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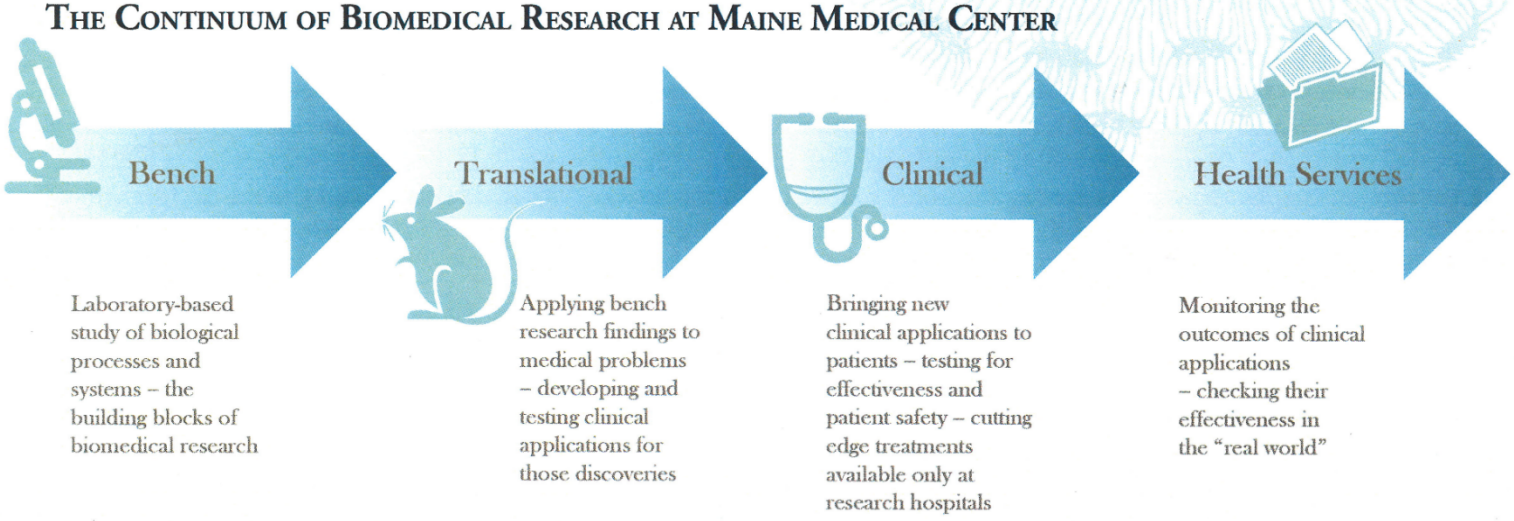
Maine Medical Center
Research Institute

