The Mindset Report - Blueprint for Change

Volume 2

Faculty Guidelines for Implementing Change in Undergraduate Engineering and Engineering Technology Education

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Engineering Mindset
INCLUSIVE MINDSET FOR THE FUTURE

For more information on the Vision and Change in Undergraduate Engineering and Engineering Technology Education Initiative, see
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ASEE and NAE Report Collaboration

Founded in 1893, the American Society for Engineering Education (ASEE) is a nonprofit organization of individuals and institutions committed to furthering education in engineering and engineering technology. ASEE is the lead organization for this report, an effort that began when Sheryl Sorby was President of ASEE in 2020. Sheryl challenged the profession to review the state of undergraduate engineering and engineering technology education in preparing engineers. A 10-member Steering Committee was formed. With the urging of NSF, the Steering Committee began working with the National Academy of Engineering (NAE). The NAE is a part of the National Academies of Sciences, Engineering, and Medicine, a private, independent, nonprofit institution created by the federal government in 1863 to “provide independent, objective advice to inform policy with evidence, spark progress and innovation, and confront challenging issues for the benefit of society.” The mission of the NAE is to “advance the welfare and prosperity of the nation by providing independent advice on matters involving engineering and technology and by promoting a vibrant engineering profession and public appreciation of engineering.” The collaboration between ASEE and NAE led to this report with support from the National Science Foundation (NSF).

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Section 1: Create Flexible Program Structures to Remove Barriers

Introduction

Following their origins in the Grinter report, traditional engineering degree programs are inherently inflexible. There are exceptions in some engineering programs, but this is not the norm. At most institutions, students' ability to progress toward an engineering degree is contingent upon their success in introductory sequences of traditional math and science courses, most of which have notoriously high DFW rates. Beyond the courses themselves, the interconnections between courses enforced through traditional prerequisite structures represent an additional barrier to student progression in engineering. Further, the rigid prerequisite structure ignores much of what we know about how deep learning occurs. Just-in-Time (JiT) teaching and learning provide an alternative path to deep learning when compared to the traditional model of curriculum design. In the prerequisite model, students learn a concept in their first year but don't apply it to real-world examples until their third or fourth year, by which time they have forgotten the concept altogether and must re-learn it. With JiT teaching/learning, students learn foundational theories and immediately apply them to real-world problems, gaining a deeper understanding of the topic at hand. As such, there is a need to shift the mindset of engineering education toward more flexible attainment of student learning outcomes without some of the barriers associated with the traditional prerequisite structure of the engineering curriculum.

Each of the following recommendations includes representative steps that institutions may consider to adopt more flexible program structures, aligning with their mission and the student populations they serve.

Addressing Recommendation 1.1: Instead of a one-size-fits-all all-math requirement in the expected level of incoming math preparation, incorporate in-context mathematics across the introductory curriculum to help alleviate student inequities due to K-12, economic, first-generation, and other differences.

Implementing this approach in undergraduate engineering would involve creating multiple pathways and entry points into the curriculum that allow students with varying levels of pre-college mathematics preparation to begin with different courses and still complete the required core mathematics content and engineering degree within four years.

To implement this recommendation effectively, faculty, administrators, and institutions might consider the following approaches in their contexts:

1. Engineering curriculum pathways and mathematics prerequisites (*Engineering Departments, Deans)*

- Conduct a comprehensive review of the engineering curriculum and identify where specific math concepts (e.g., algebra, trigonometry, derivatives, integrals, matrices) are used in each engineering course.
- Reduce mathematics prerequisites to the minimum level necessary for fundamental engineering coursework.

- Identify gaps where important math concepts aren't being reinforced and opportunities for better integration with the Mathematics Department.

2. Contextual content in the mathematics sequence *(Mathematics and Engineering Classroom Faculty)*

- Collect examples and applications that teach and reinforce select math concepts in context, from resources such as the MAA, ASEE, Engineering Unleashed, etc.
- Incorporate existing textbook problems that use real engineering data or scenarios for math concepts.
- Adapt existing applied projects that integrate mathematical theory, modeling of a physical system component, physical or simulated prototyping, and a final report or presentation.

3. Computational tools integration *(Mathematics Classroom Faculty)*

- Shift from using extensive hand calculations with a singular focus on mathematical theory to the use of modern computational tools that emphasize key mathematical concepts.
- Introduce MATLAB or Python (or another computational tool) in the first year, focusing on basic programming, data analysis, and data visualization. In upper years, use these tools for numerical methods, modeling, data science, and more advanced problem-solving approaches.
- Create and revise examples, problem sets, and projects to emphasize data collection, analysis, and mathematical modeling.

4. Assessment approaches (*Mathematics Classroom Faculty*)

- Utilize assessment strategies that support and enable student learning and growth.
- Implement online adaptive learning systems (such as ALEKS) that adjust question difficulty based on student performance and create individualized study plans.
- Utilize existing engineering-contextualized math problems at various difficulty levels.
- Use frequent, low-stakes formative assessments (practice) and summative assessments (graded), with opportunities for learning and growth reflected in grades.

5. Math-Engineering collaboration (*Mathematics and Engineering Faculty, Departments*)

- Form "math-engineering integration teams" with faculty from both departments.
- Host meetings to discuss curriculum alignment and develop integrated materials.
- Organize opportunities for math and engineering faculty to share successful integration strategies.
- Implement a co-teaching model for key courses, with math and engineering instructors jointly leading classes.

6. Student support services *(Deans, Administrators)*

- Train mentors and tutors in effective mindset, mentoring, and tutoring techniques, and how to explain math concepts in engineering contexts.
- Offer both drop-in hours and scheduled appointments for one-on-one or small group tutoring.
- Utilize evidence-based approaches such as peer mentoring and supplemental instruction.
- Allocate a dedicated space within the engineering building for a mathematics support center, staffed with graduate students and upper-level undergraduates who excel in both math and engineering.

7. Mathematics onboarding programs for diverse learners *(Deans, Administrators)*

- Create pathways for community college, dual-enrollment, and other students to support successful transfer into required math courses.

- Create intentional integration of evidence-based strategies to foster a sense of mathematics competence as a part of engineering identity formation in first-year students.
- Focus on strengthening fundamental (precalculus) math skills and concepts.
- Incorporate training on study skills, time management, organizational skills, self-discipline, motivation, question-asking, and navigating college life.
- Design a summer bridge program for incoming first-year students from underprepared backgrounds.

8. Industry integration (*Faculty, Career Development/Industry Liaisons, Administrators, Industry*)
- Arrange for engineers to guest-lecture on applied math in their fields.
- Organize "Math in Industry" symposia where professionals present mathematical challenges in their work.
- Work with partner companies to develop a series of real-world case studies.
- Develop internship opportunities that specifically focus on mathematical modeling or data analysis in engineering contexts.

9. Hiring and ongoing professional development for faculty *(Deans, Department Chairs, MAA, ASEE)*
- Seek candidates with an interest in teaching and engagement with the MAA, Project NEXT, and other national-level training on pedagogical best practices and innovative approaches.
- Offer ongoing professional development training for mathematics faculty from societies such as the MAA, ASEE, etc., on effective pedagogy and educational strategies.

10. A calculus sequence for the 21st century *(Engineering and Mathematics Departments, Chairs, Deans, MAA and ASEE National Leaders)*
- Engage mathematics and engineering faculty to revisit the course content of precalculus, calculus, differential equations, and other required mathematics courses and restructure these courses to focus on needed concepts and skills in mathematics, as well as effective and appropriate utilization of technology appropriate for a 21st-century engineering education.
- Remove legacy manual techniques from mathematics courses so that students are not burdened with learning unnecessary skills, and to create space for modern concepts and skills more appropriate for the 21st century.
- Partner with publishers to create textbooks, problem banks, and supporting curricular materials that align with this content and focus, including integrated precalculus content, applications, and computational tools.

11. ABET mathematics requirements *(Professional societies, Engineering Deans, Program Evaluators, ABET Commissioners)*
- Discuss moving away from a definition of college-level mathematics that assumes math starts with calculus and focus on the mathematics content that evidence shows engineers need and use in engineering practice (such as math content aligned with the Fundamentals of Engineering Exam). An example of such a change might be:

  College-Level Mathematics: College-level mathematics consists of mathematics that requires a degree of mathematical ~~sophistication~~ [applicability that aligns with the practice of engineering and program outcomes]~~ at least equivalent to that of introductory calculus~~. ~~For illustrative purposes, some examples of college-level mathematics include calculus, differential equations, probability, statistics, linear algebra, and discrete mathematics.~~

- Engage with professional society accreditation committees to consider how the modified definitions of math and science might impact individual program criteria.
- Recognizing the increasingly interdisciplinary nature of STEM disciplines, we recommend that ABET institute an option for "flex" credits (up to 8–10 semester credit hours) between the 30 credits of Mathematics & Science and the 45 credits of Engineering & Computer Science content (maintaining 75 credits minimum)
- Given the curricular prerequisites required for entry-level courses and the impact on equity in attaining an engineering degree, we need to revisit the assumption that all students entering engineering programs are prepared for calculus.

12. Culture and mindset *(Faculty, Staff, and Administrators in Engineering and Mathematics Departments)*

- Foster an inclusive, asset-based mindset where diverse student backgrounds and perspectives are valued, and mathematical thinking is seen as a skill set to be developed rather than a gatekeeper or barrier to success in engineering.
- Respect the cultural difference between liberal arts (pure) mathematics and professional (applied) mathematics, showing how mathematical applications in engineering are crucial to solving practical, real-world problems while still respecting the theoretical foundations.
- Bridge the gap between views of mathematics as a service department and the goals of professional disciplines by aligning math coursework with 21st-century engineering workforce needs, ensuring students are prepared for careers that may involve advanced mathematical modeling or hands-on problem-solving.

Addressing Recommendation 1.2: Modularize the engineering curriculum to allow students to flexibly choose their pathways through fundamental courses and as a means to offer electives on important and emerging topics in engineering and engineering technology.

In a typical engineering degree program, students demonstrate their learning in semester-long chunks, including five or more simultaneous courses. These often include "toxic combinations" of courses that contribute to high withdrawal and failure rates, particularly in the first year of the degree program. Implementing a modularized approach would enable more personalized learning paths while ensuring that students acquire essential skills. It would also mitigate the consequences associated with dropping or failing an entire semester-long course, allowing students to make progress toward their degrees one skill set at a time.

To implement this recommendation, an institution might consider the following:

1. Curriculum analysis and redesign *(Engineering Faculty)*

- Form a task force comprising faculty, industry advisors, and educational specialists to thoroughly review the current curriculum.
- Identify core themes and competencies and map out all existing courses and their interconnections.
- Use backward design principles to define the essential skills and knowledge graduates should possess.

- Divide courses into smaller, logically coherent modules. For example, a traditional "Thermodynamics" course might be divided into modules on "Basic Thermodynamic Principles," "Cycles and Engines," and "Applied Thermodynamics in Systems.
- Create a competency matrix that links modules to specific skills and knowledge areas.
- Establish a module credit system (e.g., 0.5 or 1 credit per module) to sum up to equivalent full course credits.

2. Module development *(Engineering Faculty, Instructional Designers)*

- Develop a standardized template for module creation to ensure consistency across the curriculum.
- Include learning objectives, content outlines, recommended resources, assessment methods, and estimated time commitment in each module.
- Create both foundational modules (e.g., "Introduction to Programming" or "Statics Basics") and advanced, specialized modules (e.g., "Machine Learning in Engineering" or "Sustainable Materials").
- Design modules of varying durations (e.g., 2-week intensive modules, 7-week half-semester modules) to allow for scheduling flexibility.
- Incorporate various learning modalities within modules: video lectures, interactive simulations, hands-on projects, and peer collaboration activities.
- Develop interdisciplinary modules that combine engineering with other fields, such as business, environmental science, or public policy.

