117TH CONGRESS
1ST SESSION

S. 1839

To coordinate Federal research and development efforts focused on modernizing mathematics in STEM education through mathematical and statistical modeling, including data-driven and computational thinking, problem, project, and performance based learning and assessment, interdisciplinary exploration, and career connections, and for other purposes.

IN THE SENATE OF THE UNITED STATES

MAY 26, 2021

Ms. HASSAN (for herself and Mrs. BLACKBURN) introduced the following bill; which was read twice and referred to the Committee on Health, Education, Labor, and Pensions

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A BILL

To coordinate Federal research and development efforts focused on modernizing mathematics in STEM education through mathematical and statistical modeling, including data-driven and computational thinking, problem, project, and performance based learning and assessment, interdisciplinary exploration, and career connections, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ''Mathematical and Statistical Modeling Education Act''.

SEC. 2. MATHEMATICAL AND STATISTICAL MODELING EDUCATION.

(a) FINDINGS.—Congress finds the following:

(1) The mathematics taught in schools, including statistical problem solving and data science, is not keeping pace with the rapidly evolving needs of the public and private sector, resulting in a STEM skills shortage and employers needing to expend resources to train and upskill employees.

(2) According to the Bureau of Labor Statistics, the United States will need 1,000,000 additional STEM professionals than it is on track to produce in the coming decade.

(3) The field of data science, which is relevant in almost every workplace, relies on the ability to work in teams and use computational tools to do mathematical and statistical problem solving.

(4) Many STEM occupations offer higher wages, more opportunities for advancement, and a higher degree of job security than non-STEM jobs.

(5) The STEM workforce relies on computational and data-driven discovery, decision-making, and predictions, from models that often must quan-

tify uncertainty, as in weather predictions, spread of disease, or financial forecasting.

(6) Most fields, including analytics, science, economics, publishing, marketing, actuarial science, operations research, engineering, and medicine, require data savvy, including the ability to select reliable sources of data, identify and remove errors in data, recognize and quantify uncertainty in data, visualize and analyze data, and use data to develop understanding or make predictions.

(7) Rapidly emerging fields, such as artificial intelligence, machine learning, quantum computing and quantum information, all rely on mathematical and statistical concepts, which are critical to prove under what circumstances an algorithm or experiment will work and when it will fail.

(8) Military academies have a long tradition in teaching mathematical modeling and would benefit from the ability to recruit students with this expertise from their other school experiences.

(9) Mathematical modeling has been a strong educational priority globally, especially in China, where participation in United States mathematical modeling challenges in high school and higher education is orders of magnitude higher than in the

United States, and Chinese teams are taking a majority of the prizes.

(10) Girls participate in mathematical modeling challenges at all levels at similar levels as boys, while in traditional mathematical competitions girls participate less and drop out at every stage. Students cite opportunity for teamwork, using mathematics and statistics in meaningful contexts, ability to use computation, and emphasis on communication as reasons for continued participation in modeling challenges.

(b) DEFINITIONS.—In this section:

(1) DIRECTOR.—The term ''Director'' means the Director of the National Science Foundation.

(2) FEDERAL LABORATORY.—The term ''Federal laboratory'' has the meaning given such term in section 4 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3703).

(3) FOUNDATION.—The term ''Foundation'' means the National Science Foundation.

(4) INSTITUTION OF HIGHER EDUCATION.—The term ''institution of higher education'' has the meaning given such term in section 101(a) of the Higher Education Act of 1965 (20 U.S.C. 1001(a)).

(5) MATHEMATICAL MODELING.—The term ''mathematical modeling'' has the meaning given the term in the 2019 Guidelines to Assessment and Instruction in Mathematical Modeling Education (GAIMME) report, 2nd edition.

(6) OPERATIONS RESEARCH.—The term ''operations research'' means the application of scientific methods to the management and administration of organized military, governmental, commercial, and industrial processes to maximize operational efficiency.

(7) STATISTICAL MODELING.—The term ''statistical modeling'' has the meaning given the term in the 2021 Guidelines to Assessment and Instruction in Statistical Education (GAISE II) report.