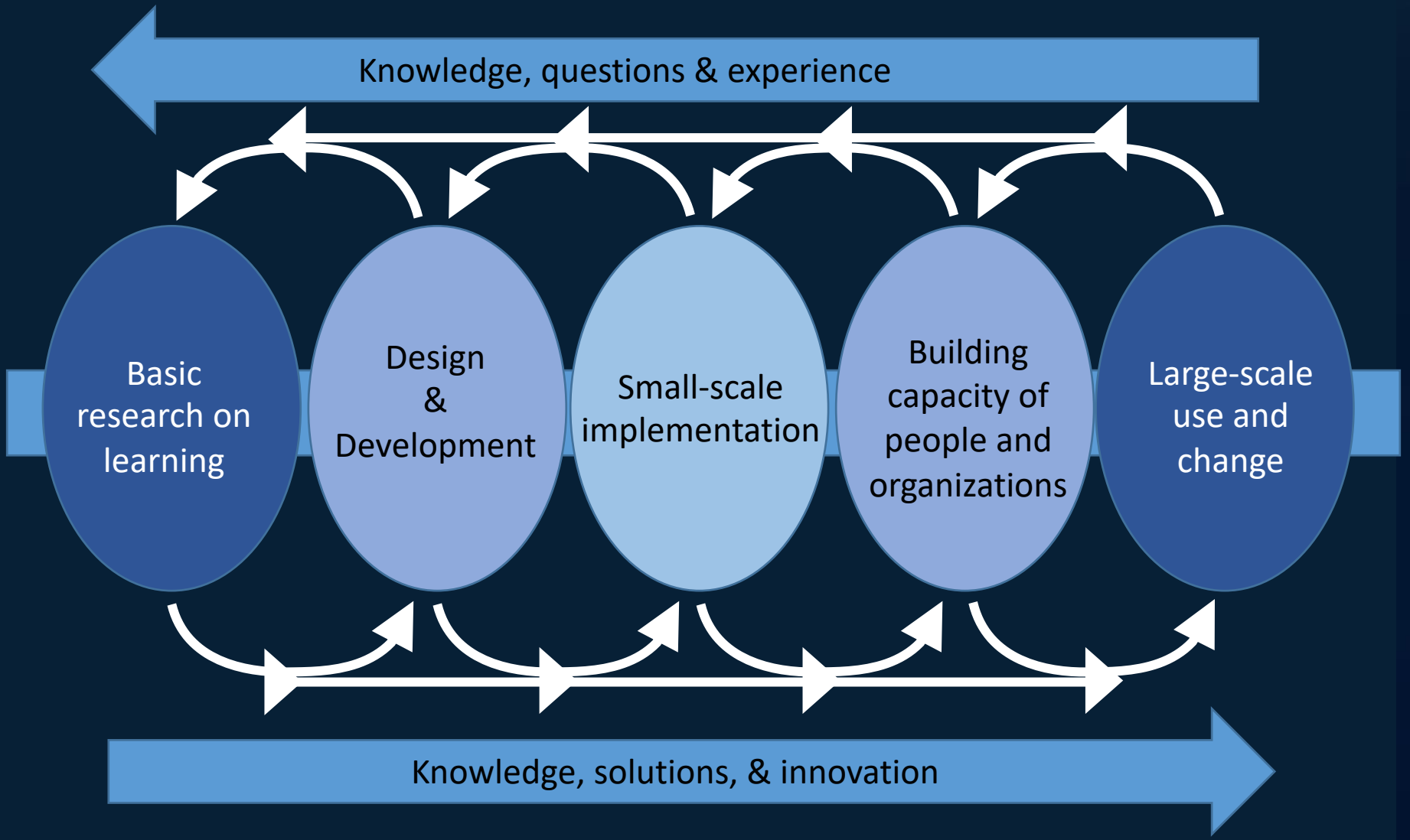
Research at Maine Medical Center Research Institute

The Maine Medical Center Research Institute (MMCRI) strives to provide a growing, visionary, and nurturing environment for scientists with core strengths in molecular biology and genetics, outcomes and health services research, and clinical research. Along with being a center for biomedical research, the institute is also a catalyst for economic and academic growth in the region. Our curiosity and determination are opening new doors in the treatment and detection of diseases. MMCRI is divided into both laboratory-based and clinical research divisions, including the Center for Molecular Medicine, Clinical and Translational Research, the Center for Psychiatric Research, and the Center for Outcomes Research and Evaluation.

The Continuum of Biomedical Research at Maine Medical Center



Each of these components of research is thriving at Maine Medical Center.



From Ferrini-Mundy, J., Singer, S., & Scherer, L. (2016). The reform of undergraduate science, technology, engineering, and mathematics education in context: Preparing tomorrow's STEM professionals and educating a STEM-savvy public. In G. Weaver, W. Burgess, A. Childress, & L. Slakey (Eds.), *Transforming institutions: Undergraduate STEM education for the 21st century.*