3. Flexible pathway design *(Engineering Faculty, Administrators)*

- Create multiple tracks or concentrations within each engineering discipline, composed of different module combinations.
- Implement a system of core modules that all students must complete, regardless of their chosen path.
- Allow for wildcard slots in the curriculum where students can choose modules from any engineering discipline or even from other departments.
- Develop a digital platform that enables students to visualize various pathway options and their corresponding outcomes.
- Create challenge-based pathways where students select modules to solve a complex, real-world engineering problem.
- Design capstone modules that integrate knowledge from multiple previous modules, ensuring comprehensive learning despite the flexible structure.

4. Advising system *(Engineering Faculty, Administrators)*

- Implement regular (e.g., monthly) check-ins between students and advisors to review progress and adjust pathways as needed.
- Create peer advising programs where upper-year students mentor younger students on module selection and career planning.
- Organize pathway showcase events where students can learn about different module combinations and their real-world applications.
- Develop a system for tracking and analyzing student module choices to inform future curriculum development and advising strategies.
- Develop an AI-assisted advising tool that can suggest module combinations based on student interests, performance, and career goals.

- Recruit and train a team of dedicated academic advisors who are familiar with the modular system and various engineering career paths.

5. Assessment and quality control *(Engineering Faculty, Department Chairs)*
- Establish a curriculum committee responsible for ongoing review and approval of modules.
- Develop a system for module reviews that allows students to provide detailed feedback on each completed module.
- Regularly bring in external reviewers from industry and academia to evaluate the relevance and quality of modules.
- Implement various assessment methods within modules, including project-based assessments, peer evaluations, and traditional exams.
- Develop a comprehensive exit assessment or project that evaluates students' overall competencies, regardless of their specific module path.
- Implement learning analytics to track student performance across modules and identify areas for curriculum improvement.

6. Technology infrastructure *(University Administration)*
- Create a user-friendly interface for students to browse, select, and register for modules.
- Implement blockchain technology for secure and transparent recording of completed modules and acquired competencies.
- Develop virtual and augmented reality platforms to deliver immersive content for certain modules, especially those involving complex 3D concepts or hazardous experiments.
- Invest in or develop a customized learning management system (LMS) that can handle modular course structures, prerequisite tracking, and flexible scheduling.
- Develop a digital transcript system that clearly communicates a student's unique modular journey to potential employers.

7. Faculty development *(Centers for Teaching and Learning)*
- Organize workshops and training sessions on effective teaching methods for modular education.
- Provide incentives (e.g., grants, teaching load reductions) for faculty to develop innovative modules.
- Encourage team teaching across departments to create truly interdisciplinary modules.
- Implement a mentoring system in which experienced faculty members guide those new to modular teaching.
- Create a platform for faculty to share best practices, resources, and experiences in modular teaching.
- Provide training on using new technologies and tools specifically designed for modular education.

8. Industry collaboration *(Deans, Department Chairs, Industry)*
- Establish an industry advisory board specifically for the modular curriculum.
- Develop a program for industry professionals to become adjunct instructors for specialized modules.
- Organize module fairs where companies can showcase how different module combinations align with various roles in their organization.
- Create micro-credentials or badges recognized by industry partners to complete certain module combinations.

- Create industry challenge modules where companies present real problems for students to solve.
- Develop a system for companies to sponsor modules related to their field, providing real-world data and case studies.

9. Accreditation considerations *(Engineering Faculty, Department Chairs)*

- Develop case studies of student pathways to demonstrate to accreditation bodies how the system ensures comprehensive engineering education.
- Consider piloting the system with a professional accreditation consultant to identify and address potential issues that may arise.
- Engage early and often with accreditation bodies to ensure the modular system meets all necessary standards.
- Develop a comprehensive mapping system that shows how different module combinations fulfill accreditation criteria.
- Create detailed documentation of learning outcomes, assessment methods, and quality control measures for the modular system.
- Implement a robust system for tracking and reporting student progress and achievements in the modular curriculum.

10. Pilot program *(Engineering Departments)*

- Conduct regular surveys and focus groups with participating students and faculty to gather qualitative feedback.
- Select a specific engineering department or program to pilot the modular system.
- Implement the pilot over a full academic year, including a subset of core modules and electives.
- Analyze quantitative data on student performance, module selection patterns, and learning outcomes.
- Prepare a comprehensive report on the pilot, including successes, challenges, and recommendations for full-scale implementation.
- Use insights from the pilot to refine the modular system before rolling it out to the entire engineering program.
- Start with a cohort of volunteer students willing to try the new system and provide detailed feedback.

Addressing Recommendation 1.3: Assess for competency (mastery) and employ formative assessments using techniques such as "ungrading" instead of focusing on current grading and assessment practices.

Foundational courses in math, science, and engineering typically involve a relatively small number of high-stakes assessments, such as midterm and final exams. These exacerbate the negative consequences of "toxic combinations" of courses, since exams in multiple courses tend to occur at the same point in the semester. Moreover, these assessments tend to place more focus on student performance than on student learning. This makes engineering particularly difficult for students who struggle with test anxiety, as well as those who may be initially underprepared for the rigors of an engineering degree program. As such, the implementation of competency-based assessment methods would represent a far more inclusive and learning-oriented mindset.

Implementing this recommendation might involve the following steps:

1. Define competencies *(Engineering Faculty and Departments)*

- Develop a system of foundational skills or competency levels (e.g., novice, intermediate, advanced) with clear descriptors for each level for each course.
- Create a detailed competency map for each engineering discipline, breaking down high-level skills into specific, measurable outcomes.
- Engage faculty, industry advisors, and alumni in the competency definition process to ensure relevance and comprehensiveness.
- Align competencies with a comprehensive analysis of industry needs, accreditation requirements, and future trends in engineering.

2. Design formative assessments *(Engineering Faculty)*

- Develop assessments and rubrics that focus on specific competencies rather than overall performance.
- Implement frequent, low-stakes checkpoints throughout courses to gauge and award student progress.
- Utilize technology for immediate feedback, such as online quizzes with detailed explanations.
- Create a diverse range of assessment tools, including project-based assessments, simulations, peer reviews, and self-reflections.
- Design assessments that mimic real-world engineering challenges to increase relevance and engagement.

3. Implement "ungrading" techniques *(Engineering Faculty and Departments)*

- Shift from traditional grading to a system of "mastery" or "not yet" for each competency.
- Encourage students to write reflective essays on their learning progress, rather than focusing solely on numerical grades.
- Implement learning portfolios where students curate evidence of their competency development.
- Use contract grading, where students and instructors agree on criteria for different grade levels at the start of the course.
- Implement a system of badges or microcredentials to recognize mastery of specific competencies.

4. Train faculty and staff *(Engineering Faculty, Chairs, Deans)*

- Organize intensive workshops on competency-based education, formative assessment, and "ungrading" techniques.
- Establish a mentoring or coaching system where experienced faculty guide others in implementing the new approach.
- Offer incentives (e.g., reduced teaching load, grants) for faculty who champion the new system.
- Create an online resource center with best practices, sample rubrics, and case studies.

5. Develop a robust feedback system *(Engineering Faculty and Departments)*

- Train faculty to provide constructive, actionable feedback that focuses on improvement.
- Develop a system that enables students to respond to feedback and demonstrate how they've incorporated it.
- Use learning analytics to identify trends and pinpoint areas where students commonly struggle.
- Implement a digital platform for tracking student progress across multiple competencies.

6. Revise policies and procedures *(Engineering Deans, Institutional Administrators, Registrars)*

- Form a task force to review and revise all academic policies affected by the new system.
- Establish clear guidelines for representing competency-based assessments on official transcripts and within the GPA system.
- Establish policies for handling student appeals and reassessments in the new system.
- Develop procedures for transfer credits and prior learning assessment within the competency framework.
- Develop a new method for calculating overall student performance, possibly replacing GPA with a competency dashboard.

7. Engage students *(Engineering Faculty, Departments, and Deans)*

- Create student guides, syllabus language, teaching modules, and FAQs explaining the benefits and mechanics of the new approach.
- Involve student representatives in committees overseeing the implementation and refinement of the new system.
- Develop an orientation to introduce new students to the competency-based system.
- Implement a peer mentoring program where experienced students guide others in navigating the system.
- Provide training on self-assessment techniques and how to maximize learning in a competency-based environment.

8. Implement gradually *(Engineering Faculty, Departments, and Deans)*

- Select one or two courses in each department to pilot the new approach.
- Collect comprehensive data on student performance, satisfaction, and learning outcomes during the pilot phase.
- Conduct focus groups and surveys with students and faculty to identify strengths and areas for improvement.
- Use insights from the pilot to refine the approach before wider implementation.
- Develop a multi-year rollout plan with clear milestones and assessment points.

9. Collaborate with stakeholders *(Engineering Chairs and Deans)*

- Establish partnerships with other institutions implementing similar systems for knowledge sharing, potentially supported by organizations such as ASEE or Engineering Unleashed.
- Engage alumni and employers in providing feedback on the relevance of competencies to their professional experiences.
- Create a communication strategy to inform graduate schools about the new assessment approach.
- Organize regular roundtable discussions or advisory boards with employers, alumni, and graduate schools to gather feedback on graduate preparedness.

10. Ensure continuous improvement *(Engineering Chairs and Deans)*

- Implement annual reviews of each competency's relevance and assessment methods, as well as the competency framework.
- Stay connected with educational research and attend conferences on competency-based education for new insights.
- Foster a culture of innovation where faculty and students are encouraged to suggest improvements.

- Develop a system for tracking post-graduation outcomes to assess long-term effectiveness.

Addressing Recommendation 1.4: Assess prerequisites to allow for maximum student flexibility and alternative pathways through the curricula.

Implementing a more flexible approach to prerequisites in engineering curricula can significantly improve the accessibility and adaptability of academic programs. By reducing rigid course sequences and offering students multiple ways to gain required knowledge and skills, institutions can create more inclusive and diverse learning pathways. This approach acknowledges the varied backgrounds and experiences that students bring to their studies, allowing them to progress through the curriculum in a manner that better aligns with their individual strengths and learning needs. Ultimately, a more flexible system can support student retention, enhance engagement, and lead to a more skilled and well-prepared engineering workforce.

To achieve this, a comprehensive strategy is required, focusing on curriculum mapping, prerequisite review, competency-based assessments, and flexible course sequences. This will involve collaboration among faculty, the integration of technology, and enhanced advising services to guide students through these learning pathways. The steps outlined in the following section provide examples of approaches to developing a flexible prerequisite system. By carefully implementing and evaluating these changes, as well as other innovative approaches, institutions can create an academic environment that fosters student success and ensures continued innovation in engineering education.

Implementing a more flexible approach to prerequisites in engineering curricula is a crucial step toward creating diverse learning pathways. Potential steps toward implementing this recommendation might include the following:

1. Comprehensive curriculum mapping *(Engineering Faculty and Departments)*

- Create a detailed map of all courses and their current prerequisites.
- Identify the specific knowledge and skills each prerequisite is intended to provide.
- Analyze the actual content overlap between courses and their prerequisites.

2. Prerequisite review process *(Engineering Faculty)*

- Form interdisciplinary teams to review each prerequisite.
- Evaluate whether each prerequisite is truly necessary or merely a traditional requirement.
- Consider alternative ways students might gain the required knowledge or skills.

3. Develop competency-based prerequisites *(Engineering Faculty, Instructional Designers)*

- Replace course-based prerequisites with specific competency requirements.
- Create assessments to measure these competencies independently of course completion.
- Allow students to demonstrate competencies through various means (prior learning, online modules, etc.).

4. Implement flexible pathways *(Engineering Faculty, Administration)*

- Allow for concurrent enrollment in courses that were previously strictly sequential.
- Design multiple course sequences that lead to the same degree outcomes.
- Create “bridge” or “just-in-time” modules to fill specific knowledge gaps.