(8) STEM.—The term ''STEM'' means the academic and professional disciplines of science, technology, engineering, and mathematics.

(c) PREPARING EDUCATORS TO ENGAGE STUDENTS IN MATHEMATICAL AND STATISTICAL MODELING.—The Director shall provide grants on a merit-reviewed, competitive basis to institutions of higher education and nonprofit organizations (or a consortium thereof) for research and development to advance innovative approaches to support and sustain high-quality mathematical modeling edu-

cation in schools operated by local education agencies, including statistical problem solving, data science, operations research, and computational thinking. The Director shall encourage applicants to form partnerships to address critical transitions, such as middle school to high school, high school to college, and school to internships and jobs.

(d) APPLICATION.—An entity seeking a grant under subsection (c) shall submit an application at such time, in such manner, and containing such information as the Director may require. The application shall include the following:

(1) A description of the target population to be served by the research activity for which such grant is sought, including student subgroups described in section 1111(b)(2)(B)(xi) of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 6311(b)(2)(B)(xi)), and students experiencing homelessness and children and youth in foster care.

(2) A description of the process for recruitment and selection of students, educators, or local educational agencies to participate in such research activity.

(3) A description of how such research activity may inform efforts to promote the engagement and achievement of students in prekindergarten through

grade 12 in mathematical modeling and statistical modeling using problem-based learning with contextualized data and computational tools.

(4) In the case of a proposal consisting of a partnership or partnerships with 1 or more local educational agencies and 1 or more researchers, a plan for establishing a sustained partnership that is jointly developed and managed, draws from the capacities of each partner, and is mutually beneficial.

(e) PARTNERSHIPS.—In awarding grants under subsection (c), the Director shall encourage applications that include—

(1) partnership with a nonprofit organization or an institution of higher education that has extensive experience and expertise in increasing the participation of students in prekindergarten through grade 12 in mathematical modeling and statistical modeling;

(2) partnership with a local educational agency, consortium of local educational agencies, or Tribal educational agencies;

(3) an assurance from school leaders to making reforms and activities proposed by the applicant a priority;

(4) ways to address critical transitions, such as middle school to high school, high school to college, and school to internships and jobs;

(5) input from education researchers and cognitive scientists, as well as practitioners in research and industry, so that what is being taught is up-to-date in terms of content and pedagogy;

(6) a communications strategy for early conversations with parents, school leaders, school boards, community members, employers, and other stakeholders; and

(7) resources for parents, school leaders, school boards, community members, and other stakeholders to build skills in modeling and analytics.

(f) USE OF FUNDS.—An entity that receives a grant under this section shall use the grant funds for research and development activities to advance innovative approaches to support and sustain high-quality mathematical modeling education in public schools, including statistical modeling, data science, operations research, and computational thinking, which may include—

(1) engaging prekindergarten through grade 12 educators in professional learning opportunities to enhance mathematical modeling and statistical problem solving knowledge, and developing training and

best practices to provide more interdisciplinary learning opportunities;

(2) conducting research on curricula and teaching practices that empower students to choose the mathematical, statistical, computational, and technological tools that they will apply to a problem, as is required in life and the workplace, rather than prescribing a particular approach or method;

(3) providing students with opportunities to explore and analyze real data sets from contexts that are meaningful to the students, which may include—

(A) missing or incorrect values;

(B) quantities of data that require choice and use of appropriate technology;

(C) multiple data sets that require choices about which data are relevant to the current problem; and

(D) data of various types including quantities, words, and images;

(4) taking a school or district-wide approach to professional development in mathematical modeling and statistical modeling;

(5) engaging rural local educational agencies;

(6) supporting research on effective mathematical modeling and statistical modeling teaching

practices, including problem- and project-based learning, universal design for accessibility, and rubrics and mastery-based grading practices to assess student performance;

(7) designing and developing pre-service and in-service training resources to assist educators in adopting transdisciplinary teaching practices within mathematics and statistics courses;

(8) coordinating with local partners to adapt mathematics and statistics teaching practices to leverage local natural, business, industry, and community assets in order to support community-based learning;

(9) providing hands-on training and research opportunities for mathematics and statistics educators at Federal laboratories, institutions of higher education, or in industry;

(10) developing mechanisms for partnerships between educators and employers to help educators and students make connections between their mathematics and statistics projects and topics of relevance in today's world;

(11) designing and implementing professional development courses and experiences, including men-

toring for educators, that combine face-to-face and online experiences;

(12) addressing critical transitions, such as middle school to high school, high school to college, and school to internships and jobs; and

(13) any other activity the Director determines will accomplish the goals of this section.