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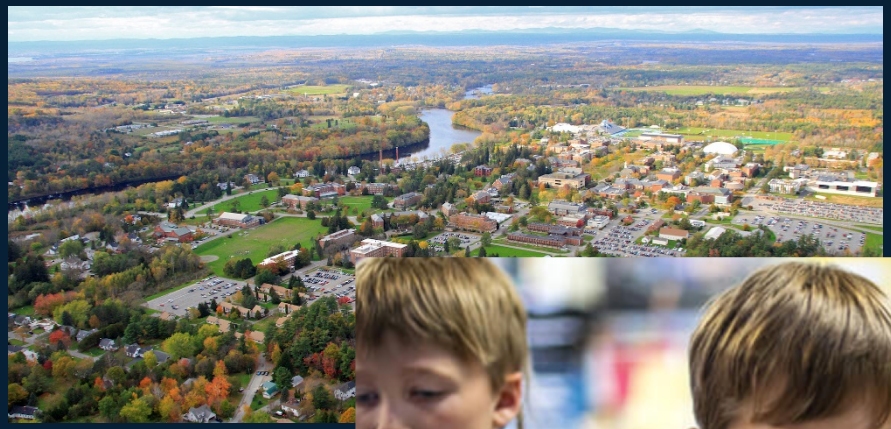
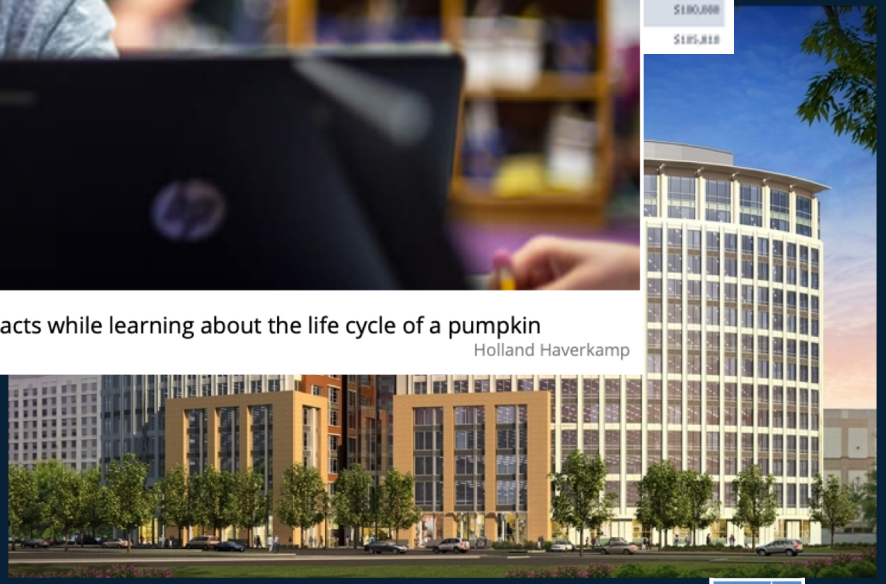
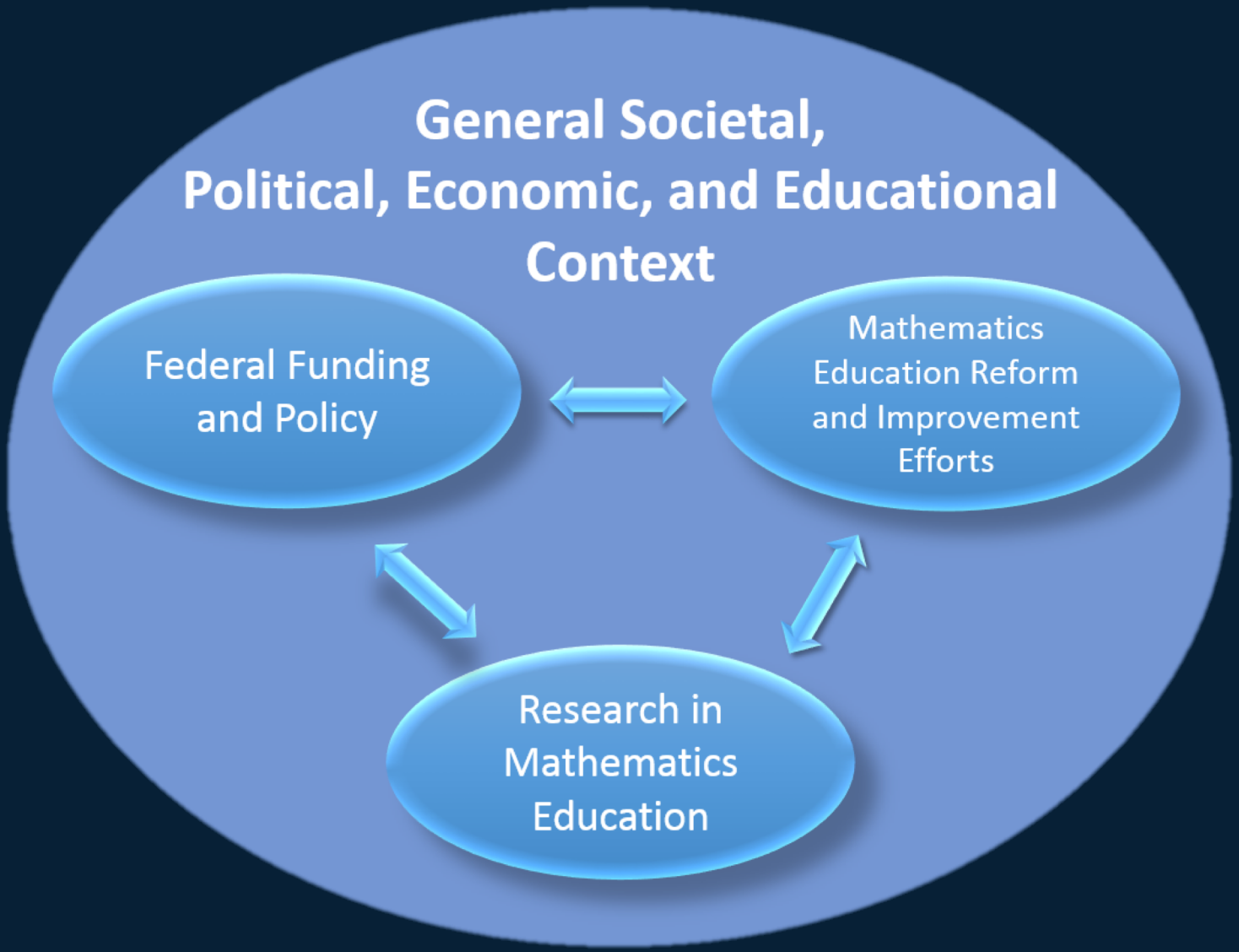