5. Enhance advising and guidance *(University Administration)*
- Train academic advisors on the new flexible prerequisite system.
- Develop tools to help students understand their options and make informed choices.
- Implement early warning systems to identify students who may be struggling due to knowledge gaps.

6. Utilize technology *(University Administration)*
- Implement degree audit software that can handle complex prerequisite structures.
- Create an AI-assisted course planning tool for students.
- Develop online modules for self-paced learning of prerequisite material.

7. Pilot and evaluate *(Engineering Departments)*
- Start with a few courses or a single department to test the new approach.
- Gather data on student performance, progression, and satisfaction.
- Use insights from the pilot to refine the approach before wider implementation.

8. Faculty development *(University Administration, Centers for Teaching and Learning)*
- Offer support for redesigning courses to be more modular and adaptable.
- Encourage the development of teaching methods that accommodate varied student backgrounds.
- Provide training on teaching classes of students with diverse prior knowledge.

9. Policy revision *(Engineering Faculty, College and University Administration)*
- Update academic policies to reflect the new flexible prerequisite system.
- Ensure alignment with accreditation requirements.
- Develop clear guidelines for transfer credits and prior learning assessment.

10. Continuous improvement *(Engineering Departments)*
- Regularly review the effectiveness of the new prerequisite system.
- Stay updated on best practices in curriculum flexibility from other institutions.
- Solicit ongoing feedback from students, faculty, and industry partners.

Implementing this flexible prerequisite system requires careful planning, robust support systems, and a commitment to ongoing evaluation and improvement. However, it has the potential to significantly enhance student success and create more diverse, adaptable engineering graduates.

Addressing Recommendation 1.5: Create student-centered paid internship and co-op programs integrated into engineering curricula that encourage, support, and recognize the value of work experiences.

Work-based learning programs provide students with relevant experiences that complement their academic training and develop engineering skills, all within an environment that fosters higher motivation to learn. By creating flexible pathways that encourage and support student participation in internships and co-ops, programs can better prepare students for the engineering profession while increasing their employability upon graduation.

To implement this recommendation, several strategies should be considered. First, establishing strong partnerships with industry stakeholders can ensure the availability of diverse and meaningful work opportunities. It may also be necessary to adapt the curriculum to integrate internships and co-op experiences as a key component, allowing students to earn academic credit. Additionally, providing students with thorough preparation and support throughout their placements, along with structured reflection and assessment, would enhance the overall learning experience. Offering financial support would help ensure that all students, regardless of their economic background, have the opportunity to participate. Finally, ongoing program evaluation would be valuable in measuring the effectiveness of these initiatives and promoting continuous improvement.

Co-ops and internships embrace an inclusive mindset by increasing access and offering flexible pathways through the curriculum. The following are potential steps and strategies to consider when developing/enhancing a co-op/internship model in a department or college.

1. Partner with industry *(Engineering Departments, Chairs, and Deans)*
- Establish relationships with local and national companies in relevant engineering fields.
- Create a network of potential employers willing to offer paid internships and co-op positions.

2. Curriculum integration *(Engineering Faculty, Administration, Registrars)*
- Develop course credits for internship experiences.
- Redesign the engineering curriculum to include dedicated time slots for internships/co-ops.
- Ensure that internship experiences align with learning objectives and skill development goals.

3. Preparation and support *(University Career Services)*
- Offer workshops on resume writing, interview skills, and professional etiquette.
- Provide guidance on selecting appropriate internships that align with students' interests and career goals.

4. Flexible scheduling *(Internship/Co-op Offices, Engineering Departments)*
- Consider alternating academic semesters with work terms.
- Offer summer internship programs.
- Allow for internships during academic semesters, using summer months to build in appropriate time.

5. Reflection and assessment *(Engineering Faculty and Administration)*
- Implement reflective assignments for students to document their learning and experiences.
- Conduct regular check-ins with students and employers.
- Use feedback to continually improve the program.

6. Recognition *(Engineering Departments, University Administration)*
- Organize events to showcase student internship projects and experiences.
- Develop a system to formally recognize internship/co-op experiences on transcripts or through special certifications.

7. Financial support *(Industry Partners, Advancement and Development)*
- Ensure all internships are paid positions.
- Consider offering additional scholarships or grants to support students during their internships.

8. Career services integration *(University Administration)*

- Involve the university's career services in managing the program.
- Provide ongoing career counseling and support.

9. Employer engagement *(University Career Services)*

- Regularly gather feedback from participating employers.
- Offer training for employers on how to create meaningful internship experiences.

10. Program evaluation *(Engineering Departments, University Career Services)*

- Continuously assess the program's effectiveness through feedback from both students and employers.
- Track long-term outcomes such as job placement rates and career progression.

Addressing Recommendation 1.6: Create curricula and support structures that provide more seamless transitions between engineering technology and engineering undergraduate degree programs while ensuring students are prepared with the necessary skills and knowledge to succeed in their chosen field.

One approach is to align foundational courses that teach core principles of science and engineering, potentially through common course modules or by revising existing courses to create more overlap between the two program pathways. Incorporating more experiential learning opportunities within the engineering program could further enrich students' educational experience. Developing interdisciplinary coursework that bridges the gap between engineering technology and engineering, such as courses that explore the practical applications of engineering principles or the engineering design process, may also be valuable.

Flexible transfer policies could enhance accessibility for students with diverse backgrounds, experiences, and skill sets. This might involve recognizing prior learning, accepting earned credits from recognized programs, offering accelerated coursework, or providing a variety of elective options. Incorporating best practices in transfer models, such as creating advising programs and mentorship opportunities, could further support students during their transition between programs. For example, George Mason's College of Science transfer program serves as a model for facilitating student transitions (https://science.gmu.edu/academics/transfer-programs).

Working with the National Society of Professional Engineers to enable BS engineering technology graduates to test for licensure as engineers and collaborating with the U.S. Office of Personnel Management (OPM) to update job classifications would allow graduates to pursue roles currently reserved for traditionally classified engineers. These strategies aim to create a more integrated and flexible system that recognizes the value of both engineering technology and engineering pathways. To implement this recommendation, institutions might consider the following:

1. Experiential learning opportunities *(Engineering/Technology Faculty, Industry Partners)*
Integrate hands-on projects, internships, and co-op experiences that blend elements of both engineering technology and engineering, helping students see connections between the fields.

2. Curriculum alignment *(Engineering/Technology Faculty)*
This involves mapping out the curricula of both engineering technology and engineering programs to identify overlaps, gaps, and potential bridge courses. It may include standardizing foundational courses and creating flexible pathways between programs.

3. Articulation agreements *(University Administration, Academic Departments)*
Develop formal agreements between institutions offering engineering technology and engineering programs to facilitate the transfer of credits and recognition of prior learning.

4. Bridge programs *(Engineering/Technology Faculty and Administration)*
Create specific courses or summer programs designed to help students transition between engineering technology and engineering programs, focusing on filling any knowledge or skill gaps.

5. Advising and mentoring *(Engineering/Technology Faculty, University Administration)*
Implement a robust advising system that guides students through potential transition pathways, helps them understand the implications of their choices, and supports them throughout the transition process.

6. Industry partnerships *(Engineering Departments, Industry Partners)*
Engage with industry partners to ensure that both engineering technology and engineering curricula align with current industry needs and that transition pathways reflect real-world career opportunities.

7. Support services *(University Administration)*
Provide academic support services (tutoring, study groups, supplemental instruction) specifically designed to help students navigate the transition between programs.

8. Technology integration *(University Administration)*
Ensure that both programs have access to up-to-date technology and software, minimizing disparities that could hinder transitions.

9. Ongoing assessment and improvement *(Engineering Departments)*
Regularly evaluate the effectiveness of transition pathways, gathering data on student success rates, challenges faced, and post-graduation outcomes to continually refine the program.

10. Flexible degree structures *(Engineering/Technology Faculty)*
Redesign degree programs with built-in flexibility, such as allowing students to earn an engineering technology degree on the way to an engineering degree, or vice versa.

11. Skill assessment and development *(Engineering/Technology Faculty)*
Develop tools to assess students' skills and knowledge, identifying areas where additional support may be needed for successful transition. This could include diagnostic tests and targeted skill-building workshops.

12. Faculty development *(Engineering/Technology Departments)*
Provide professional development opportunities for faculty to understand both engineering technology and engineering approaches, fostering a more integrated teaching environment.

Section 2: Evidence-based Pedagogy: Creating a Student-Centered Engineering Education

Introduction

In the rapidly evolving landscape of engineering education, traditional teaching methods often fall short in addressing the diverse needs of students. Evidence-based pedagogy, grounded in research and data, offers a transformative approach to creating a student-centered learning environment. By leveraging empirical evidence, educators can design and implement strategies that enhance student engagement, foster critical thinking, and improve learning outcomes. This approach not only prioritizes students' individual learning styles and preferences but also adapts to the dynamic demands of the engineering field. As we delve into the principles and practices of evidence-based pedagogy, we uncover the potential to revolutionize engineering education, making it more inclusive, effective, and aligned with the future of technology and innovation.

Student-centered learning offers numerous benefits that can significantly enhance the educational experience. Here are some key advantages:

1. **Increased Engagement**: Students are more likely to be engaged and motivated when they have a say in their learning process. This active participation fosters a deeper connection to the material.
2. **Personalized Learning**: Tailoring education to individual needs allows students to learn at their own pace and style, accommodating diverse learning preferences and abilities.
3. **Development of Critical Thinking Skills**: Student-centered learning promotes critical thinking and problem-solving skills by encouraging students to explore, question, and solve problems.
4. **Enhanced Collaboration**: This approach often involves group work and peer-to-peer learning, which helps students develop teamwork and communication skills.
5. **Greater Retention of Knowledge**: When students are actively involved in their learning, they tend to retain information better and understand concepts more thoroughly.
6. **Empowerment and Autonomy**: Students gain a sense of ownership over their education, which can boost their confidence and independence.
7. **Adaptability to Future Challenges**: Student-centered education prepares students to adapt to future challenges and changes in their field by focusing on skills like critical thinking, collaboration, and self-directed learning.

Addressing Recommendation 2.1: Integrate hands-on and collaborative learning pedagogies that balance student ownership and choice and effectively working with others.

Implementing hands-on and collaborative learning pedagogies in engineering education requires a comprehensive transformation of traditional teaching methods. At its core, this change begins with a redesign of the curriculum, shifting from lecture-based instruction to project-based and problem-based learning opportunities. This restructuring must carefully balance the need to cover required content with the introduction of new teaching methodologies and assessment strategies.

Student choice plays a crucial role in this transformation. Students can pursue topics that align with their interests by offering diverse project options within each course, while still meeting the learning objectives. This personalization extends to interdisciplinary collaboration, where engineering students work alongside peers from other fields, mirroring the multidisciplinary nature of real-world engineering challenges.

Industry partnerships provide authentic contexts for applying engineering skills. By developing real-world challenges in collaboration with industry partners, students gain practical experience while building professional connections. However, these partnerships require careful management to align industry needs with academic requirements and address potential intellectual property concerns.

The physical learning environment must evolve to support these new pedagogical approaches. Collaborative learning spaces should facilitate group work and hands-on activities while also providing areas for individual study. This transformation often requires significant investment in space redesign and specialized equipment maintenance.

Effective team formation and management are essential components of collaborative learning. Programs should implement strategies that consider personality types, skills, and interests when forming teams, while providing training in team dynamics and conflict resolution. Technology integration supports these efforts through project management software, collaborative design tools, and virtual reality platforms for shared experiences.

Peer learning and mentorship programs create additional layers of support, with upper-level students guiding younger peers through projects. This approach fosters a collaborative learning environment that also develops leadership skills. Regular reflection activities and self-assessment tools help students understand their learning process and team dynamics, leading to continuous improvement.