(g) EVALUATIONS.—All proposals for grants under this section shall include an evaluation plan that includes the use of outcome oriented measures to assess the impact and efficacy of the grant. Each recipient of a grant under this section shall include results from these evaluative activities in annual and final projects.

(h) ACCOUNTABILITY AND DISSEMINATION.—

(1) EVALUATION REQUIRED.—The Director shall evaluate the portfolio of grants awarded under this section. Such evaluation shall—

(A) use a common set of benchmarks and tools to assess the results of research conducted under such grants and identify best practices; and

(B) to the extent practicable, integrate the findings of research resulting from the activities funded through such grants with the findings of

other research on student's pursuit of degrees or careers in STEM.

(2) REPORT ON EVALUATIONS.—Not later than 180 days after the completion of the evaluation under paragraph (1), the Director shall submit to Congress and make widely available to the public a report that includes—

(A) the results of the evaluation; and

(B) any recommendations for administrative and legislative action that could optimize the effectiveness of the grants awarded under this section.

(i) AUTHORIZATION OF APPROPRIATIONS.—For each of fiscal years 2022 through 2026, there are authorized out of funds appropriated to the National Science Foundation, $10,000,000 to carry out the activities under this section.

SEC. 3. NASEM REPORT ON MATHEMATICAL AND STATISTICAL MODELING EDUCATION IN PRE-KINDERGARTEN THROUGH 12TH GRADE.

(a) STUDY.—Not later than 60 days after the date of enactment of this Act, the Director shall seek to enter into an agreement with the National Academies of Sciences, Engineering and Medicine (in this section referred to as ''NASEM'') (or if NASEM declines to enter

into such an agreement, another appropriate entity) under which NASEM, or such other appropriate entity, agrees to conduct a study on the following:

(1) Factors that enhance or barriers to the implementation of mathematical modeling and statistical modeling in elementary and secondary education, including opportunities for and barriers to use modeling to integrate mathematical and statistical ideas across the curriculum, including the following:

(A) Pathways in mathematical modeling and statistical problem solving from kindergarten to the workplace so that students are able to identify opportunities to use their school mathematics and statistics in a variety of jobs and life situations and so that employers can benefit from students' school learning of data science, computational thinking, mathematics, statistics, and related subjects.

(B) The role of community-based problems, service-based learning, and internships for connecting students with career preparatory experiences.

(C) Best practices in problem-, project-, and performance-based learning and assessment.

(2) Characteristics of teacher education programs that successfully prepare teachers to engage students in mathematical modeling and statistical modeling, as well as gaps and suggestions for building capacity in the pre-service and in-service teacher workforce.

(3) Mechanisms for communication with stakeholders, including parents, administrators, and the public, to promote understanding and knowledge of the value of mathematical modeling and statistical modeling in education.

(b) PUBLIC STAKEHOLDER MEETING.—In the course of completing the study described in subsection (a), NASEM or such other appropriate entity shall hold not less than one public meeting to obtain stakeholder input on the topics of such study.

(c) REPORT.—The agreement under subsection (a) shall require NASEM, or such other appropriate entity, not later than 24 months after the effective date of such agreement, to submit to the Secretary of Education and the appropriate committees of jurisdiction of Congress a report containing—

(1) the results of the study conducted under subsection (a);

(2) recommendations to modernize the processes described in subsection (a)(1); and

(3) recommendations for such legislative and administrative action as NASEM, or such other appropriate entity, determines appropriate.

(d) AUTHORIZATION OF APPROPRIATIONS.—For the fiscal year 2022, there are authorized out of funds appropriated to the National Science Foundation, $1,000,000 to carry out the activities under this section.

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