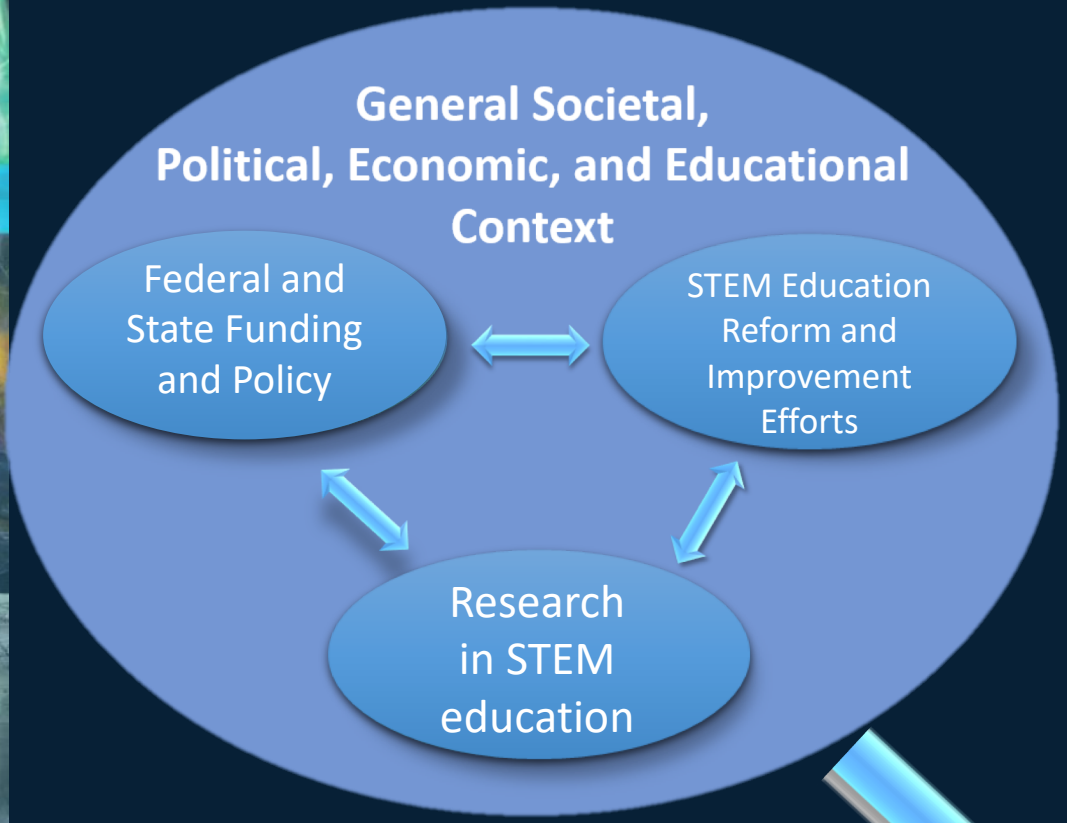
A third grader at Great Salt Bay Community School reacts while learning about the life cycle of a pumpkin

