The following is an output of the *SIAM Convening on Climate Science, Sustainability, and Clean Energy* which was funded by the NSF grant DMS 2227218. It is one of nine recommendations to federal research and development agencies for support of research and education to advance scientific knowledge, anticipate future conditions, accelerate clean energy innovations and sustainable practices, and increase resilience in the face of climate change. Read the full report and other recommendations at www.siam.org.

Transforming Education to Address Complex Futures

Big Idea. The world is facing challenges of increasing complexity at an accelerating pace. Mathematics, modeling, data science, and systems analysis are central to researching and developing solutions for complex problems. However, today's students often find it difficult to place coursework into a broader context and synthesize subject areas. A collaborative approach to curricula, classes, and pedagogy should be designed to cross boundaries among STEM, social science, and other disciplines and graduate thinkers who can contribute professionally and personally to solutions for society's Grand Challenges (e.g., climate, human health, food security, national security).

Reasoning and Justification. Work to prepare for complex futures is timely, given the recent, global examples of extreme weather, clean energy and its role in energy security, the global pandemic, and supply chain challenges. There is a need to ensure that students in all majors eventually develop an increased awareness of these problems through interdisciplinary courses and project work so they understand their role as a citizen and professional, and have the capacity and skills to develop and contribute to solutions. NSF is in the unique position at the interface of scientific advancement and education, with expertise across disciplines and focused on far-reaching efforts that advance society to develop this improved workforce. NSF also has experience with funding award structures that could be applicable to this topic, making implementation more straightforward.

Requirements. Implementation of this idea requires a shift toward a collaborative, less siloed mindset within academia and between academia, industry, and government. Three steps are envisioned to get there: (1) A 3–5-year pilot period, when multiple institutions develop and test transformative strategies for curriculum design and pedagogy. (2) An assessment period, where successful strategies are identified and refined. (3) A broad promulgation of lessons learned through replication and continued innovation. At all stages, stakeholders – including students, faculty, university leadership, industry, non-profit organizations, and government – should be consulted to ensure that disparate needs and ideas are being addressed.

Value and Impact. The adoption of revised educational paradigms can meet the needs of both students and industry. Integrating industrial partners into the education pipeline will (1) offer new insights into the pedagogical process; (2) attract new students into STEM associated fields and improve retention rates; (3) enhance workforce readiness and align degree programs more closely with emerging societal needs. The approach outlined will result in innovations including, but not limited to:

- Pedagogical practices that promote more active and engaged learning through incorporation of relevant issues and context into lessons
- Adoption of curricula that are adaptable to university strengths while promoting interdisciplinary work
- Disruption of academic silos and traditional academic reward systems to improve inter/transdisciplinary education and/or research collaboration teams
- Improved U.S. leadership and economic competitiveness through greater capacity for innovation
- General increase in public awareness of issues surrounding complex problems, for example sustainability and climate
- Improved general numeracy as K-12 and community learning are implemented

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