Assessment methods must evolve to effectively evaluate both individual contributions and group outcomes in collaborative projects. This includes developing new rubrics for complex, open-ended projects and finding ways to balance formative and summative assessments. To implement these new approaches effectively, faculty need comprehensive training and support, including workshops on facilitation skills and project-based learning methodologies.

Several challenges must be addressed for successful implementation. Time constraints and resource allocation pose significant hurdles, as hands-on and collaborative learning often require more time and resources than traditional lectures. Scalability and consistency across different project choices and team experiences must be carefully managed. Additionally, students may need support in adjusting to more active and self-directed learning approaches.

The transformation also requires addressing workload management for faculty, ensuring assessment validity, and maintaining inclusivity for diverse learning needs. Accreditation requirements must be met while fostering a departmental culture that embraces these new pedagogical approaches. Despite these challenges, the benefits are substantial: more engaged students, enhanced teamwork skills, and graduates better prepared for the collaborative nature of modern engineering work.

Success in implementing these changes requires a holistic approach that considers all aspects of the educational experience. By carefully addressing each challenge while focusing on improved student learning and preparation, institutions can create more effective and engaging engineering education programs that better serve both students and industry needs.

Addressing Recommendation 2.2: Implement methods to support learners both in and outside the classroom (e.g., through scaffolding, etc.).

Creating a comprehensive learning environment that supports students both in and outside the classroom requires multiple integrated approaches. At its core, differentiated instruction caters to diverse learning styles and abilities through a range of teaching strategies, including visual aids, hands-on activities, and flexible pacing. This approach is enhanced by scaffolding techniques that provide temporary support as students master new concepts, gradually reducing assistance as proficiency increases.

Supplemental instruction plays a vital role in reinforcing classroom learning. These additional sessions, led by peer mentors or teaching assistants, offer extra practice opportunities and clarification of complex topics. This support is complemented by robust online learning platforms that feature video tutorials, interactive simulations, and practice problems, which students can access at their convenience.

Adaptive learning technologies represent a significant advancement in personalized education. These systems adjust to individual student progress, creating customized learning paths and targeted practice opportunities. Similarly, peer tutoring programs provide one-on-one or small group assistance, offering personalized support while helping both tutors and tutees develop a deeper understanding.

Faculty engagement extends beyond the classroom through structured office hours and mentoring programs. These interactions offer students crucial opportunities to seek clarification, discuss career goals, and establish professional relationships. Study skills workshops further support student success by developing essential academic skills in time management, test-taking strategies, and effective study techniques.

Early alert systems serve as a crucial safety net, identifying struggling students before they fall too far behind. These systems enable timely intervention and support, connecting students with appropriate resources when they need them most. Learning communities provide an additional layer of support by grouping students who are taking similar courses together, thereby fostering peer support and collaborative learning opportunities.

Virtual collaboration tools have become increasingly important, enabling study groups, discussion forums, and project work to continue outside traditional class hours. These platforms extend learning opportunities and facilitate peer-to-peer support in flexible, accessible formats. Additionally, comprehensive accessibility services ensure that students with disabilities receive appropriate accommodations and support, including assistive technologies and note-taking services.

Implementing these support systems faces several challenges, including resource allocation, coordination between services, and student engagement. Institutions must strike a balance between the need for personalized support and the practicalities of serving large student populations, while ensuring that services remain culturally sensitive and inclusive.

Success requires strong faculty buy-in and a cultural shift toward viewing support as an integral part of education rather than an optional add-on. Regular assessment and continuous improvement ensure that support methods evolve to meet the changing needs of students and align with current best practices in education. Comprehensive learner support significantly improves student success, retention, and overall educational outcomes despite these challenges.

Addressing Recommendation 2.3: Align time and evaluation with expected outcomes via inclusive assessment practices and continuous formative feedback.

Implementing inclusive assessment practices and continuous formative feedback requires a fundamental shift in how we approach evaluation in higher education. The foundation begins with outcomes-based curriculum design, where learning objectives are clearly defined, measurable, and aligned with both industry needs and accreditation standards such as ABET Student Outcomes (1) to (7). These outcomes must balance specific technical skills with broader competencies while remaining adaptable to evolving field requirements.

Authentic assessment tasks are the cornerstone of this approach, providing students with real-world engineering challenges that demonstrate their skills in meaningful contexts. Various assessment methods, such as projects, presentations, portfolios, and peer assessments, enhance this approach by allowing students to showcase their knowledge and abilities in multiple ways. Detailed rubrics guide these assessments, clearly outlining expectations and criteria for different performance levels.

Continuous formative feedback is essential in this system, which features regular check-ins and progress reports throughout the learning process. Technology-enhanced feedback tools provide quick, targeted responses; however, it is essential to ensure that technology enhances personal interaction rather than replacing it. Self-assessment and reflection opportunities allow students to develop metacognitive skills and take ownership of their learning journey.

Peer feedback mechanisms create extra learning opportunities by enabling students to both give and receive constructive criticism. This process needs careful planning and training to ensure quality and fairness, while also helping to develop essential professional skills. Flexible deadlines and pacing enable students to progress at varying rates while still achieving course objectives; however, this flexibility must be balanced with the required structure and institutional constraints.

Inclusive assessment design guarantees accessibility and fairness for all students, including those with disabilities and those from diverse cultural backgrounds. This approach also applies to grading practices, emphasizing mastery of outcomes instead of comparing performance. Regular analysis of assessment data enables the identification of trends and areas needing improvement, allowing for the continuous refinement of teaching and evaluation methods.

Implementation challenges include significant time management demands, faculty development needs, and student adaptation to new assessment formats. Technology integration must be carefully managed, and institutional policies may need to be adjusted to accommodate new approaches and methods. Maintaining consistency across courses while ensuring scalability for different class sizes presents additional challenges.

Success relies on strong support from faculty, students, and administration, along with proper resource allocation for training, technology, and support systems. Despite these challenges, transforming assessment from a basic measurement tool to a crucial part of the learning process can result in more engaged students and graduates who are better prepared for professional success. This systemic approach fosters a more equitable and effective learning environment while upholding high academic standards and meeting accreditation requirements.

Addressing Recommendation 2.4: Engage and support faculty in some form of systematic professional development and evaluation of their educational innovations through scholarly approaches.

Implementing systematic professional development and evaluation of educational innovations requires a comprehensive approach centered on faculty support and engagement. A key first step is establishing a Center for Engineering Education Innovation, which will serve as a hub for research, resources, and professional development activities. This center can coordinate various initiatives while integrating with existing departmental structures.

Faculty Learning Communities (FLCs) constitute another essential component, creating spaces for educators to meet regularly, discuss teaching practices, and collaboratively develop innovative approaches. These communities can be strengthened through a Teaching Fellowship program that provides resources and support for significant educational innovation projects, enabling faculty to engage deeply with pedagogical advancement.

Regular workshops, seminars, and mentoring opportunities provide ongoing professional development. These activities emphasize innovative teaching methods, assessment techniques, and the integration of educational technology. A structured peer observation system allows experienced educators to share their expertise, fostering a collaborative learning environment among faculty members.

Supporting scholarly approaches to teaching innovation requires dedicated funding mechanisms. An Engineering Education Research Grant program can finance small-scale educational research projects, while Teaching Innovation Awards recognize outstanding contributions to engineering education. These initiatives help elevate the status of teaching excellence within the academic community.

Documentation and sharing of best practices play a vital role through Teaching Portfolios and annual Engineering Education Symposiums. These platforms allow faculty to showcase their innovations, research findings, and outcomes in a scholarly manner. Teaching Circles provide additional opportunities for focused discussions and collaborative problem-solving among small faculty groups.

Educational technology support and Scholarship of Teaching and Learning (SoTL) training enable faculty to effectively implement new tools and conduct rigorous studies of their teaching practices. A structured career framework enables educators to effectively communicate their expertise levels and guides professional development pathways, providing evidence for evaluation during hiring, promotion, and review processes.

Implementation challenges include time constraints, shifts in institutional culture, and inadequate resource allocation. Faculty must balance teaching innovation with research and other responsibilities, while institutions need to develop effective ways to measure impact and ensure scalability. Overcoming resistance to change and maintaining long-term engagement require careful attention to recognition and reward systems.

Success depends on creating a supportive ecosystem that values teaching innovation alongside traditional research. This cultural transformation, while challenging, can lead to significant improvements in engineering education quality, benefiting both faculty and students through enhanced teaching practices and learning outcomes.

See Appendix 1 for a comprehensive professional development plan for faculty, outlining steps to build a support structure for curriculum innovation.

Addressing Recommendation 2.5: Identify or create digital technology platforms that need to be built to support alternative approaches to learning and evaluation.

Developing effective educational platforms requires careful consideration of various components and the involvement of key stakeholders. The process begins with a comprehensive needs assessment, gathering data through surveys, focus groups, and interviews with educators, students, and administrators. This initial phase helps identify pain points in digital learning and specific requirements for supporting alternative learning methods, while analysis of emerging pedagogical approaches ensures alignment with current educational research.

Research into existing platforms forms a crucial second step, evaluating current learning management systems and the need for specialized tools. This investigation helps identify strengths and weaknesses in how existing platforms support collaborative learning, track non-traditional outcomes, and address user experience and accessibility needs. Alternatively, the addition of movable whiteboards to a classroom, where groups of students solve engineering problems concurrently while the instructor checks with each group, may be sufficient to implement collaborative learning with an existing learning management system. These insights define key requirements, including adaptive learning capabilities, analytics for tracking diverse outcomes, and integration possibilities with external tools.

Platform development can take two paths: modifying existing platforms through plugins and extensions or developing new ones using Agile methodologies. Either approach requires close collaboration with educators and students in the design process, prioritizing user experience and intuitive interface design. Pilot testing in diverse educational settings provides crucial feedback through surveys, usage analytics, and regular check-ins with participants.

Comprehensive training and support systems are essential for a successful implementation. This includes developing video tutorials, user guides, and sample lesson plans, as well as establishing help desk services and peer support networks. Regular evaluation and continuous improvement ensure that the platform remains effective by tracking adoption rates, user engagement, and its impact on learning outcomes.

The platform should support various alternative learning approaches, including project-based learning, competency-based education, and flipped classroom methodologies. Features might include project management tools, granular skill tracking, and robust video hosting capabilities. Gamification elements, peer learning systems, and personalized learning paths can enhance engagement and effectiveness.

Implementation challenges encompass survey fatigue during the needs assessment, the difficulty of evaluating various existing solutions, and the requirement to balance diverse stakeholder needs. Additionally, development costs, finding qualified developers, and ensuring interoperability with current systems present further obstacles. Training and support also encounter difficulties in addressing differing levels of technical proficiency and resistance to change.

Success requires continuous collaboration among educators, technologists, administrators, and learners while maintaining flexibility and a willingness to adapt as the educational landscape evolves. By effectively addressing these challenges and focusing on pedagogical goals, institutions can create more engaging, effective, and personalized learning experiences that better prepare students for the modern world.

Section 3: An Inclusive and Diverse Engineering Education Learning Environment

Introduction

In today's globalized world, fostering an inclusive and diverse learning environment in engineering education is crucial. Such environments reflect students' varied backgrounds and perspectives, enriching the educational experience by promoting creativity, innovation, and collaboration. An inclusive approach ensures that all students, regardless of gender, ethnicity, socioeconomic status, or disability, have equal access to opportunities and resources. The diversity of students' backgrounds in the classroom encourages the exchange of ideas and challenges conventional thinking, leading to more robust problem-solving and design processes. As we explore the strategies and benefits of creating an inclusive and diverse engineering education learning environment, we uncover the potential to cultivate a generation of engineers who are not only technically proficient but also socially conscious and equipped to address the complex challenges of the future.