Holland Haverkamp





Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg; See Ferrini-Mundy, J. (2018). Education Reform, Research, and Policy: Interwoven Influences on Mathematics Education in the United States. In J. Cai (Ed.) *Compendium for research in mathematics education.* Reston, VA: National Council of Teachers of Mathematics.



Improved teaching, opportunity to learn, inclusion, understanding, and achievement, in mathematics

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg;

STEM Workforce and STEM-Literate Public

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* **I**nvited Lecture, ICME 13, Hamburg;

STEM Workforce and STEM-Literate Public

Virtual Worlds

Augmented Reality

Making

Games

Citizen Science

Online Learning

Social Media

Science Centers

After-school Programs

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NSF Investment in Systemic Change and Standards (late 1980s through early 2000s)

General context:

- Poor U.S. performance on international comparative assessments in mathematics
- Concerns from business and other leaders about low expectations for education (*A Nation at Risk - NAS*)
- Conceptual proposition (e.g., Smith & O'Day) about systemic reform and the role of education standards

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg;

Mathematics education reform and improvement efforts:

- NCTM *Curriculum and Evaluation Standards for School Mathematics* with emphasis on what students should know and be able to do, as well as on pedagogical approaches
- Development of state standards
- Emphasis on teacher professional development

Research in mathematics education:

- Understanding of learning of fundamental concepts in mathematics (number, arithmetic operations, etc.); problem solving
- Less on teaching, assessment, policy

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg;

Federal funding and policy:

- U.S. Department of Education Eisenhower Math and Science State Grant Program and National program (for teacher professional development)
- NSF Systemic Initiatives programs
- NSF Mathematics Instructional Materials Development programs
- NSF Research in Teaching and Learning Program

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg;

From the solicitation for NSF's Urban Systemic Program in Science, Mathematics, and Technology Education, NSF 00-34

Districts should also provide the following:

- Evidence for the use of district-wide profiles or strategies to determine the degree to which **standards-based science and mathematics curriculum** is being implemented, including a mechanism for evaluating the system's science and mathematics education infrastructure, instructional workforce needs, and the instructional workforce's competency and capacity to deliver the curriculum.
- Pertinent information regarding the use of an **established district-wide accountability plan** that relies heavily on an array of assessment measures to document student progress, including baseline data on science and mathematics student achievement.

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg;

From the solicitation for NSF's Urban Systemic Program in Science, Mathematics, and Technology Education, NSF 00-34

- A statement of all **polices that support a high quality SMET education for all students** and identification of strategies to ensure that policies are implemented.
- Evidence of the **convergence of resources** in support of a unitary program for science and mathematics education.
- A leadership **plan for assisting principals** in their roles as educational leaders.
- A well-developed **teacher and student support system**.

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg;

From the solicitation for NSF's Urban Systemic Program in Science, Mathematics, and Technology Education, NSF 00-34

- Ongoing and effective strategies for **community engagement**, outreach, and parent involvement.
- An established or emerging plan for **developing effective partnerships** in support of standards-based science and mathematics teaching and learning.

Optional: Support for **research on practice** may be embedded in the K-12 plan.

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg;

From NSF Solicitation: Materials for Middle School mathematics Instruction: NSF 89-41

"Coming from a long process of deliberation and consensus, the NCTM Curriculum and Evaluation Standards and Everybody Counts document first steps toward this plan [for improvement of mathematics education]. …They provide a sound philosophical basis for changes in content, method, and assessment. They signal high current interest in mathematics education providing both a foundation and an opportunity for improvement. The purpose of this solicitation is to enhance this opportunity…." (p. 4)

Slide from Ferrini-Mundy, J. (2016). *The ecosystem for improving mathematics education perspectives about policy, reform and research.* Invited Lecture, ICME 13, Hamburg;

