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118TH CONGRESS, 1st Session | HOUSE OF REPRESENTATIVES | REPORT 118–62

MATHEMATICAL AND STATISTICAL MODELING EDUCATION ACT

MAY 16, 2023.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. LUCAS, from the Committee on Science, Space, and Technology, submitted the following

R E P O R T

[To accompany H.R. 1735]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, Space, and Technology, to whom was referred the bill (H.R. 1735) 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, having considered the same, reports favorably thereon with an amendment and recommends that the bill as amended do pass.

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39–006

The amendment is as follows:

Strike all after the enacting clause and insert the following:

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 quantify 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, including computer science.

(c) PREPARING EDUCATORS TO ENGAGE STUDENTS IN MATHEMATICAL AND STATISTICAL MODELING.—The Director shall make awards 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 education in schools that are private, faith-based, or homeschools, or operated by local educational agencies, including statistical modeling, 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 an award 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 an award 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, including students from groups historically underrepresented in STEM, 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 making awards under sub (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, a 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 an award under this section shall use the award for research and development activities to advance innovative approaches to support and sustain high-quality mathematical modeling education in public schools, private schools (including faith-based schools), or homeschools, 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 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 mentoring for educators, that combine face-to-face and online experiences;

(12) reduce gaps in access to learning opportunities for students from groups historically underrepresented in STEM;

(13) provide support and resources for students from groups historically underrepresented in STEM;

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

(15) researching effective approaches for engaging students from groups historically underrepresented in STEM; and

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

(g) EVALUATIONS.—All proposals for awards under this section shall include an evaluation plan that includes the use of outcome oriented measures to assess the impact and efficacy of the award. Each recipient of an award 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 awards made under this section. Such evaluation shall—

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

(B) to the extent practicable, integrate the findings of research resulting from the activities funded through such awards 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 awards made under this section.

(i) FUNDING.—From amounts appropriated or otherwise made available for the Directorate for STEM Education of the National Science Foundation, the Director shall allocate up to $10,000,000 for each of fiscal years 2024 through 2028 to carry out this section.

SEC. 3. NASEM REPORT ON MATHEMATICAL AND STATISTICAL MODELING EDUCATION IN PREKINDERGARTEN 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, in-

cluding 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-, 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) FUNDING.—From amounts appropriated or otherwise made available for the Directorate for STEM Education of the National Science Foundation, the Director shall allocate up to $1,000,000 for fiscal year 2024 to carry out this section.

SEC. 4. LIMITATIONS.

(a) LIMITATION ON FUNDING.—Amounts made available to carry out sections 2 and 3 shall be derived from amounts appropriated or otherwise made available to the National Science Foundation.

(b) SUNSET.—The authority to provide awards under this Act shall expire on September 30, 2028.

PURPOSE AND SUMMARY

H.R. 1735, the *Mathematical and Statistical Modeling Education Act* coordinates 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.

BACKGROUND AND NEED FOR LEGISLATION

Many STEM occupations require computational and data-driven discovery, decision-making, and predications using models that often must quantify uncertainty, as in weather predictions, spread of disease, or financial forecasting.

The mathematics education provided in PreK–12 schools, including statistical problem solving and data science, is not keeping pace with the rapidly evolving needs of the public and private sector. The resulting STEM skills shortage has forced employers to expend resources to train and upskill employees.

H.R. 1735, the *Mathematical and Statistical Modeling Education Act,* directs the National Science Foundation to support research to

improve STEM education at the K–12 level, including innovations to incorporate mathematical and statistical modeling with a real-world context. The legislation also provides for a National Academies of Sciences, Engineering, and Medicine study to assess best practices for and barriers to successful implementation of such innovations.

H.R. 1735 has been endorsed by the American Statistical Association (ASA), the Institute for Operations Research and the Management Sciences (INFORMS), the Consortium for Mathematics and its Applications (COMAP), the American Mathematical Association of Two-Year Colleges (AMATYC), the New Hampshire Learning Initiative (NHLI), the National Council of Teachers of Mathematics (NCTM), the Center for Innovation in Education (C!E), and the Business Software Alliance (BSA).

LEGISLATIVE HISTORY

During the 117th Congress, the Subcommittee on Research and Technology held a two-part hearing on April 28, 2021, and May 6, 2021, to discuss opportunities and challenges for leveraging and expanding the National Science Foundation's mission to continue to advance excellent research; improve STEM education and research training; increase research accessibility, and accountability; and accelerate research to address major societal challenges.