When students from diverse backgrounds come together, they bring unique perspectives, experiences, and ways of thinking. This diversity fosters a rich environment where ideas can be freely exchanged and debated. Here are some specific ways this dynamic benefits problem-solving and design processes:

1. **Varied Perspectives**: Students from different cultural, social, and academic backgrounds approach problems differently. This variety in perspectives can lead to innovative solutions that might not emerge in a more homogenous group.
2. **Enhanced Creativity**: Exposure to different viewpoints and ideas stimulates creativity. Students are encouraged to think outside the box and consider alternative approaches, which can lead to more creative and effective solutions.
3. **Critical Thinking**: Diverse classrooms challenge students to question assumptions and consider multiple angles. This critical examination of ideas helps refine and improve solutions.
4. **Collaborative Skills**: Working with peers from different backgrounds enhances students' collaborative abilities. They learn to communicate across cultural and social boundaries, which is essential in today's globalized workforce.
5. **Inclusive Solutions**: When diverse voices are included in the problem-solving process, the solutions developed are more likely to be inclusive and considerate of a broader range of needs and preferences. This is particularly important in engineering, where designs often need to serve diverse populations.
6. **Resilience and Adaptability**: Exposure to diverse ideas and ways of thinking helps students become more adaptable and resilient. They learn to navigate and integrate different viewpoints, a valuable skill in professional and personal contexts.

By embracing diversity in the classroom, educators can cultivate a learning environment that not only improves academic outcomes but also equips students to thrive in a diverse and interconnected world.

Addressing Recommendation 3.1: Evaluate the systems in place in our engineering and engineering technology programs and make changes that will create a fair and equitable system for all students.

Creating a fair and equitable system in engineering education requires a comprehensive, multi-faceted approach starting with a thorough audit of current practices and policies. This initial assessment examines admission processes, grading systems, and program requirements while analyzing demographic data and performance metrics across different student groups.

Gathering extensive feedback through surveys, focus groups, and anonymous suggestion systems helps understand the experiences of students, faculty, and staff. This feedback illuminates systemic barriers, whether embedded in admission criteria, course prerequisites, or resource accessibility. The insights gained can lead to detailed action plans with specific, measurable goals and clear timelines for implementation, if the engineering school or department truly desires change

Implementation involves revising existing policies, providing comprehensive training on inclusive practices, and enhancing support services through programs like peer mentoring and summer bridges. Curriculum development plays a crucial role, incorporating diverse perspectives and accommodating various learning styles. Assessment methods can expand beyond traditional examinations to include projects, presentations, and peer evaluations.

Mentorship and networking opportunities emerge through structured programs pairing underrepresented students with supportive faculty or industry professionals. Career fairs and student organizations focused on underrepresented groups further strengthen these connections. Financial support mechanisms benefit from careful examination to ensure equitable distribution of scholarships, while creating new funding opportunities for internships and professional development.

Building an inclusive culture encompasses diversity events, success stories of diverse alumni, and spaces for open dialogue about equity challenges. Regular data collection and periodic surveys enable continuous monitoring of progress, with strategies evolving based on findings. Collaboration with industry partners, particularly those demonstrating strong commitment to diversity and inclusion, creates valuable opportunities through internships, sponsorships, and mentorship programs.

Engineering education specifically benefits from revising introductory courses to balance support with rigor, enhancing spatial skills training, and promoting interdisciplinary projects. Laboratory experiences become more accessible through flexible hours and additional support for less experienced students. The integration of ethics and social responsibility throughout the curriculum fosters inclusive team dynamics and promotes consideration of diverse user needs in engineering design.

Alternative pathways for students from non-traditional backgrounds, including bridge programs and flexible degree paths, open new doors to success. Accountability measures, including diversity committees and regular reporting on initiative progress, help maintain momentum. These efforts face various challenges, from data privacy concerns to resource constraints, while balancing academic standards with accessibility.

Creating an equitable system emerges as an ongoing process, demanding continuous evaluation and refinement of approaches. Success stems from sustained commitment, open communication, and adaptable strategies that effectively serve all students and prepare them for success in the field.

An additional idea for effectively implementing the mindset report’s recommendations is to identify opportunities to connect with units that are already implementing changes in their processes. When departments are revising their promotion and tenure criteria, updating application procedures, or modifying grading systems, share relevant insights from the Mindset Report that align with and support their initiatives. Additionally, reach out to key decision-makers who might be seeking inspiration for change, such as registrars and deans, as these leadership positions are often catalysts for institutional transformation.

Addressing Recommendation 3.3: Provide professional development for faculty and staff to foster the development of a mindset that centers on lifelong learning to support faculty's understanding of inclusive and equitable teaching practices.

Faculty Engaged in Lifelong Learning

On the national level, programs such as the National Effective Teaching Institute, the Center for the Integration of Research, Teaching, and Learning (CIRTL), and the Inclusive STEM Teaching Project offer opportunities for STEM instructors to engage in lifelong learning that focuses on best teaching practices, including evidence-based methods for creating welcoming learning environments. However, instructors must seek out these opportunities independently if their institutions are not formally connected to these programs. Instructors' familiarity with these initiatives varies widely. Additionally, research shows that new faculty members often join their institutions feeling less confident in their teaching abilities, especially if they did not participate in significant teaching preparation during their doctoral programs. Even experienced faculty may require learning opportunities regarding new teaching methods and technological tools to enhance their practice. Given this gap in teaching knowledge, there is a heightened need for professional development in teaching at the start of a faculty member's career and throughout their tenure.

At the institutional and departmental levels, the availability and significance of teaching professional development opportunities for career advancement vary significantly based on faculty roles, institutional types and missions, and the political context. Some institutions use their centers for teaching and learning or other faculty development programs to offer orientation programs and workshops that support faculty lifelong learning. Since the racial reckoning in the U.S. in 2020, highlighted by health disparities related to the COVID-19 pandemic and the murder of George Floyd, awareness of the importance of inclusion on campuses has grown. Institutions have expanded their programming to focus on inclusive and equitable teaching practices, as well as other structural issues within the institutions. However, in subsequent years, a backlash has emerged in some areas, leading to the questioning, minimizing, or outright elimination of these types of programs.

To create welcoming classroom environments, it is essential to gain a deeper understanding of students' experiences and educational outcomes. This learning involves a systems-level analysis and uses disaggregated institutional data by demographics, extending beyond an individual instructor's course. While some instructors may gather data about their own students for classroom practices or accreditation processes, they often miss professional development focused on (1) equitable assessment strategies and (2) interpreting this data without a deficit perspective. A deficit mindset prioritizes "fixing the student" instead of addressing structural issues at the institutional level.

To support lifelong learning on diversity, equity, and inclusion, it is essential to incorporate the principle of choice. This allows faculty participants to engage with content that enriches their personal journeys, rather than mandatory training disconnected from broader institutional efforts, which can raise concerns about indoctrination and the reinforcement of anti-diversity views. Additionally, including praxis is crucial for understanding positionality and its impact on behaviors and attitudes. By leveraging these aspects, faculty participants, regardless of their backgrounds, can continuously learn about themselves and others while actively contributing to a welcoming learning environment.

This established infrastructure creates a strong foundation for examining practices and policies that promote a welcoming environment and address barriers to success for underrepresented students facing inequities. Shifting the focus from blaming students for their experiences to altering institutions based on a renewed understanding of inequities will lead to tailored solutions that better meet the diverse needs of the student population. In institutions where DEI efforts face political challenges, achieving this proposed mindset may be difficult without legal actions that reverse the trend of eliminating DEI programs or creative efforts to work within existing constraints.

As part of the offer letter at a high-research-activity doctoral university in the Northeast, new faculty are expected to complete a multi-series virtual training that covers topics such as identity, culture, conflict, systems of power, and resistance and allyship. These modules provide research-based information, opportunities for reflection, and activities for participants to engage with others on these topics. By modeling inclusive practices during the training, faculty can consider how to adapt these learning experiences to their own classes.

For ongoing professional development at a doctoral university in the Midwest with a high level of research activity, faculty are invited to join a faculty learning community focused on equity-centered engineering. Faculty explore and practice equity-focused teaching (EfT) strategies, examine relevant literature, design or revise course materials, and exchange feedback in a supportive environment. They can also receive personalized consultations or student feedback sessions, known as small-group instructional diagnoses, from a consultant at the Teaching and Learning Center to specifically address their course needs. In recognition of their active participation, faculty receive a stipend.

At a high-research-activity doctoral Jesuit university in the Midwest, the engineering promotion and tenure guidelines include a teaching evaluation criterion that states, “Candidates must implement the department’s mandatory active learning teaching style, as determined from the chair’s evaluation.” University faculty and staff are provided the opportunity to participate in access and success training courses that link these principles to the Jesuit mission of social justice and their roles at the university.

An additional direction could be implementing a microcredentialing system that recognizes and rewards faculty commitment to inclusive teaching practices. By developing a structured pathway of digital badges or certificates tied to specific learning modules, departments can create tangible milestones for professional development in positionality awareness. Faculty members could work towards earning an “Inclusive Teaching Expert” designation, demonstrating their mastery of inclusive practices and dedication to equitable education. When these credentials are formally recognized in promotion and tenure considerations, they not only motivate participation but also institutionalize the importance of inclusive teaching excellence within the academic culture.

ASEE Faculty Teaching Excellence Program

The **NSF-Funded ASEE Faculty Teaching Excellence Program** is a national initiative aimed at improving and recognizing teaching excellence among engineering and engineering technology faculty.

The program addresses a long-standing issue: many engineering faculty members enter academia with little or no formal training in teaching. The goal is to create a **national framework** that supports and certifies faculty development in teaching and learning.

Key Features

- **Three-Level Framework**:
    1. **Level 1**: Covers foundational educational concepts for teaching college-level engineering.
    2. **Level 2**: Focuses on applying these concepts in real classroom settings.
    3. **Level 3**: Recognizes faculty who lead broader educational initiatives beyond their own classrooms.
- **Collaborative Development**: The program is led by the **ASEE Faculty Teaching Excellence Task Force**, chaired by Dr. Donald Visco, and involves nearly two dozen partner institutions. The **National Effective Teaching Institute (NETI)** is also contributing content [1] [2].

This initiative aims to:

- Elevate the status of teaching in engineering education.
- Provide structured, recognized pathways for faculty development.
- Ultimately, improve student learning outcomes and broaden participation in engineering.

Addressing Recommendation 3.4: Modify engineering curricula to emphasize a humanized socio-technical framework.

A Humanized Pedagogy

A humanized approach requires an anti-deficit mindset. Shaun Harper proposes an anti-deficit achievement framework for researching students of color at various stages of the STEM pipeline, from K–12 schools to doctoral degree attainment, and transitions into science research and long-term industry careers. The framework provides examples of anti-deficit questions that illuminate three key pipeline points: pre-college socialization and readiness, college achievement, and post-college persistence in STEM. It also outlines nine researchable dimensions of achievement: familial factors, K–12 school influences, out-of-school college preparatory experiences, classroom interactions, out-of-class engagement, experiential and external opportunities, industry careers, graduate school enrollment, and research careers (Harper 2010).

Lee et al. (2023) present a model that emphasizes the dynamic interactions among students' characteristics, the contexts in which they are, and the support systems of their learning environment, as shown in Figure 1. The authors state that they provide the engineering education community with a well-developed method for analyzing student experiences and identifying barriers that need to be removed to combat marginalization. They explain that their motivation stems from a desire to make undergraduate engineering programs more supportive and easier to navigate, especially for students from underrepresented or underserved backgrounds. This human-centered approach encourages systems thinking.