Highlights in U.S. Federal Funding and Policy

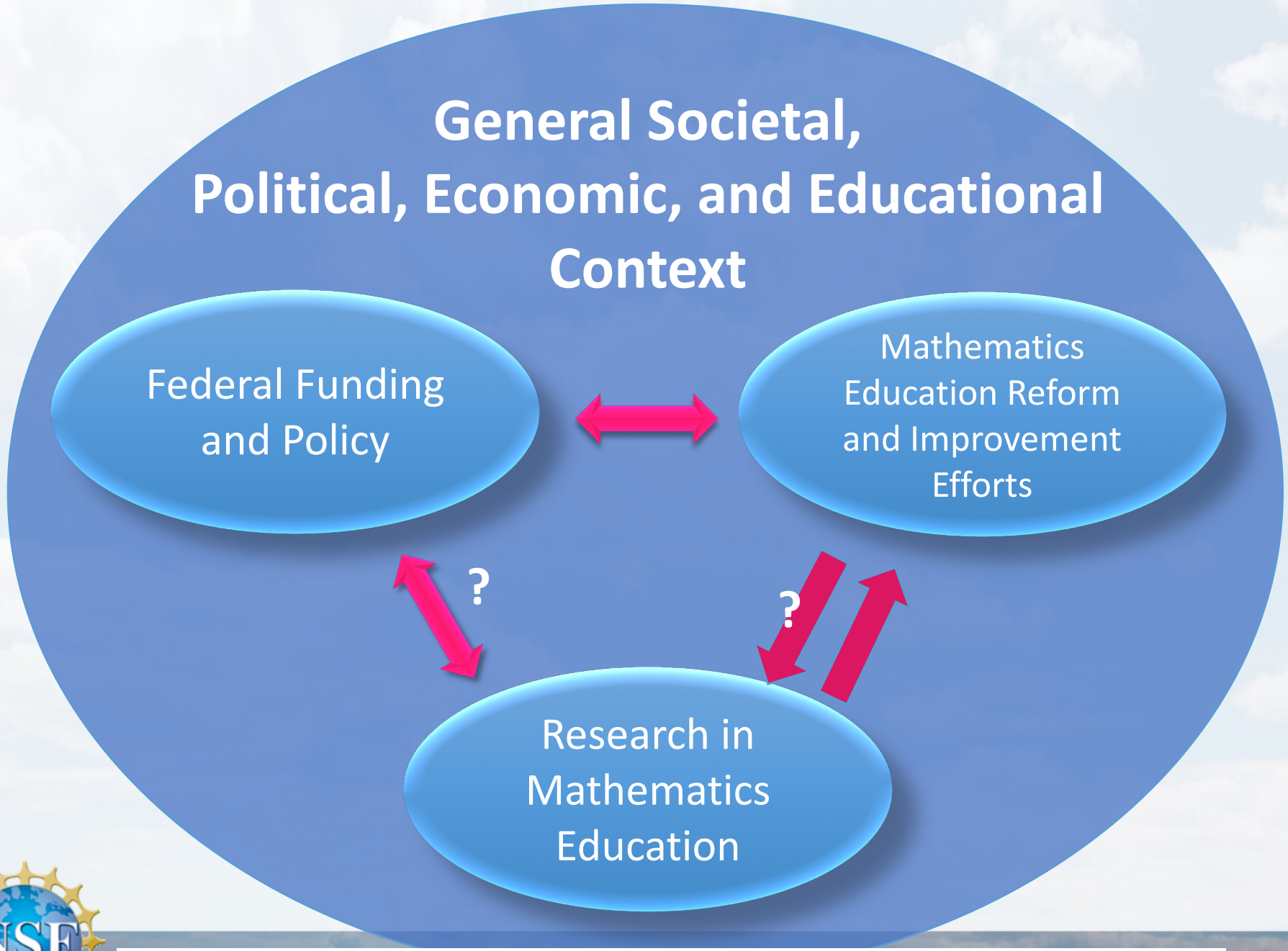
Every Student Succeeds Act 2015, US Department of Education:

- College and career ready standards
- Annual statewide assessments and local pilots
- State-driven student performance targets
- Supports for struggling schools
- Focus on evidence-based rationales

