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General Comment

See attached file(s) for prepared comments.

Attachments

Riel and Chen - Response to RFI for 2025 Federal AI Plan

Accelerating Advancements in American AI Infrastructure through High-Impact Educational Programs in AI and Computing

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Re: Request for Information on the Development of a 2025 National Artificial Intelligence (AI) Research and Development (R&D) Strategic Plan ([90 FR 17835](#); NSF-2025-OGC-0001)

America has unquestionably been the global leader in AI research since its infancy in the 1950s-1960s. With the latest surge in generative AI approaches that have captured the imaginations of the public, the United States continues to lead AI research and development (R&D) efforts through businesses and academic institutions alike. However, as AI technologies become rapidly adopted across the globe, adequate public investment in the U.S. AI research enterprise is essential to maintain this competitiveness across industries.

It is imperative that federal investments not only include basic research in computing, AI, and cybersecurity systems, but also investments in the complementary ecosystem of educational programs to support learning about and the integration of AI technologies. Investment in AI-based education will provide direct, effective pathways toward preparing tomorrow's AI-enabled scientists, develop AI-enabled teaching approaches and technologies to accelerate student learning, and increase the skills of the incumbent workforce across sectors to readily respond to inevitable changes that will occur in the future with AI and other technologies.

This responses in this paper suggest several target areas that should be prioritized in the National Artificial Intelligence R&D Strategic Plan. These suggestions are informed by principles in computing education, educational technology, and workforce development research. As experts in these fields, we investigate the comprehensive ecosystems in which AI systems are innovatively deployed. From this perspective, we stress that investments must be made in the national AI R&D Plan toward providing support and education in AI for the plan to readily scale.

As a part of any public investments in AI, the national AI plan must include (1) R&D on supportive educational programs on AI to improve AI readiness, (2) R&D on AI systems for supporting education and workforce development programs, and (3) R&D on the adoption of sound standards to ensure secure and reliable AI systems across sectors.

Research in educational AI has repeatedly demonstrated a significant promise in teaching and learning with and about AI. However, these potentials must be tempered with principled usage and rigorous research to ensure that investments meet expectations and demonstrate the intended broader impacts. With the novelty of generative AI research, it is too easy today for organizations to fall victim to "AI snake oil" filled with sweeping claims without solid evidence.

We believe that without rigorous, practice-based evidence demonstrating effectiveness across the board, programs risk delivering more hype than rewards.

Toward these goals, we suggest four priorities for AI in education that can amplify the outputs of the federal AI R&D plan.

AI Education Priority 1: Learning about AI. We must prepare both the future workforce and support the upskilling of the current workforce to integrate AI into personal practices and business operations. Education is the primary mechanism toward understanding and effectively interacting with advanced technologies at the forefront of American innovation like AI, as well as quantum computing, energy, robotics, and advanced manufacturing. R&D on effective educational programming and curricula at all levels is essential for the successful adoption of AI innovations and the creation of novel AI applications. Suggested R&D priorities for supporting AI competency include:

1. Programs that develop **fundamental computational thinking and computer science skills** for all Americans in PreK-12 and higher education as a strong foundation for AI.
2. **AI literacy** in both formal education and informal settings that enable Americans of all ages to creatively and productively use AI in their everyday lives and work.
3. Programs that provide learners of all ages with **exposure to AI technologies in everyday life**, particularly in informal settings like libraries, museums, and after-school programs, or local community organizations, agencies, clubs, and churches.
4. **PreK-12 teacher and college faculty AI training programs** to support teachers' own development of AI literacy and computing fundamentals skills in relation to their teaching practices across all subjects and age ranges. This enables classroom settings where students will productively engage with AI and other emerging technologies. Additionally, this should ideally be part of broader efforts to develop teachers' skills in computing and technology toward the integration of technology in classroom teaching.
5. **Workforce training programs for responsible AI adoption** that are delivered through evidence-based training and professional development approaches across industries, particularly for knowledge-based industries that require licensure continuing education, such as law, fintech, education, and healthcare. Hands-on and experiential learning programs where participants use AI directly in practice are particularly valuable.

AI Education Priority 2: Learning with AI. Generative AI has quickly and prominently transformed the learning experience at all educational levels, which has fundamentally transformed our educational systems and understandings of academic integrity. R&D is now essential toward identifying the best ways to use AI in education so that we ensure that students are acquiring the skills and knowledge that are necessary to succeed in an AI-enabled future. Early research on educational approaches that maximize the power of AI have demonstrated significant promise at providing personalized, on-demand learning support for all Americans at both the PreK-12 and higher education levels. Investment in R&D on effective AI applications

that support teaching and learning across all academic subjects can promote learning in ways that meet students' unique individual needs and provide the necessary exposure to AI technologies that can lead to later success.