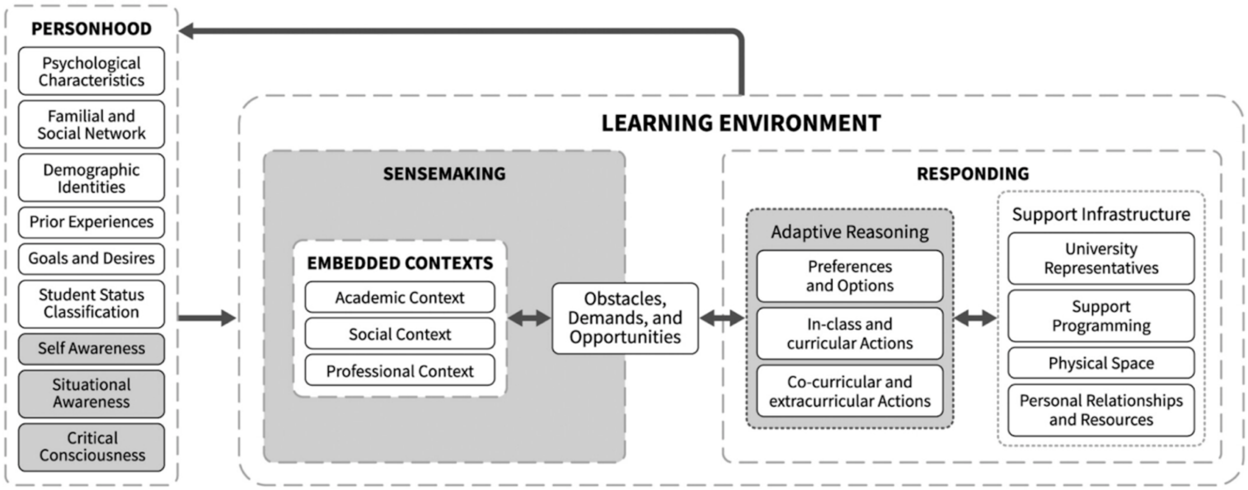

FIGURE 1 from Lee et al. (2023), "Conceptual model of student navigation of the undergraduate engineering learning environment. The model consists of five fundamental relationships (*learning environment*, *personhood*, *embedded contexts*, *sensemaking*, and *responding*). It represents the bidirectional process of a student entering a *learning environment* with their *personhood*, giving meaning to their collective experiences (i.e., *sensemaking*), and *responding* to their obstacles, demands, and opportunities in coordination with the support infrastructure in the learning environment. This model aims to illustrate how the learning environment creates different obstacles for engineering students to understand how students navigate those obstacles. The white boxes represent observable constructs, and the gray boxes represent cognitive processes that are not easily observed." (901)

Addressing Recommendation 3.5: Expand user-centered design practices common within engineering to a whole student-centered design of learning environments (where whole means students' comprehensive identities and experiences are valued, included, and affirmed).

Creating a student-centered learning environment begins with thorough research that utilizes mixed-methods approaches. This encompasses ethnographic studies, demographic analysis, and literature reviews on inclusive educational practices. By conducting surveys, interviews, focus groups, and classroom observations, institutions can gather valuable insights into students' experiences and needs. The data should then be analyzed with advanced tools to identify patterns and develop representative student personas.

Goal-setting forms the foundation of successful implementation. Using SMART criteria, institutions should establish clear objectives that align with their broader mission while addressing the academic, social-emotional, and cultural aspects of learning. To ensure goals reflect true inclusivity, a diverse committee of stakeholders, including students, educators, administrators, and community members, should be involved in this process.

The ideation and prototyping phase uses design thinking methods to create innovative solutions. This involves organizing hackathons, developing pilot programs, and examining successful models from other institutions. Student participation is essential at this stage, with design teams guiding parts of the prototyping process and platforms established for submitting and voting on ideas.

Testing and iteration involve creating prototypes and collecting detailed feedback. Institutions can evaluate the effectiveness of their designs using A/B testing, usability sessions, and both quantitative and qualitative data. This process should be cyclical, with distinct iteration phases and documentation of lessons learned to guide future improvements.

Successful implementation requires a phased approach and careful attention to change management. Educators should be provided with comprehensive training modules and ongoing professional development opportunities, supported by a mentorship program pairing experienced adopters with newcomers. Regular pulse surveys and dedicated feedback channels help track adoption and satisfaction.

Building a culture of inclusion requires training staff in cultural competence through workshops, seminars, and role-playing exercises. Regular reviews of the curriculum ensure representation and reduce bias, while also creating opportunities for students to share their experiences through cultural events and student-led diversity councils.

Personalizing learning experiences can be achieved through the use of adaptive technologies and diverse resources. Institutions should create flexible assessment options and train educators to implement various formats. This approach enables students to showcase their learning in ways that align with their strengths and backgrounds.

Physical and digital spaces must be designed with accessibility and inclusion in mind. This includes applying universal design principles, creating flexible learning environments, and ensuring digital platforms accommodate various learning and communication styles. Regularly rotating diverse materials and involving students in curation helps maintain an inclusive atmosphere.

Establishing effective feedback loops through surveys, analytics, and periodic reviews enables institutions to monitor their progress and identify areas that need improvement. Data should be analyzed by various demographic factors to identify disparities and inform early interventions for at-risk students.

Finally, collaboration with the community strengthens the learning environment through partnerships with local organizations, cultural events, and project-based learning initiatives. This connection to the larger community provides students with real-world experiences while fostering a sense of belonging and purpose.

By adopting a comprehensive approach, educational institutions can foster learning environments that genuinely value, include, and affirm students' diverse identities and experiences. Success hinges on maintaining consistent involvement from stakeholders, particularly student participation, throughout the entire process.

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Section 4: Leveraging Strategic Partnerships

Introduction

In the quest to advance engineering education, strategic partnerships have become increasingly pivotal. Engineering programs can bridge the gap between theoretical knowledge and practical application by collaborating with industry leaders, academic institutions, government agencies, accreditors, K-12 school districts, community colleges, and non-profit organizations. These partnerships provide students with access to cutting-edge technology, real-world projects, and professional mentorship, enriching their educational experience and preparing them for the workforce. Moreover, strategic alliances foster innovation in curriculum development, ensuring educational content remains relevant and aligned with industry trends. As we explore the impact of these collaborations, we uncover how leveraging strategic partners can drive transformative changes in engineering education, ultimately producing graduates who are technically proficient and equipped with the skills and insights needed to thrive in a rapidly evolving technological landscape.

Volume 1 of the Blueprint Report covers most recommendations for leveraging strategic partnerships. Addressing Recommendation 5.1 focuses on integrating experiential learning into the undergraduate engineering education experience. In higher education, experiential learning has emerged as a powerful tool to bridge the gap between academic theory and real-world application. By incorporating experiential learning opportunities at the program level, institutions can provide students with hands-on experiences that are deeply rooted in societal and professional contexts. This approach not only enhances students' understanding of their field but also equips them with the practical skills and insights needed to navigate complex professional landscapes. Through internships, cooperative education, service-learning projects, and industry collaborations, students gain exposure to real-world challenges and develop a sense of social responsibility. As we explore strategies for integrating experiential learning, we uncover the potential to transform educational programs, making them more dynamic, relevant, and impactful for students' personal and professional growth.

Addressing Recommendation 5.1: Integrate experiential learning for all students in a societal and professional context at the program level.

Experiential learning in engineering education is a pedagogical approach that combines theoretical knowledge with practical, hands-on experiences. It allows students to apply classroom concepts to real-world situations, developing technical skills alongside critical thinking, problem-solving, and professional competencies. Some of the most effective experiences are those that engage with external stakeholders. While experiential learning has many forms, the key components include:

1. Active participation
2. Reflection on experiences
3. Practical application of theory
4. Real-world problem-solving (particularly volatile, uncertain, complex, and ambiguous)
5. Interdisciplinary collaboration

Experiential learning holds value at both the lower and upper levels of the curriculum, across four-year and community colleges. To facilitate a transition to more experiential learning, a shared site (repository) with modules created by professional societies, government organizations, and industry groups could present and host topics and challenges. More experiential learning will increase students' interest in and motivation to understand the engineering sciences as they are used in realistic designs and encourage them to consider the societal impact of these designs.

There are many well-established opportunities to implement experiential learning at a lower cost and lower time commitment. Note that, generally, engineering education has focused on improving learning outcomes, rather than examining the costs of offering different learning experiences in depth. Some examples of experiential learning include Project-Based Learning (PBL) to anchor the curriculum, promoting teamwork, interdisciplinary collaboration, and iterative problem-solving through long-term projects that mirror real-world engineering challenges. Strong industry partnerships are valuable, offering students internships, co-ops, and exposure to professionals through guest lectures, workshops, and sponsored projects. Community engagement encourages students to address local issues through service-learning initiatives with non-profit organizations and community groups. The curriculum could also incorporate case studies and role-playing to explore real engineering scenarios and ethical dilemmas. Capstone projects offer students the opportunity to apply their learning in final-year projects, which are evaluated by external stakeholders. Reflective practice, including journaling and debriefing sessions, promotes continuous improvement. Programs can promote interdisciplinary collaboration across departments and organize hackathons or design challenges. Professional skills development is crucial, as it integrates leadership, communication, and ethics training. Faculty development ensures that instructors are equipped to facilitate these activities, engage with industry, and align their efforts with accreditation requirements, such as those from ABET. Lastly, assessment and feedback methods must evaluate both technical and soft skills while involving input from peers, industry partners, and stakeholders to ensure continuous improvement.

Another real opportunity here is industry-sponsored micro-credentials. This space is rapidly growing, and there is a real need to make these experiences better and more rigorous. There are lots of opportunities for external entities to engage with engineering education.

Implementation Framework for Engineering Experiential Learning

This implementation framework offers a comprehensive approach to integrating experiential learning throughout the entire four-year engineering program. Some key aspects that make this approach effective:

1. Progressive skill development from basic community engagement to complex professional projects
2. Multiple touchpoints with industry and community partners throughout the program
3. Integration of both technical and professional skills development
4. Clear assessment methods and quality assurance measures

To begin implementing this framework:

1. Start with a pilot program in one department or track
2. Focus on developing 2-3 strong industry partnerships initially
3. Establish the necessary infrastructure and support systems
4. Train faculty in experiential learning methods

Program Structure Overview

Year 1: Foundation & Community Engagement

- Introduce first-year design projects focused on local community needs
- Partner with local nonprofits and community organizations
- Develop basic professional skills through workshops and mentorship
- Implement service-learning components in introductory engineering courses

Year 2: Industry Exposure & Technical Applications

- Incorporate industry-sponsored design challenges into core courses
- Establish job shadowing programs with local engineering firms
- Create interdisciplinary project teams addressing real-world problems
- Integrate professional ethics and societal impact discussions

Year 3: Advanced Project Work & Internships

- Mandatory summer internship or cooperative education experience
- Cross-disciplinary capstone project preparation
- Industry mentor matching program
- Professional development seminars with practicing engineers

Year 4: Capstone Integration & Professional Transition

- Year-long capstone project with industry or community partners
- Leadership roles in underclass student projects
- Professional portfolio development
- Career transition preparation

Implementation Components

Curriculum Integration

1. Modified course structures to include experiential elements
    - Project-based learning in technical courses
    - Real-world case studies
    - Field visits and site tours
    - Guest lectures from industry professionals
2. Assessment methods
    - Portfolio-based evaluation
    - Peer and self-assessment
    - Industry partner feedback
    - Community impact evaluation

Partnership Development

1. Industry Collaborations
    - Advisory board establishment

- Internship programs
- Project sponsorships
- Mentorship networks

2. Community Partnerships
   - Local government agencies
   - Non-profit organizations
   - Schools and educational institutions
   - Social service organizations

Resource Requirements

1. Physical Infrastructure
   - Maker spaces and fabrication labs
   - Collaboration spaces
   - Project storage areas
   - Meeting rooms for industry partners
2. Human Resources
   - Industry liaison officer
   - Community engagement coordinator
   - Technical support staff
   - Project mentors
3. Administrative Support
   - Partnership management
   - Legal agreements
   - Insurance and liability
   - Project documentation

Quality Assurance Measures

Monitoring and Evaluation

1. Regular assessment of:
   - Student learning outcomes
   - Partner satisfaction
   - Program effectiveness
   - Community impact
2. Feedback mechanisms:
   - Student surveys
   - Partner interviews
   - Alumni tracking
   - Employer feedback

Continuous Improvement

1. Annual program review
2. Curriculum updates based on industry trends
3. Partnership evaluation and renewal

4. Resource allocation assessment

Section 5: Engineering a New Mindset for Engineering Education

Introduction

"Engineering Education Needs a Revolution," an essay published in 2021, outlined the need for a "sea change" in how we go about educating engineers. Change of the magnitude advocated for in this essay will only come about with a shift in mindset.