On May 28, 2021, H.R. 3588 the *Mathematical and Statistical Modeling and Education Act* was introduced by Representative Houlahan and co-sponsored by Representatives Baird, McNerney, Ross, Ellzey, and Sherrill. The bill was referred to the House Science, Space and Technology Committee and reported favorably on April 5, 2022. On July 26, 2022, H.R. 3588 passed the House of Representatives without amendment and was referred to the Senate Committee on Health, Education, Labor, and Pensions.

On March 23, 2023, H.R. 1735 the *Mathematical and Statistical Modeling and Education Act* was introduced by Representative Houlahan and co-sponsored by Representatives Baird (R–IN), Lee (D–PA), and Stevens (D–MI). The bill was referred to the House Science, Space and Technology Committee and reported favorably, as amended, on March 29, 2023.

COMMITTEE VIEWS

The Committee intends for the Director to encourage applications that include partnerships with a nonprofit organization or an institution of higher education that has extensive experience and expertise in increasing and diversifying participation of prekindergarten through grade 12 students in STEM education activities, including mathematics more generally, not necessarily specific to mathematical modeling and statistical modeling.

SECTION-BY-SECTION

Section 1. Short title

The short title of this legislation is "Mathematical and Statistical Modeling and Education Act."

Section 2. Mathematical and statistical modeling education

Directs the National Science Foundation to provide awards for research and development related to mathematical modeling education. It directs NSF to devote no less than $10,000,000 per year from fiscal year 2024 through 2028 for these awards.

Section 3. NASEM report on mathematical and statistical modeling education in pre-kindergarten through 12th Grade

Directs the National Science Foundation (NSF) to enter into an agreement with the National Academies of Sciences, Engineering, and Medicine to carry out a study to assess opportunities and challenges related to implementing innovations in mathematical modeling education. It directs NSF to provide $1 million in fiscal year 2024 to carry out this section.

COMMITTEE CONSIDERATION

On March 29, 2023, the Committee met in open session and ordered reported favorably the bill, H.R. 1735, as amended, a quorum being present, by a record vote of 36 yeas and 0 nays.

ROLL CALL VOTES

Clause 3(b) of rule XIII requires the Committee to list the recorded votes on the motion to report legislation and amendments thereto. The following reflects the recorded votes taken during the Committee consideration:

Full Committee Markup
Bill: HR 1735, motion to report

Sponsor: Houlahan, Baird

Majority	Aye	No	Present
Frank Lucas, Oklahoma	1		
Bill Posey, Florida	1		
Randy Weber, Texas	1		
Brian Babin, Texas	1		
Jim Baird, Indiana	1		
Daniel Webster, Florida	1		
Mike Garcia, California	1		
Stephanie Bice, Oklahoma	1		
Jay Obernolte, California	1		
Chuck Fleischmann, Tennessee			
Darrell Issa, California	1		
Rick Crawford, Arkansas	1		
Claudia Tenney, New York	1		
Ryan Zinke, Montana	1		
Scott Franklin, Florida	1		
Dale Strong, Alabama	1		
Max Miller, Ohio	1		
Rich McCormick, Georgia	1		
Mike Collins, Georgia	1		
Brandon Williams, New York	1		
Tom Kean, New Jersey	1		
Minority	**Aye**	**No**	**Present**
Zoe Lofgren, California	1		
Suzanne Bonamici, Oregon	1		
Haley Stevens, Michigan	1		
Jamaal Bowman, New York	1		
Deborah Ross, New Carolina	1		
Eric Sorensen, Illinois	1		
Andrea Salinas, Oregon	1		
Val Foushee, North Carolina	1		
Kevin Mullin, California	1		
Jeff Jackson, North Carolina	1		
Emilia Sykes, Ohio	1		
Maxwell Frost, Florida	1		
Yadira Caraveo, Colorado	1		
Summer Lee, Pennsylvania	1		
Jennifer McClellan, Virgina	1		
Ted Lieu, California			
Sean Casten, Illinois	1		
Paul Tonko			
Total	36	0	

Date: 3/29/23

Measure:

Offered By:

Amendment No.:

Result?	Agreed To: [X]		
	Not Agreed To: [ ]		
	Withdrawn: [ ]		
Voice Vote	*Ayes*	*Nays*	*Present*
	36	**0**	

APPLICATION OF LAW TO THE LEGISLATIVE BRANCH

The Committee finds that H.R. 1735 does not relate to the terms and conditions of employment or access to public services or accommodations within the meaning of section 102(b)(3) of the Congressional Accountability Act (Public Law 104–1)

STATEMENT OF OVERSIGHT FINDINGS AND RECOMMENDATIONS OF THE COMMITTEE

In compliance with clause 3(c)(1)of rule XIII, and clause (2)(b)(1) of rule X, the Committee's oversight findings and recommendations are reflected in the descriptive portions of this report.

