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Submitter Information

Organization: University of Pittsburgh School of Computing & Information

General Comment

Submittal in response to RFI from University of Pittsburgh School of Computing & Information (SCI)

Attachments

RFI Response National AI Strategic Plan Univ Pittsburgh SCI final

University of Pittsburgh School of Computing & Information (SCI)
Submittal in Response to
Request for Information (RFI) on the Development of a 2025 National Artificial
Intelligence (AI) Research and Development Strategic Plan

This submittal is in response to the RFI on the Development of a 2025 National Artificial Intelligence (AI) Research and Development Strategic Plan.¹ It encourages R&D in the following priority areas identified by the RFI: “fundamental advances in AI algorithms”, and “human-AI interaction”. This submittal also draws on the April 2025 Executive Order “Advancing Artificial Intelligence for American Youth”² to encourage innovation in these priority areas across two critical application contexts, “Improving Education through Artificial Intelligence” and “Enhancing Training for Educators in Artificial Intelligence.”

This response is submitted by a team from the School of Computing and Information (SCI) at the University of Pittsburgh.³ SCI’s faculty represents expertise across the following areas:

- Machine Learning
- Natural Language Processing
- Knowledge Representation and Reasoning
- Computer Vision
- Uses of Generative AI
- Human-Agent Interaction
- Human-Robot Interaction
- Learning Sciences
- Design of Technology-Mediated Learning Environments
- Computer Science Education
- Artificial Intelligence Education

Several faculty members research educational applications of AI, including intelligent tutoring systems, intelligent recommender systems, and pedagogical learning companions, as well as technologies that support computing, data, and AI literacies. Many of SCI’s faculty collaborate with other Pitt faculty with complementary expertise to this executive order, including faculty in ⁴Pitt’s Learning Research and Development Center⁴, Department of Psychology, Department of English, the School of Education, and the School of Social Work.

The rise of generative AI has enabled sophisticated chat-based interactions with intelligent agents, opening up new possibilities for how people, individually and in groups, can learn about

¹ <https://www.federalregister.gov/documents/2025/04/29/2025-07332/request-for-information-on-the-development-of-a-2025-national-artificial-intelligence-ai-research>

² <https://www.whitehouse.gov/presidential-actions/2025/04/advancing-artificial-intelligence-education-for-american-youth/>

³ <https://www.sci.pitt.edu/>

⁴ <https://www.lrdc.pitt.edu/>

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new domains in conversation with AI. SCI's team envisions a future where students of all ages work together with a personalized learning companion in a productive union of humans and machines that serve their desired developmental advancements and facilitate learning about any topic, both under the supervision of a teacher in a classroom setting, and independently in informal contexts or to satisfy their own curiosity. Realizing this future in the US would create a more competitive workforce as citizens are better equipped to master new skills that emerge within the context of an evolving technological landscape and leverage generative AI to increase their productivity.

To realize this future, the following are areas of essential research and development that should feature prominently in the National AI Research and Development Strategic Plan:

1. **AI systems that use pedagogically sound dialogue to drive student conceptual learning in a particular topic.** These systems would be able to use conversation to elicit student reasoning, support them in reflecting on their ideas, recommend additional resources to pursue, and engage them in exploring a topic more deeply. While generative AI systems have shown amazing capabilities in generating conversations with students and recommending resources, they have not explicitly incorporated the body of knowledge we already have as a society for what features of these interactions elicit the best learning outcomes. At Pitt, projects in this area include automatic assessment of different aspects of student dialogue, including collaborative argumentation and student reflections. They also involve exploring dialogue-based interventions delivered by a robot to collaborating students to promote rapport, balanced participation, and lexical alignment, as well as scaffolding-based interventions to support constructive dialogue between peers. Other thrusts of research explore how to assess student knowledge and recommend appropriate learning resources, as well as the effects of transparency, explainability, and student control on the effectiveness of these recommendations. ***Further research is necessary*** to explore in what ways conversations involving Large Language Models (LLMs) adhere to these pedagogical dimensions, how accurate LLMs are in identifying productive learning behaviors, and few-shot learning and fine-tuning techniques for incorporating good pedagogical knowledge in these LLM-based interactions. This would include exploring the boundaries of productive anthropomorphism for human-AI interaction, which remain unresolved, as well as investment in simulated student technologies to allow training of sophisticated pedagogical models without the need for large amounts of real-world data.
2. **AI systems that can partner with students to support them in learning how to complete authentic and complex real-world tasks.** With the growth of LLMs and

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Vision-Language Models (VLMs), generative AI systems can augment human performance on a variety of tasks, and people will need to learn how to use these systems productively as part of their jobs. Thus, it is important in formal and informal educational contexts to teach students how to partner with generative AI on real-world tasks, as well as to research what system functionality is necessary for generative AI to be an effective partner in learning contexts. For example, projects at Pitt have been exploring how AI-based systems and LLMs can offer feedback on student argumentative writing, creative writing, and writing in one's second language, supporting the revision process. Other projects have been exploring the different roles an AI-based robotic learning partner could play in computer science education. ***Further research is necessary*** to determine within a learning context how generative AI can serve as an effective partner, as well as exploring the design of student and teacher interfaces to scaffold effective use of generative AI.

3. **AI systems that can teach students and teachers about how they function and how best to use them.** Alongside the first two research areas, there is a need to educate students and teachers about the capabilities of AI-based systems, their drawbacks, and how to use them most effectively. For example, projects at Pitt have investigated how individuals develop appropriate system models of LLMs, how these mental models shape expectations, trust, and creative applications of the technology, and how best to support learners in understanding and reflecting on how AI is used in technology-enhanced learning experiences. Other projects have explored how to build on students' goals and interests to develop technologies that support the development of data literacies. ***Further research is necessary*** to examine how generative AI technologies themselves can best communicate their functionality, their confidence in the information they are providing, and potential gaps, as a way of educating students and teachers about AI more broadly.

Summary

The School of Computing & Information at the University of Pittsburgh recommends that the following areas of investigation feature prominently in the 2025 National Artificial Intelligence (AI) Research and Development Strategic Plan:

1. Exploring how conversations involving LLMs can be designed to align with learning sciences principles, supporting cognitive, social, and affective dimensions of learning, while maintaining boundaries related to anthropomorphism and fostering appropriate trust in human-AI interactions.

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2. Determining how generative AI can serve as an effective partner within a learning context, as well as exploring the design of student-facing interfaces and AI models that can scaffold students in using generative AI in effective ways.
3. Examining how generative AI technologies themselves can integrate expert pedagogical knowledge (e.g., coaching, reflective questions, feedback) to communicate their functionality, helping students and teachers form appropriate system models and acquire broader computing and AI literacies.

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