	• Build up collaborations with other faculties, institutions, and industry • Bundle competencies across disciplines • Shared pool of assets • Overarching centers • Create a national strategy and infrastructure	• Start at school level • Basic skills already for non-graduates • Offer standalone and interdisciplinary courses • Integration of competencies into existing disciplines • Tailor offer to the needs of the target groups	• Modern learning and teaching concepts (e.g., mixed teams) • Lean based on real-world data • Scholarships for cross-discipline work • Create opportunities for teachers • Train-the-trainer offers

Key question 5: Action items from expert workshop

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Structures & Collaboration	Competences & Integration	Teaching/Training
1. Create required space in curricula and access to best practices, data and infrastructure 2. Educate department heads and convince executives, then roll-out 3. Build up joint physical spaces, community of teaching practices, and cross-X collaborations and make use of open content	1. Create data education labs to support self-study 2. Start earlier at school, e.g. by educating next-gen teachers 3. Create a standardized DL competence framework	1. Make data literacy a prerequisite for accredited programs 2. Standardize data literacy education 3. Paired teaching (data scientist and domain experts, contextualized)

Data Literacy Education: Funding Program of the Stifterverband and the Heinz Nixdorf Foundation on the Context of the “Future Skills” Initiative

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- **Goal:** Funding of concepts for acquiring data literacy competences for students of all disciplines at German universities and colleges
- **Award:** 3 times 250,000 €
- **Duration:** 3 years (starting October 2018)
- **Submissions:** 47 concepts
- **Procedure:** Expert discussion in public section meeting (September 28, 2018)
- **Three winners:**
  - Georg-August-Universität Göttingen
  - Leuphana Universität Lüneburg
  - Hochschule Mannheim
- **Five more finalists:**
  - Hochschule für Technik und Wirtschaft Berlin
  - Ruhr-Universität Bochum
  - Universität Hildesheim
  - Johannes Gutenberg-Universität Mainz
  - Universität Regensburg
- For more information visit: https://www.stifterverband.org/data-literacy-education

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