According to Wikipedia:

> *A **mindset** refers to an established set of attitudes of a person or group concerning culture, values, philosophy, frame of reference, outlook, or disposition. It may also arise from a person's worldview or beliefs about the meaning of life.* ("Mindset", 2025)

Our current mindset influences our views of engineering education—there is an accepted norm regarding what engineering education "is," based on the realities of the past. In this time of disruption all around us—generative AI, stackable credentials, online learning, funding uncertainties, and skyrocketing student debt—our mindset of the past must give way to a new mindset that embraces change and looks toward the future.

The mindset shift we envision is our all-hands-on-deck moment. Faculty must shift their mindset away from insisting on delivering an engineering education that is virtually unchanged from the education they experienced, and in some cases, endured. Students must shift their mindset away from one where they are merely ticking boxes and taking prescribed courses.

The culture of the engineering discipline, often characterized by a focus on technical expertise, efficiency, and precision, can inadvertently shape the mindset of individuals working within it. This culture can foster a preference for certainty, a resistance to ambiguity, and a tendency to prioritize individual achievement over collaboration and teamwork. While these traits can be valuable in certain contexts, they may also limit our ability to address complex, multifaceted problems that require creativity, empathy, and a willingness to embrace uncertainty.

To effectively serve the evolving demands of society and prepare engineers for the challenges of the 21st century, it is imperative to challenge and reimagine the cultural norms of the engineering discipline. By fostering a culture that values diversity, collaboration, and a growth mindset, we can empower engineers to think critically, problem-solve creatively, and contribute to a more equitable and sustainable future. Research indicates that faculty mindset can significantly influence teaching effectiveness (Brown et al., 2023), underscoring the importance of mindset training, particularly for tenured faculty, and promoting greater faculty diversity.

Engineering educators and curricula must actively work to cultivate a growth mindset in all students, emphasizing the belief that abilities can be developed through effort and perseverance. This approach is essential for addressing the complex problems of our world, which often require interdisciplinary solutions and a diverse range of perspectives. By fostering a growth mindset and challenging the cultural norms of the engineering discipline, we can create a more inclusive and innovative environment that benefits both students and society as a whole.

Historically, engineering programs deliberately filtered out students deemed less capable. While explicit weeding-out has decreased, many current practices still reflect this philosophy. We suggest that what is often interpreted as student ability is actually a reflection of prior opportunities, influenced by factors like family wealth, K-12 education quality, and access to additional resources.

This results in several problematic practices in engineering education:

- Assuming high background knowledge
- Grade curving that forces failures
- Rapid, shallow coverage of material
- Overemphasis on memorization

Engineering education should shift to a student-centered approach that recognizes students' diverse backgrounds and creates personalized pathways to success rather than forcing attrition.

We posit that the current engineering culture has led to the adoption of mindsets that are no longer serving us well, and seek to address three limiting mindsets that are prevalent in the engineering discipline:

1. Fixed mindset vs. growth mindset,
2. "Weed-out" mindset vs. "weave-in" mindset, and
3. Rigid curriculum mindset vs. flexible pathways mindset.

What Is a Growth Mindset?

As defined by Dr. Carol Dweck, a growth mindset is the belief that our abilities are malleable and can be developed through effort and perseverance. This understanding is rooted in the concept of neuroplasticity, which highlights the brain's capacity for continuous learning and change throughout life.

Understanding mindset is not as simple as labeling someone as entirely "fixed" or "growth" oriented; it is deeply contextual and can shift based on situation, subject, and stress. Consider a PhD student who might display a growth mindset in research but cling to fixed beliefs about their writing abilities, or how quickly someone can flip from "I can improve" to "I'm just not good at this" when receiving critical feedback. This contextual nature of mindset becomes particularly evident when examining implicit bias in STEM fields, where societal pressures and stereotypes can trigger fixed mindset responses, especially around gender. Even well-intentioned individuals who believe in growth and development can find themselves defaulting to fixed thinking when faced with certain triggers or threats. The key is not to label ourselves or others as having one type of mindset, but rather to recognize how different contexts and situations might push us toward or away from a growth-oriented perspective, and then work to create environments that support productive responses to our mindset.

Our perceptions of our abilities and self-narratives often stem from the type of feedback we receive early in life. There are two primary feedback forms, one of which is more conducive to learning than the other.

1. **Intelligence-based feedback**, which often involves praising a child or adult for being smart, talented, or naturally good at something, can inadvertently undermine effort and long-term results. This type of feedback can lead to a fixed mindset, where individuals believe their abilities are innate and unchangeable.

2. **Effort-based feedback**, on the other hand, focuses on persistence, dedication, and the learning process. Acknowledging and praising a person's effort, dedication, or resilience can foster a growth mindset and encourage continued improvement.

When combined with a *stress-is-enhancing* mindset, the benefits of a growth mindset are significantly amplified. Research conducted by Dr. Alia Crum and colleagues demonstrates how we perceive stress can significantly impact our performance. Individuals can improve their performance on challenging tasks by reframing stress as a positive force that mobilizes resources and enhances cognitive function.

Stress signals the body and brain to increase alertness, energy, and focus. It also stimulates the release of neurotrophins, which promote learning and memory by facilitating neuroplasticity. While short bouts of stress can be beneficial, prolonged stress can have negative consequences, particularly if it disrupts sleep.

To harness the power of a growth mindset and a stress-is-enhancing mindset, it is important to recognize that stress, although uncomfortable, can be a catalyst for improved performance. By practicing mindfulness and reframing stress as a positive force, individuals can develop greater stress tolerance and enhance their abilities.

A growth mindset is not merely a personal trait but a powerful tool for shaping the future of our world. By fostering a belief in the malleability of our abilities, we empower ourselves and others to tackle the complex and pressing challenges facing humanity.

A growth mindset is essential for solving big, world-threatening problems. It encourages us to embrace challenges as opportunities for growth, to persevere through setbacks, and to seek innovative solutions. By cultivating a growth mindset, we can foster a culture of resilience, adaptability, and creativity that is vital for addressing the complex issues of our time.

Moreover, a growth mindset can lead to greater satisfaction in our work. When we believe that our abilities can be developed through effort and perseverance, we are more likely to find meaning and fulfillment in our careers. A growth mindset encourages us to take on new challenges, to learn from our mistakes, and to strive for continuous improvement.

A growth mindset also emphasizes the value of diverse perspectives and interdisciplinary collaboration. By recognizing the contributions of all disciplines, we can develop more comprehensive and effective solutions to ill-defined problems. A growth mindset encourages us to seek out different viewpoints, to challenge our assumptions, and to work together toward common goals.

Finally, a growth mindset is fundamental to lifelong learning. When we believe our abilities can be developed over time, we are more motivated to seek out new knowledge and skills. A growth mindset encourages us to embrace curiosity, to explore new ideas, and to stay relevant in a rapidly changing world.

Cultivating a Growth Mindset

To foster a growth mindset within engineering programs, providing tools and resources that support self-reflection and mindset change is essential. This includes implementing tools like Dweck's mindset tool, guiding engineers through self-assessment, and conducting longitudinal studies to track progress.

Recognizing that engineering culture has often neglected the human and social aspects of the profession, we must encourage engineers to adopt a mindset that values diverse perspectives and acknowledges that humans are multi-dimensional and benefit from multiple intersecting identities. This involves fostering a culture of interdisciplinary collaboration and promoting the value of different ways of knowing, as well as valuing knowledge and practices from non-engineering disciplines.

A participatory action research framework can be a valuable tool for implementing mindset change. By providing engineers with tools for reflection, assessment, behavior change, and a guidebook and reward system, we can support their journey toward a growth mindset. Establishing clear expectations and metrics will help measure the impact of these interventions on diversity, inclusion, and problem-solving abilities.

To successfully change mindsets, it is crucial to lead by example and support others through the change process. At the end of this chapter, we describe how Kotter's Change Model could be used to support this work.

Dr. Carol Dweck coined the term "**growth mindset"** to describe research on improving learning that is anchored in the belief that our abilities are malleable—and indeed they are, because our brains can continually learn and change throughout our lifespan, due to neuroplasticity.

Our understanding of our abilities and our narratives of why we are "good" and "bad" at certain things often arises from the unconscious (or conscious) understanding of the **types of feedback** we receive early in life, which persists throughout our lives. There are two basic kinds of feedback; one is better for improving learning than the other.

- **Intelligence/Performance-based feedback** is associated with identity labels. Praise involves telling a child (or adult) they are smart and talented, learn things easily, or are really good at a particular skill. However, identity-label feedback actually undermines effort and results in the long run! This type of feedback is problematic because when we inevitably fail to perform well, we assume it is due to something central to our identity. For that and many other reasons, it is generally good to avoid intelligence/performance-based feedback.
- **Effort-based feedback**, on the other hand, is performance-enhancing and is always associated with "verb" (action) states. This type of praise focuses on persistence, effort, dedication, or how a person kept working through an error or challenge. For example, saying, "That was a solid effort," or "You're pushing really hard to learn, which is so good!" or "It's great the way you kept trying when you had a setback," etc., is ideal for enhancing performance as it leads to more of what's required to improve and generalizes to other scenarios.
- **Effort-based feedback** is essential when someone performs well, not just when they fall short of a goal.

Enhance Results by Combining Growth Mindset with Stress-Is-Enhancing Mindset

The benefits of a growth mindset are significantly enhanced when combined with the "**stress-is-enhancing**" **mindset**, developed by Dr. Alia Crum and colleagues, which is based on how we *perceive* the effects of stress. When people are educated about the negative effects of stress, their performance tends to decline. However, when people are educated about the positive effects of stress, they tend to improve their performance on difficult cognitive tasks.

How Does Stress Enhance Performance?

Stress signals the body and brain to mobilize more resources to meet challenges better. Stress may feel uncomfortable, but it also:

1. Increases adrenaline and dopamine release in the brain and body, resulting in heightened alertness, increased energy, and improved focus.
2. Enhances cognition (thinking) and triggers the release of neurotrophins (neural growth factors) that support learning and memory by facilitating neuroplasticity (brain rewiring).
3. Brief episodes of stress (lasting 1-2 hours or less) can boost the immune system to protect against illness. More prolonged bouts can be problematic, especially if they alter sleep.

Takeaways & Tools

- Even though stress may not always feel good in the moment, adjust your mindset to remind yourself that stress puts you in an action-oriented state, which enhances performance.
- You can change (and lower) your stress response by remembering the positive benefits of stress.
- With practice, you will become more comfortable in stressful situations and develop greater stress tolerance.

As covered in the full-length Huberman Lab (Huberman, 2024) episode on growth mindset, when a stress-is-enhancing mindset is combined with a growth mindset, the results are synergistic (greater than the sum of each), long-lasting, and in many cases generalize to other useful scenarios: relationships, athletics, academics, and more. In short, we can all benefit from adopting these mindsets through cognitive feedback and praise, as well as reframing “failures” and actions.

Weaving Students In instead of Weeding Students Out Mindset

Jenna Carpenter served as ASEE’s President in 2022-2023 and is the founding dean of Campbell University’s ABET-accredited engineering program. She has spoken widely about Campbell’s (and her) mission to transform engineering education from a “weed-out“ to a “weave-in” culture.