Evidence-Based Policymaking Commission Act of 2016

NSF-Supported Research in Mathematics Education -- Today

- Foundational studies to better understand mathematics teaching and learning
- Strong continued work on understanding of mathematical concepts and processes
- More large-scale effectiveness studies to enable scaling up across settings
- Sophisticated means for measuring teachers' mathematical knowledge for teaching
- Contributions to assessment advances, measurement of indicators of reform



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General Societal, Political, Economic, and Educational Context, 1990s - today: RESEARCH

Students leaving STEM majors because of poor instruction (Seymour, E., Hewitt, N., & Friend, C. (1997). *Talking About Leaving.)*

Research on undergraduate STEM learning

- calculus learning studies in 1980s/1990s
- concept inventories (Hestenes et al., 1985, etc.)
- PER movement 1970s (see Meltzer & Otero 2015, Am. J. Phys.)
- first school of engineering education – Purdue, 2004

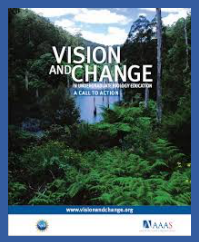
PNAS Proceedings of the National Academy of Sciences of the United States of America

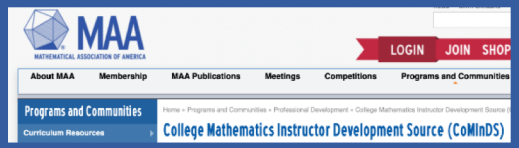
Active learning increases student performance in science, engineering, and mathematics. 2014.

Scott Freeman, Sarah L. Eddy, Miles McDonough, Michelle K. Smith, Nnadozie Okoroafor, Hannah Jordt, and Mary Pat Wenderoth

General Societal, Political, Economic, and Educational Context, 1990s - today: REFORM AND IMPROVEMENT EFFORTS

- Calculus reform ("*A Pump, Not a Filter*") – 1980s
- Universities hiring DBER scholars in disciplinary departments
- Professional societies taking on improvement efforts
- Disciplinary groups partnering to make change

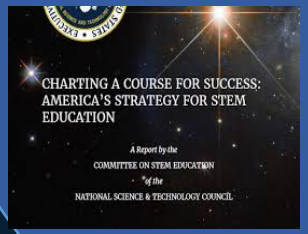




General Societal, Political, Economic, and Educational Context, 1990s - today: FEDERAL FUNDING AND POLICY

Federal agencies investing in STEM (STEM for All, Computer Science for All, WH STEM Education Strategic Plans)

Government policy leaders from STEM education research



Influential National Academies Studies (*Discipline-Based Education Research: Understanding and improving learning in undergraduate science and engineering*, 2012)

IUSE: EHR program is a core NSF undergraduate STEM education program that seeks to improve the effectiveness of undergraduate STEM education for both majors and non-majors. The program is open to application from all institutions of higher education and associated organizations. NSF places high value on educating students to be leaders and innovators in emerging and rapidly changing STEM fields as well as educating a scientifically literate populace. In pursuit of this goal, IUSE: EHR supports projects that have the potential to improve student learning in STEM through development of new curricular materials and methods of instruction, and development of new assessment tools to measure student learning. In addition to innovative work at the frontier of STEM education, this program also encourages replications of research studies at different types of institutions and with different student bodies to produce deeper knowledge about the effectiveness and transferability of findings.

Revolutionizing Engineering Departments (hereinafter referred to as RED) is designed to build upon previous efforts in engineering education research. Specifically, previous and ongoing evaluations of the NSF Engineering Education and Centers Division program and its predecessors, as well as those related programs in the Directorate of Education and Human Resources, have shown that prior investments have significantly improved the first year of engineering students' experiences, incorporating engineering material, active learning approaches, design instruction, and a broad introduction to professional skills and a sense of professional practice – giving students an idea of what it means to become an engineer. Similarly, the senior year has seen notable change through capstone design experiences, which ask students to synthesize the technical knowledge, skills, and abilities they have gained with professional capacities, using reflective judgment to make decisions and communicate these effectively. However, this ideal of the senior year has not yet been fully realized, because many of the competencies required in capstone design, or required of professional engineers, are only partially introduced in the first year and not carried forward with significant emphasis through the sophomore and junior years.