STATEMENT OF GENERAL PERFORMANCE GOALS AND OBJECTIVES

Pursuant to clause 3(c)(4) of rule XIII, the goal of H.R. 1735 is 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.

DUPLICATION OF FEDERAL PROGRAMS

Pursuant to clause 3(c)(5) of rule XIII, the Committee finds that no provision of H.R. 1735 establishes or reauthorizes a program of the Federal Government known to be duplicative of another Federal program, including any program that was included in a report to Congress pursuant to section 21 of Public Law 111–139 or identified in the most recent Catalog of Federal Domestic Assistance.

FEDERAL ADVISORY COMMITTEE ACT

The committee finds that the legislation does not establish or authorize the establishment of an advisory committee with in the definition of section 5(b) of the Federal Advisory Committee Act.

UNFUNDED MANDATE STATEMENT

The Committee adopts as its own the estimate of Federal mandates prepared by the Director of the Congressional Budget Office pursuant to section 423 of the Unfunded Mandates Reform Act.

EARMARK IDENTIFICATION

Pursuant to clauses 9(e), 9(f), and 9(g) of rule XXI, the Committee finds that H.R. 1735 does not include any congressional earmarks, limited tax benefits, or limited tariff benefits

COMMITTEE COST ESTIMATE

Pursuant to clause 3(d)(1) of rule XIII, the Committee adopts as its own the cost estimate prepared by the Director of the Congressional Budget Office pursuant to section 402 of the Congressional Budget Act of 1974.

NEW BUDGET AUTHORITY, ENTITLEMENT AUTHORITY, AND TAX EXPENDITURES

Pursuant to clause 3(c)(2) of rule XIII, the Committee finds that H.R. 1735 would result in no new or increased budget authority, entitlement authority, or tax expenditures or revenues.

CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

With respect to the requirements of clause (3)(c)(3) of rule XIII and section 402 of the Congressional Budget Act of 1974, the Committee has received the following cost estimate for H.R. 1713 from the Director of Congressional Budget Office:

H.R. 1735, Mathematical and Statistical Modeling Education Act

As ordered reported by the House Committee on Science, Space, and Technology on March 29, 2023

By Fiscal Year, Millions of Dollars	2023	2023-2028	2023-2033
Direct Spending (Outlays)	0	0	0
Revenues	0	0	0
Increase or Decrease (-) in the Deficit	0	0	0
Spending Subject to Appropriation (Outlays)	0	38	51

Increases *net direct spending* in any of the four consecutive 10-year periods beginning in 2034?	No	Statutory pay-as-you-go procedures apply?	No
		Mandate Effects	
Increases *on-budget deficits* in any of the four consecutive 10-year periods beginning in 2034?	No	Contains intergovernmental mandate?	No
		Contains private-sector mandate?	No

H.R. 1735 would authorize the appropriation of $10 million annually over the 2024–2028 period for the National Science Foundation (NSF) to award grants to nonprofit organizations and institutions of higher education to develop approaches for teaching mathematical modeling, and to report to the Congress on those grants. The bill would also authorize the appropriation of $1 million in 2024 for the NSF to enter into an agreement with the National Academies of Science, Engineering, and Medicine to study factors enhancing or impeding mathematical modeling education.

For this estimate, CBO assumes that the legislation will be enacted late in fiscal year 2023 and that the authorized amounts will be appropriated each year. Based on historical spending patterns for similar programs, CBO estimates that implementing H.R. 1735 would cost $38 million over the 2024–2028 period and $13 million after 2028.

The costs of the legislation, detailed in Table 1, fall within budget function 250 (general science, space, and technology).

TABLE 1.—ESTIMATED INCREASES IN SPENDING SUBJECT TO APPROPRIATION UNDER H.R. 1735

	By fiscal year, millions of dollars—						
	2023	2024	2025	2026	2027	2028	2023–2028
Authorization	0	11	10	10	10	10	51
Estimated Outlays	0	3	6	9	10	10	38

The CBO staff contact for this estimate is Willow Latham-Proença. The estimate was reviewed by H. Samuel Papenfuss, Deputy Director of Budget Analysis.

PHILLIP L. SWAGEL,
Director, Congressional Budget Office.

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