

## When People Come First

### A Human-Centered Approach to Computer Science Education

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# When People Come First: A Human-Centered Approach to Computer Science Education

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## Abstract

The rise of AI tools is reshaping computer science education, shifting the focus from coding skills to teaching students how to effectively use these technologies. Understanding students' mental models and fostering computational and metacognitive skills are now essential, as over-reliance on AI can weaken critical thinking. This panel explores how a human-centered approach can balance these challenges, sharing strategies to optimize learning while addressing the risks of cognitive offloading in an AI-driven world.

## CCS Concepts

• **Social and professional topics** → *Computing education*; • **Human-centered computing** → **Interactive systems and tools**; **HCI theory, concepts and models**.

## Keywords

Computer Science Education, AI-Assisted Learning, Human-Centered Learning, Mental Models, Metacognitive Skills

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## 1 Summary

Coding practices are changing as AI-based tools become widely used. This shift means that computer science education now focuses not only on coding skills but also on teaching students how to use these new tools effectively [6]. When people work with complex systems, they rely on mental models, representations that help them understand, reason, and predict the outcome of interaction with the tool [8]. By understanding students' mental models of AI tools

for coding, educators can better decide what to teach in today's world.

In the age of AI, not only students build mental models of AI tools, but AI systems also create their own models of user behavior to better assist them. Some researchers even talk about a mutual understanding between humans and AI, where both sides learn from each other over time [1]. An example of this is the *Promptly* tool, which shows that training both students and AI can lead to better use of AI in programming courses [2].

AI tools are also changing what skills students need to be good at for coding. In the past, success in coding depended on memorizing and recalling information, but now the focus is on metacognitive skills. Today, tools require students not to write code, but rather read, understand, evaluate, and prompt code generated by large language models [3]. This change makes one of the most important skills computational thinking (CT). Computational thinking is defined as “a way humans solve problems with the help of a computer”. CT consists of the ability to think in abstraction, decomposition, algorithms, evaluation, and generalization. New teaching tools are being developed to help students build these skills [5].

However, these changes also introduce a threat, such as learners' over-reliance on code generation models [3]. Over-reliance on these tools may cause students to skip careful reading of problem statements and may weaken important critical thinking skills. This problem is known as cognitive offloading. Cognitive offloading can be described as the reliance on external tools or resources to manage cognitive tasks rather than processing the information internally [7]. Studies demonstrated that when individuals delegate tasks like remembering information or solving basic perceptual problems to external aids (e.g., calculators, notepads), there is often a corresponding decline in internal cognitive processing or skill maintenance. Current research is already showing evidence that intensive use of AI tools can lead to decline in critical thinking more generally [4].

In our panel, we will discuss how a human-centered approach to computer science education can help address these challenges. We will share successful teaching practices and explore how understanding students' mental models and metacognitive skills can lead to better educational outcomes.

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## 2 Panel presentation structure

Table 1 outlines the panel structure. The moderator will introduce the panelists and discuss dispositions in the context of human-centered CS education. The panelists, whose position statements appear in the next section, will present their perspectives.

As shown in Table 1, the session includes enough for active audience participation. The moderator will also include early questions from remote participants to ensure their involvement.

**Table 1: Panel Structure**

Description	Duration
1. Introductions and Background	3 minutes
2. Panelists' Presentations	30 minutes
3. Audience Q&A	25 minutes
4. Summary	2 minutes

## 3 Position Statements

### 3.1 Agnia Sergeyuk - moderator

**Agnia Sergeyuk**<sup>1</sup> is the head of Human-AI Experience team at JetBrains Research and a PhD candidate at Delft University of Technology, with her Specialist degree in Clinical Psychology. Her research covers various topics, from the cognitive aspects of reading code to understanding the needs people have when interacting with AI systems. She will moderate the panel, introduce the panelists, outline dispositions, facilitate the audience with questions and discussions, and summarize the session.

### 3.2 Ilya Zakharov - students' mental models of AI

**Ilya Zakharov**<sup>2</sup>, a senior researcher at Human-AI Experience team at JetBrains Research and a PhD in Psychology. He has a diverse background in the intersection between psychology, neuroscience and behavioral genetics, with focus on individual differences in cognition and intelligence. In his recent research he focuses on humans' mental models of AI and the roles human assign AI at a workplace. He is interested in understanding how taking into account different mental models human have about AI can be utilized for the more effective human-AI interaction.

### 3.3 Maliheh Izadi - AI's mental models of students

**Maliheh Izadi**<sup>3</sup>, an assistant professor at Delft University of Technology. She holds a PhD in Software Engineering from Sharif University of Technology. Her research focuses on building smart software systems through tailoring machine learning and NLP techniques to source code. She studies, designs, and develops learning-based models, specifically LLMs for source code, to automate software engineering and developer-related tasks such as understanding, generating, and documenting source code. She is interested in

how AI can diagnose students' current mental models and create customized learning paths.