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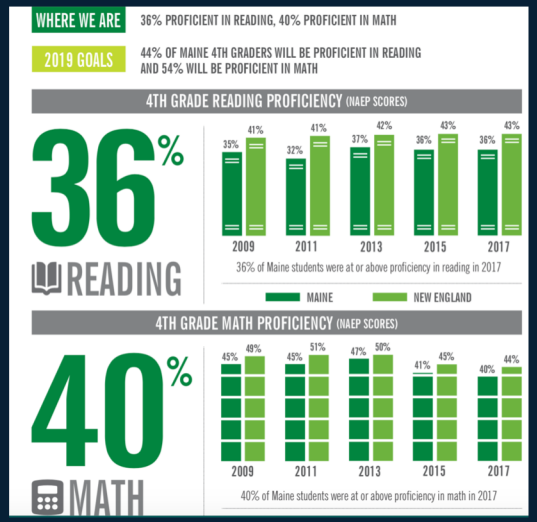
Challenges in Maine

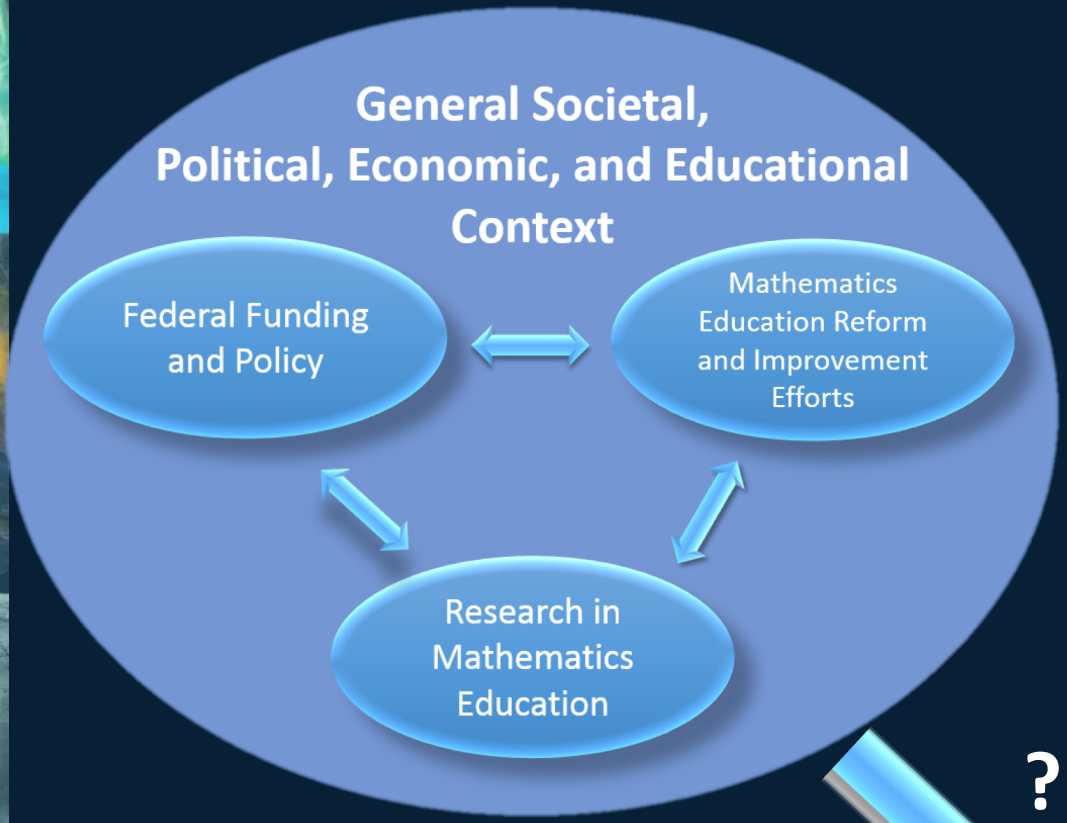
- Low college attainment
- Poor entry preparation in mathematics
- STEM teacher shortages in K-12
- Need to prepare a workforce for tomorrow in an increasingly high-tech set of industries

EDUCATE MAINE



2019 Goals:

- Maine students will increase their proficiency in math to 47%
- 55%of Maine 11th grade students will be proficient in math
- 44% of Maine adults have a postsecondary credential of value



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Thank you.

Joan.ferrinimundy@maine.edu