

Skills for future learning: digitalization

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Abstract

Learning and teaching in digital learning environments and with AI offers many new opportunities. Specifically recent advances in Artificial Intelligence (AI), encompassing a range of data-driven and deep learning-based systems, have expanded the repertoire of tools available to students and teachers and have been rapidly integrated into classrooms across schools and universities. This development has intensified the discussion of digitization and around the use of AI in education. Using these digital environments and the tools they offer effectively poses challenges to learners, teachers and parents and, in particular, requires specific and new skills.

Background & Key Theories

- **AI literacy:** Teaching children necessary skills playfully to let them gain a basic understanding of AI systems and be prepared to use technology responsibly and independently (Meinert et al., 2021)
- **Inoculation Theory:** Learners develop cognitive resilience against real threats through controlled exposure to milder forms of manipulation (“psychological vaccination”) (Kronhardt et al., 2025)
- **Teacher-AI complementarity** (Cukurova, 2025; Molenaar, 2022): Configurations of how teachers and AI interact, what actions are executed within a pedagogical task, who executes them, what dependencies exist between actors, and what skills and knowledge are required to perform those actions.

Overarching Research Questions

1. How can we protect **children** online while also letting them benefit from AI features?
2. To what extent can proactively guiding children to misinformation (e.g. logical fallacies) and encouraging them to critically assess information help overcome information disorder?
3. How does the growing use of AI shape **teachers'** professional roles, skills, and responsibilities?
4. Which skills do teachers need and which tasks do they face in AI-supported classrooms?

Prominent Methodological Approaches

- **Developing educational materials** that use playful approaches to help children understand algorithms and pattern recognition
- **Developing practical trainings** for parents and educators
- **In-situ Interventions & Scaffolding:** Development of LLM-based browser extensions that intervene directly while users are engaging with media (e.g., while reading news)
- **TAICo model:** Analysis of teachers' skills & tasks through Hierarchical Task Analysis (HTA), Skill and Knowledge Analysis (SKA) & Complementarity Analysis (CA)

Social Relevance

1. The age at which children get into contact with digital media increases, which makes protection of their privacy while getting access to digital education more important than ever.
2. Our research aims to empower users and learners by raising awareness of systematic digital exploitation and developing tools for digital self-defense against information disruption and data misuse.
3. AI-implementation in classrooms presents teachers with growing challenges, making corresponding training an essential component of their professional development.

Examples of Related Research Projects and Networks

KIKI - KI-Anwendungen im Einklang mit Kinderrechten

UDE (Prof. Nicole Krämer), University of Tübingen (IZEW), University of Bamberg, Caritas Sozialdienste Rhein-Kreis Neuss & Katholisch-Soziales Institut (KSI)



PERSONÆR - Transparency Enhancing Tool for LLM-Generated User Personas from Live Website Visits

TUDO (Prof. Jens Gerken)

PERSONÆR

FallacyCheck - A Proactive LLM-based Browser Extension to Motivate Critical Assessment of News Articles by Questioning Logical Fallacies

TU Dortmund University (Prof. Jens Gerken), Rhine-Waal University of Applied Science

Taico

TAICo - Teacher-AI Complementarity

RUB (Prof. Nikol Rummel), University for Continuing Education Krems, University of Oulu, Tallinn University, Radboud University, University College London, European Edtech Alliance, Education and Youth Board, European Digital Learning Network, The European Trade Union Committee on Education

Teacher-AI Complementarity

Future Perspectives

- The effectiveness of AI systems depends on learners' **SRL-competences for AI-supported settings**. The goal of a proposed program of research is to investigate learners' digital SRL competences, as well as matching teacher competences (Prof. Joachim Wirth, Prof. Marc Stadler, Prof. Nikol Rummel, RUB)
- Perceived trustworthiness of AI is a central mechanism shaping acceptance of AI-mediated science communication. A project is planned to investigate how AI literacy and calibrated trust can improve engagement with AI-supported science communication (Dr. Valentina Nachtigall, RUB; Dr. Maximilian Krug, UDE)
- Development of a “Counteractive Persuasive Technology” Framework to unify the design space for tools which help **restore user agency in information disorder environments** (Prof. Gerken, Kirill Kronhardt, TUDO)

Key Literature

Cukurova, M. (2025). The interplay of learning, analytics and artificial intelligence in education: A vision for hybrid intelligence. *British Journal of Educational Technology*, 56(2), 469-488.

Kronhardt, K., Zilt, A., Abed, O., Lehnert, M. J., Pascher, M., & Gerken, J. (2025). FallacyCheck-A Proactive LLM-based Browser Extension to Motivate Critical Assessment of News Articles by Questioning Logical Fallacies. In *Proceedings of the 24th International Conference on Mobile and Ubiquitous Multimedia* (pp. 504-509).

Meinert, J., Meier, Y., & Krämer, N. C. (2021). Privatheit aus medienpsychologischer Perspektive: Folgen der zunehmenden Digitalisierung für Kinder und Jugendliche. In *Aufwachen in überwachten Umgebungen* (pp. 37-60). Nomos Verlagsgesellschaft GmbH & Co. KG.

Molenaar, I. (2022). Towards hybrid human-AI learning technologies. *European Journal of Education*, 57(4), 632-645.

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