The federal AI plan should seek to accelerate educational attainment in all academic subjects via personalized learning and productive use of AI. Reliable and human-relatable AI systems are still elusive to date, and public investments in this area could generate open-access research that can be readily used by the academic, business, and public sectors alike toward driving innovation. Suggested approaches for the R&D of AI-based approaches and applications for education include:

1. **AI-first teaching approaches** that mitigate cheating and other dishonest actions with AI by embedding AI prominently within learning activities and assignments. To respond to the fundamental changes to how students are engaging in educational activities with AI (either with or without permission), R&D on equally transformative changes to educational practices with AI are needed to facilitate learning.
2. **Reliable and explainable AI technologies** that can teach content in both STEM and non-STEM subjects, but also that provide transparent internal operations that can be used to validate and trust that AI applications are providing appropriate support to learners.
3. Approaches on **reliable and accurate personalized learning**, particularly in areas of digital accessibility and assistive technologies for students with disabilities.
4. **AI technologies that are not just chatbot-based**, but instead those that push the frontier of human-computer interaction in education with new interfaces and integrations. This includes the development of new or improved AI frameworks and computational models for interacting with humans.
5. AI applications that **provide accurate evaluation and assessment of student performance**, giving students the opportunity to monitor their progress and set goals.
6. **Simulated experiences powered by AI**, broadly construed, for opportunities to learn and practice via experience. Humans tend to learn best by *doing things* and not just memorizing facts, so having robust and personalized simulated activities can dramatically increase hands-on student learning opportunities. AI agents that can interact and work alongside students on tasks that mirror real-world contexts have the potential to support authentic skill development.
7. Principles and frameworks for **ensuring that AI systems are human-relatable**, for which cross-disciplinary insights from computer science, psychology and the cognitive sciences, learning sciences, and human-computer interaction can accelerate this goal.

AI Education Priority 3: Accelerating AI-Enabled Research. A federal AI plan should prioritize supporting both current and future researchers who can benefit from using AI to accelerate research. This includes the development of infrastructural tools and education programs for researchers across disciplines in using AI. In particular, investments are needed

toward providing rapid AI onboarding for researchers who do not have expertise in computer science or computational methods. Suggested R&D approaches for the national AI plan include:

1. **Open-source materials** that provide education in using AI and ML technologies for research. Possibilities include AI productivity toolkits and workflow solutions for non-AI researchers (such as social science researchers), which will ideally remove the technical barriers that non-computer science researchers would face if adopting AI tools.
2. **Ready-to-use infrastructure tools and research-oriented AI software** featuring unified and simple-to-use user interfaces, or APIs allowing researchers to embed analytical capabilities with programming languages such as Python, R, and Stata. Additionally, any future research technologies should be developed with an eye toward the integration of autonomous AI agents that will inevitably be involved in research workflows. This priority will additionally support collaboration across disciplines on complex analyses and it would make scientific research more robust, transparent, and replicable.
3. A renewed commitment to and expansion of **the National AI Research Resource (NAIRR) and NAIRR Classroom programs**, which provide computational resources for researchers and instructors of AI courses, particularly with early stage projects.
4. Investments in funding programs for developing **graduate students, postdoctoral fellows, and new faculty** focused on R&D of AI technologies.
5. A **national interdisciplinary AI researcher fellowship** that provides training and practical experiences for AI-interested researchers and graduate students. Such an initiative could bring faculty and students from different disciplines together for intensive, hands-on projects with AI experts that emphasize cross-sector collaboration.

AI Education Priority 4: Frameworks for Responsible AI. As AI technologies become ubiquitous, it is important to understand how to use AI productively across industries while maintaining the security, integrity, and the ethical accountability of such systems. Responsible AI practices must be identified and adopted to mitigate potential risks. Additionally, assessment mechanisms should be implemented to prevent harm to individuals and companies. Our suggestions for R&D efforts in the national AI plan include:

1. **Frameworks and principles for responsible AI application and safety** in all industries, including education. This includes R&D of risk analysis frameworks across sectors, particularly within information-intensive industries, education, and security. Such frameworks can support identification of potential harms, the ability to weigh and mitigate potential risks, and balance regulatory actions taken with AI as to not prevent innovation while maintaining responsible application.
2. **Robust oversight and accountability mechanisms** must be established during the planning, implementation, and evaluation of AI initiatives across different sectors. Standards for transparent incident reporting and AI disclosure practices should be established, as well as effective procedures for AI system audits to ensure continuous improvement, accountability, and security with AI across industries.

3. **Research on preventing bad actor damage to AI systems**, which could dramatically compromise both business and educational goals where AI systems are deployed. Robust research on AI security, system breaking, poisoning, and other malicious activity is essential to prevent adversarial damage to systems, particularly in information-intensive industries. A national plan for AI R&D will assuredly include investments in the development of cybersecurity practices. However, we specifically point to the additional need for *education* on AI system security, including on how AI systems can commonly be compromised and how vigilant action can maintain system integrity to prevent harm.

Conclusion. Public investments in AI education and technologies via the National Science Foundation, the Institute of Education Sciences, the National Institutes of Health, and other federal science funding agencies are essential during this generative AI boom. These investments provide access to published research findings for all American companies, researchers, and the public sector, with which they can build novel applications at an accelerated speed. To this end, we emphasize that any projects funded under the scope of the future National AI R&D Plan adopt open science practices and broader impact plans that include cross-sector collaboration and public outreach. This will ensure that the American public can readily access and build on this base of publicly funded fundamental research on AI technologies and education. The speed by which ideas can be developed will be essential in today's rapid AI and computing ecosystem. Public research dollars have long served as a multiplier for American innovation in efficient ways, which lays a strong foundation for computational advancements.

In short, public-funded research drives American innovations, empowers educational institutions to adapt new technologies toward high academic achievement, enables the general public to readily respond to technological change, and creates new jobs, intellectual property, and technologies that ensure our future economic competitiveness and security. Educational programs are the first and best mechanisms that we have toward reaching this goal.

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