



NATIONAL SCIENCE FOUNDATION
2415 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22314

NSF 22-093

Dear Colleague Letter: Advancing Educational Innovations and Broadening Participation in STEM with Blockchain Technology

June 2, 2022

Dear Colleague:

This Dear Colleague Letter (DCL) invites submission of proposals for projects that explore and research promising uses of blockchain technology in science, technology, engineering, and mathematics (STEM) education, broadening participation, and workforce development.

BACKGROUND

The National Science Foundation supports creative, novel, and transformative research on new approaches to advancing formal and informal education, broadening participation, and strengthening workforce development in all areas of STEM, including applications of new and rapidly evolving technology. Blockchain technology is based on the concept of a distributed ledger, where copies of data contained in the ledger are distributed and stored across multiple nodes. In the world of decentralized finance, this technology is used to operate the networks underlying cryptocurrency markets. The design maintains faithful, verifiable, and exact copies of the original data, even if nodes are destroyed or compromised. All stored information is cryptographically protected and chronologically linked in an incorruptible chain. The technology also allows deployment of smart contracts, or programs operating on the blockchain, and creation of novel, cost-saving, time-saving, safe, and secure means of operating on potentially very large datasets. Typical beneficial properties of the blockchain technology include, but are not limited to:

1. Removal of intermediaries: by allowing the users to interact directly with each other and with data through the use of smart contracts;
2. Sovereignty and self-regulation: by promoting community ownership, organization, voting, and development of governance models for projects;
3. Immutability: with all records being permanent and impossible to modify;
4. Transparency: where all transactions are open and visible, while confidentiality of data such as personal information is maintained;

5. Promoting collaboration: with various collaborative forms enabled by blockchain tools; and
6. Trust and anonymity: blockchain design principles and distributed infrastructure provide confidence in its operations and resistance to malicious attacks while allowing user anonymity.

The National Science Foundation expects that applications of blockchain technology in the areas of formal and informal education, broadening participation and qualified workforce development in all areas of STEM will bring forward novel, impactful, equitable, accessible, and cost-effective solutions to facilitate the secure, traceable, and verifiable exchange of educational data among various stakeholders and benefit the broadest possible range of users. Through the Partnerships for Innovation (PFI) program, NSF also provides opportunities for researchers to increase the impact of their discoveries through partnerships, and to learn how to develop and implement a blockchain technology development roadmap, create a business model, and develop their technology into a prototype or proof of concept.

CALL FOR PROPOSALS

It is expected that a distributed ledger approach to data can offer unique advantages when applied to, for example: tracking the development and publication of curricula, lessons, or courses; maintenance and use of student records; issuing diplomas, credentials, or certificates; data storage and operation; maintenance of payment or attendance records; accreditation; validation of records; personal and group portfolios; and many other areas. The resulting tools and applications are expected to be useful and impactful in addressing complex challenges in education when utilized by students, teachers, researchers, employers, schools, informal learning organizations, university administration, parents and/or the general public, with low cost and attractive functionalities making it available to a broad range of users. Achieving this level of translation of concepts to applications requires creative approaches and transformative fundamental research, catalyzing partnerships, and accelerating the transition of discoveries from the laboratory to the marketplace for societal benefit.

Specifically, the development of new tools and applications based on blockchain technology requires rigorous research focusing on exploring new ideas and solutions through collaborative effort at the boundaries of education and other disciplines. The Directorate for Education and Human Resources (EHR) and the Directorate for Technology, Innovation and Partnerships (TIP) encourage the education research community to respond to this challenge through existing funding opportunities in EHR listed at the end of this DCL, and the Partnerships for Innovation (PFI) program in TIP. This DCL encourages proposals that contain a mix of traditional EHR-funded expertise in the areas of formal and informal education, broadening participation and workforce development in all areas of STEM, with blockchain expertise provided by collaborators in the areas of computer science, information

and communication technologies, data science, engineering, mathematics, physics, and other STEM disciplines. Note that these proposals must meet all the requirements of the corresponding funding program solicitations, including applicable deadlines and budget guidelines.

Successful projects should research and/or promote awareness, knowledge, and interest in at least one STEM discipline, and inform preparation for STEM jobs or industries of the future, while building the science, technology, engineering, and mathematics skills and practices that will be needed for these jobs. Proposals are expected to provide opportunities for broadening participation in STEM by increasing participation of groups that have historically been underrepresented in STEM fields - including women, African Americans, Hispanics, American Indians, Alaska Natives, Native Hawaiians, Native Pacific Islanders, and persons with disabilities. As appropriate, proposals may address curricula, educational approaches, educator professional development, formal and informal education, educational ecosystems, as well as the needs of other stakeholders such as industry professionals and professional societies.

General questions about this DCL should be directed to Tomasz Durakiewicz, tdurakie@nsf.gov, or Wu He, wuhe@nsf.gov. Program-specific questions about this DCL should be directed to the cognizant program directors for the programs listed below.

Sincerely,

Sylvia M. Butterfield
Assistant Director (Acting), Education and Human Resources

Erwin Gianchandani
Assistant Director for Technology, Innovation and Partnerships

LIST OF PARTICIPATING PROGRAMS

1. [Advancing Informal STEM Learning \(AISL\)](#), Toni Dancstep, tdancste@nsf.gov or Julie Johnson, jjohnson@nsf.gov
2. [Centers of Research Excellence in Science and Technology \(CREST\)](#), Luis A. Cubano, lcubano@nsf.gov
3. [Discovery Research PreK-12 \(DRK-12\)](#), Michael Steele, msteele@nsf.gov
4. [EHR Core Research \(ECR:Core\)](#), Eric Knuth, eknuth@nsf.gov
5. [HBCU Research Infrastructure for Science and Engineering \(HBCU-RISE\)](#), Luis A. Cubano, lcubano@nsf.gov
6. [Historically Black Colleges and Universities - Undergraduate Program \(HBCU-UP\)](#), Carleitta L. Paige-Anderson, cpaigean@nsf.gov

7. Innovative Technology Experiences for Students and Teachers (ITEST), Wu He, wuhe@nsf.gov or Chia Shen, cshen@nsf.gov
8. Improving Undergraduate STEM Education: Education and Human Resources (IUSE: EHR), John Jackman, jjackman@nsf.gov
9. Improving Undergraduate STEM Education: Hispanic-Serving Institutions (HSI Program), Erika Tatiana Camacho, ecamacho@nsf.gov or Michael J. Davis, mdavis@nsf.gov
10. Partnerships for Innovation (PFI), Jesus V. Soriano, phi@nsf.gov
11. Research on Emerging Technologies for Teaching and Learning (RETTL), Amy Baylor, abaylor@nsf.gov
12. Scholarships in Science, Technology, Engineering, and Mathematics Program (S-STEM), Alexandra Medina-Borja, amedinab@nsf.gov
13. Secure and Trustworthy Cyberspace (SaTC) - EDU, Li Yang, liyang@nsf.gov

REFERENCES

<https://tech.ed.gov/blockchain/>