### 3.4 Anastasia Birillo - metacognitive skills in CS education

**Anastasia Birillo**<sup>4</sup> is the head of the Education Research group at JetBrains Research<sup>5</sup> and an external PhD student in Computer Science at Utrecht University. Her research interests are in IDE learning, intelligent tutoring systems, generative AI, and low-no code programming education. She is particularly keen on exploring how CS education can shift from teaching CS concepts to helping students improve their computational thinking and meta-cognitive abilities.

### 3.5 Liudmila Piatnitckaia - cognitive offloading

**Liudmila Piatnitckaia**<sup>6</sup>, a PhD candidate at Université Paris Cité, holds master degrees in Clinical Psychology and Learning Sciences. She focuses her research on AI for Education and Critical Thinking. She will discuss potential research on cognitive offloading—the process of delegating cognitive tasks to external tools. While past research emphasized low-level functions like memory and spatial tasks, emerging studies now examine offloading high-level functions with advanced AI. Preliminary evidence suggests that as students rely on AI for analysis and creative problem-solving, they may bypass the deeper cognitive engagement.

## References

- [1] R. W. Andrews, J. M. Lilly, D. Srivastava, and K. M. Feigh. 2023. The role of shared mental models in human-AI teams: a theoretical review. *Theoretical Issues in Ergonomics Science* 24, 2 (2023), 129–175.
- [2] Paul Denny, Juho Leinonen, James Prather, Andrew Luxton-Reilly, Thezyrie Amarouche, Brett A. Becker, and Brent N. Reeves. 2023. Promptly: Using Prompt Problems to Teach Learners How to Effectively Utilize AI Code Generators. doi:10.48550/arXiv.2307.16364 arXiv:2307.16364 [cs].
- [3] Paul Denny, James Prather, Brett A. Becker, James Finnie-Ansley, Arto Hellas, Juho Leinonen, Andrew Luxton-Reilly, Brent N. Reeves, Eddie Antonio Santos, and Sami Sarsa. 2023. Computing Education in the Era of Generative AI. doi:10.48550/arXiv.2306.02608 arXiv:2306.02608 [cs].
- [4] Hao-Ping (Hank) Lee, Advait Sarkar, Lev Tankelevitch, Ian Drosos, Sean Rintel, Richard Banks, and Nicholas Wilson. 2025. The Impact of Generative AI on Critical Thinking: Self-Reported Reductions in Cognitive Effort and Confidence Effects From a Survey of Knowledge Workers. <https://www.microsoft.com/en-us/research/publication/the-impact-of-generative-ai-on-critical-thinking-self-reported-reductions-in-cognitive-effort-and-confidence-effects-from-a-survey-of-knowledge-workers/>
- [5] S. Ma, J. Wang, Y. Zhang, X. Ma, and A.Y. Wang. 2025. DBox: Scaffolding Algorithmic Programming Learning through Learner-LLM Co-Decomposition. *arXiv preprint arXiv:2502.19133* (2025).
- [6] James Prather, Juho Leinonen, Natalie Kiesler, Jamie Gorson Benario, Sam Lau, Stephen MacNeil, Narges Norouzi, Simone Opel, Vee Pettit, Leo Porter, Brent N. Reeves, Jaromir Savelka, David H. Smith, Sven Strickroth, and Daniel Zingaro. 2025. Beyond the Hype: A Comprehensive Review of Current Trends in Generative AI Research, Teaching Practices, and Tools. In *2024 Working Group Reports on Innovation and Technology in Computer Science Education (ITiCSE 2024)*. Association for Computing Machinery, New York, NY, USA, 300–338. doi:10.1145/3689187.3709614
- [7] E. F. Risko and S. J. Gilbert. 2016. Cognitive offloading. *Trends in Cognitive Sciences* 20, 9 (2016), 676–688.
- [8] Jyrki Suomala and Janne Kauttonen. 2022. Human's Intuitive Mental Models as a Source of Realistic Artificial Intelligence and Engineering. *Frontiers in Psychology* 13 (May 2022). doi:10.3389/fpsyg.2022.873289 Publisher: Frontiers.

<sup>1</sup>Agnia Sergeyuk's Google Scholar: <https://scholar.google.com/citations?user=EhNcIIwAAAAJ&hl=en&oi=ao>

<sup>2</sup>Ilya Zakharov's Google Scholar: <https://scholar.google.com/citations?user=MTOEI-oAAAAJ&hl=en&oi=ao>

<sup>3</sup>Maliheh Izadi's Google Scholar: <https://scholar.google.com/citations?user=F2D5RawAAAAJ&hl=en&oi=ao>

<sup>4</sup>Anastasia Birillo's Google Scholar: <https://scholar.google.com/citations?user=V6PG0nwAAAAJ&hl=en>

<sup>5</sup>Education Research at JetBrains Research: <https://lp.jetbrains.com/research/education/>

<sup>6</sup>Liudmila Piatnitckaia's Google Scholar: <https://scholar.google.com/citations?user=GFKmgBYAAAAJ&hl=en&oi=ao>