At Campbell University, they have implemented innovative, evidence-based practices such as:

1. Evidence-based teaching methods
2. Three different entry pathways for students with varying math preparation
3. Mandatory support programs and mentoring
4. Team-based, hands-on projects in every engineering class from day one
5. Comprehensive career development support
6. Focus on building community and student relationships

Notable achievements at Campbell include:

- 31% women in a recent graduating class, 60% women faculty
- Recognition as one of the nation’s most inclusive engineering schools
- Successfully graduating students who might fail elsewhere
- Strong industry connections and internship placements

Carpenter's broader mission is to transform engineering education to meet workforce needs by attracting and supporting talented students from all backgrounds, rather than just those who arrive at college well-prepared. Her work challenges the traditional assumption that strong academic preparation equals engineering ability. Campbell University's program is a model for others to look to as they consider changing the mindset in their engineering program to one of "weave-in" versus "weed-out."

Carpenter (November 2022) addresses the traditional "weed-out" culture in U.S. engineering education and calls for systemic change by noting that historically, engineering programs have filtered out many students based on the belief that only certain students have what it takes to become engineers.

Key points from her discussion include:

1. Current systems favor students with privileged backgrounds (family wealth, quality K-12 education, college preparation) rather than actual ability.

2. Problematic practices include:
    - Curved grading
    - Overcrowded curricula
    - Heavy focus on memorization over practical application
    - Lecture-heavy teaching methods
    - Limited opportunities for students to improve

3. Engineering education must change because:
    - There is a growing need for more engineers.
    - Demographics are shifting toward historically marginalized populations.
    - Overall declining birth rates mean fewer traditional candidates.

4. Several solutions to these problems include:
    - Creating multiple pathways for students with different backgrounds
    - Providing robust and wrap-around student support services
    - Developing engaging first-year courses
    - Building a sense of community and belonging among students, faculty, and staff
    - Teaching students study skills, motivation, organizational skills, and time management
    - Normalizing help-seeking behavior for students

Addressing Recommendation 5.1: Change the perception of engineering by promoting the idea that engineering is for everyone who wants to be a problem solver, not just those who excel in mathematics.

This recommendation is addressed in detail in an earlier section of this report, Section 1, "Creating Flexible Program Structures to Remove Barriers."

To implement Recommendation 6.1, which aims to change the perception of engineering, we need a multifaceted approach that reaches a broad audience and challenges existing stereotypes. This recommendation is part of a strategy to create a "movement" to catalyze systemic improvement in engineering education. Here is an approach to address Recommendation 6.1 specifically:

Reframing Engineering as a Comprehensive Problem-Solving Program of Study

1. **Develop Core Messaging** that consistently emphasizes problem-solving, creativity, and impact rather than just mathematical ability. This shift in focus can make engineering more appealing to a broader range of students who might be intimidated by the math-heavy stereotype. Reports such as *Messages Matter* from DiscoverE and the National Academy of Engineering *Changing the Conversation* report indicate that effective messages include:
    - Engineering is creative problem-solving for everyone.
    - Engineers make a difference in the world.
    - Diverse perspectives drive innovation in engineering.
    - Engineering skills are valuable in many careers.

2. **Launch a Multi-Channel Media Campaign** that uses diverse imagery and storylines that challenge the traditional engineer stereotype. For example, it could showcase engineers working on social impact projects or in creative industries. It should also include creating messaging guidelines for consistent communication across all platforms. That includes efforts to:
    - Develop engaging video content for social media platforms
    - Create a series of public service announcements for TV and radio
    - Design eye-catching print and digital advertisements
    - Collaborate with influencers to reach younger audiences

3. **Showcase Diverse Engineering Role Models.** This is crucial for helping students see themselves in engineering roles. Role models should include not just racial and gender diversity, but also diversity in terms of backgrounds, interests, and career paths. The *Messages Matter* report notes that targeted, appealing messages alongside profiles of people who look like them doing things they are interested in can spur interest in engineering among students. Efforts that accomplish this could include:
    - Profile engineers from various backgrounds and disciplines
    - Highlight non-traditional career paths in engineering
    - Create a speaker's bureau of diverse engineers for schools and events
    - Develop a mentorship program pairing students with working engineers

4. **Engage K-12 Education.** Early exposure to engineering concepts is key. Activities should focus on creative problem-solving rather than rote calculation. For example, students could design solutions to address local community issues, emphasizing the real-world impact of engineering (see Theme 5: Strategic Partnerships for additional details).
    - Develop age-appropriate engineering activities emphasizing creativity
    - Create classroom posters showcasing diverse engineering applications
    - Organize school visits by engineers from various fields
    - Provide resources for career counselors on engineering pathways

5. **Partner with the Entertainment Industry and Social Media.** Media representation plays a significant role in shaping perceptions. Collaborating with content creators to portray engineers as diverse, creative problem-solvers can help shift the profession's public image. Efforts could include:
    - Collaborate with TV shows and movies to portray engineers accurately

- Develop a web series featuring real-life engineering challenges—Work with Google to develop an Engineering Mindset channel?
- Create engineering-themed content for popular YouTube channels
- Sponsor engineering-focused storylines in children's programming

6. **Redesign Engineering Outreach Events.** Traditional science fairs often focus on individual projects and technical skills. Reframing these as collaborative problem-solving challenges can highlight the creative and teamwork aspects of engineering. Alternate events could include:
    - Rebrand science fairs to emphasize problem-solving and creativity
    - Organize community "Engineering for Good" challenges
    - Host family-friendly engineering festivals in public spaces
    - Create hands-on engineering exhibits for museums

7. **Leverage Social Media and Digital Platforms** to challenge the idea that engineering is for a select few and narrowly focuses on math and science. Ideas include:
    - Launch a hashtag campaign (e.g., #EngineeringForAll)
    - Create shareable infographics debunking engineering myths
    - Develop a TikTok challenge showcasing everyday engineering
    - Use AR filters to demonstrate engineering concepts

8. **Engage Professional Organizations and Industry** to help increase messaging reach and enlist their assistance in sharing these messages. Actions could include:
    - Partner with engineering societies to amplify the message
    - Encourage companies to showcase diverse engineering teams
    - Develop internship programs emphasizing creative problem-solving
    - Create industry-sponsored design challenges for students

9. **Revamp University Marketing** to help institutions reach K-12 audiences, parents, and alumni with updated messaging, to include strategies such as:
    - Update engineering program brochures to emphasize creativity and problem-solving
    - Showcase interdisciplinary projects in admissions materials
    - Host open houses featuring hands-on engineering activities
    - Create virtual tours highlighting collaborative spaces in engineering departments

10. **Advocate for Policy Changes** to support the adoption and uptake of these strategies, such as:
    - Push for broader definitions of engineering in educational standards
    - Advocate for funding for creative engineering programs in schools
    - Work with accreditation bodies to emphasize problem-solving skills
    - Promote changes in standardized testing to reflect broader engineering skills

11. **Measure and Adapt** to drive these efforts toward success and guide additional work, including:
    - Conduct regular surveys to track changes in public perception
    - Monitor application trends in engineering programs
    - Analyze social media sentiment around engineering
    - Adjust strategies based on data and feedback

Implementing these types of plans requires coordination among educational institutions, professional organizations, industry partners, and media outlets. It is a long-term effort that needs consistent messaging and regular evaluation to track its impact on public perception and student engagement with engineering.

Addressing Recommendation 5.2: Remove artificial barriers to the engineering profession through a design-by-choice flexible engineering curriculum.

Implementing Recommendation 6.2 to remove artificial barriers through a design-by-choice flexible engineering curriculum requires a significant shift in how engineering education is structured and delivered. Here's an approach to implementing this recommendation:

Develop a Flexible Engineering Curriculum Implementation Plan that incorporates the following key elements.

1. Curriculum Redesign

Core Components:

- Foundational engineering principles
- Problem-solving and design thinking
- Communication and teamwork skills
- Ethics and societal impact

Flexible Elements:

- Modular course structure
- Interdisciplinary electives
- Project-based learning opportunities
- Self-directed study options

2. Create Diverse Pathways

- Develop multiple tracks within each engineering discipline
- Offer interdisciplinary degree options
- Create "build-your-own" degree programs with faculty guidance
- Establish clear pathways for transfer students and non-traditional learners

3. Implement Competency-Based Assessment

- Define core competencies for each engineering discipline
- Develop diverse assessment methods (projects, portfolios, presentations)
- Allow students to demonstrate competencies through various means
- Create a system for recognizing prior learning and work experience

4. Enhance Advising and Support

- Train advisors on flexible curriculum options
- Implement degree planning software for students
- Provide career counseling aligned with chosen pathways
- Offer peer mentoring for students in non-traditional paths

5. Foster Industry Partnerships

- Collaborate with industry on curriculum development
- Integrate real-world projects into coursework
- Expand internship and co-op opportunities
- Develop industry-sponsored challenges and competitions

6. Leverage Technology

- Implement adaptive learning platforms
- Offer online and hybrid course options
- Use virtual labs and simulations for flexible skill development
- Create a digital portfolio system for students

7. Promote Interdisciplinary Collaboration

- Encourage cross-departmental projects
- Develop courses co-taught by engineering and non-engineering faculty
- Create interdisciplinary research opportunities for students
- Establish "innovation hubs" for cross-disciplinary work

8. Revise Admission Criteria

- Broaden admission requirements beyond math and science scores
- Implement holistic review processes
- Consider portfolios and project work in admissions
- Develop bridge programs for students needing additional preparation

9. Faculty Development

- Provide training on new teaching methodologies
- Encourage faculty to develop interdisciplinary courses
- Revise tenure and promotion criteria to value curriculum innovation
- Support faculty in industry engagement and applied research

10. Accreditation Alignment

- Work with accreditation bodies to ensure compliance
- Document how flexible pathways meet required outcomes
- Participate in pilot programs for innovative curriculum models
- Share best practices with other institutions

11. Continuous Evaluation and Improvement

- Regularly survey students, alumni, and employers
- Track student outcomes across different pathways
- Conduct longitudinal studies on career trajectories
- Adjust curriculum based on emerging industry needs and feedback

12. Marketing and Communication

- Develop clear messaging about the flexible curriculum
- Create interactive tools to explore degree pathways
- Showcase success stories of students in non-traditional paths
- Engage with high schools to promote the new approach

This plan provides a comprehensive approach to changing the perception of engineering. Here is an elaboration on some key aspects:

1. **Curriculum Redesign**: The core idea is maintaining rigorous engineering fundamentals while allowing for greater flexibility. This could involve creating a "core + electives" model where students have more choice in fulfilling their requirements. For example, instead of mandating specific advanced math courses, students could choose from a range of quantitative reasoning courses that align with their interests and career goals.

2. **Create Diverse Pathways**: This approach acknowledges various paths to becoming a successful engineer. For instance, a mechanical engineering program might offer tracks in sustainable design, robotics, or biomechanics. The "build-your-own" option could allow students to combine elements from different engineering disciplines or even incorporate non-engineering fields, such as business or psychology.

3. **Implement Competency-Based Assessment**: This shift focuses on what students can do rather than just their courses. For example, students could demonstrate proficiency through a design project instead of requiring a specific CAD course. This approach is particularly beneficial for non-traditional students with relevant work experience.

4. **Enhance Advising and Support**: With more flexible options comes a greater need for guidance. Advisors must be well-versed in various career paths and how different course combinations align with industry needs. Degree planning software could help students visualize different pathways and their outcomes.

5. **Foster Industry Partnerships**: Close collaboration with industry ensures the flexible curriculum remains relevant to real-world needs. This could involve industry professionals co-designing courses, providing real-world problems for student projects, or offering micro-internships that align with specific modules in the curriculum.

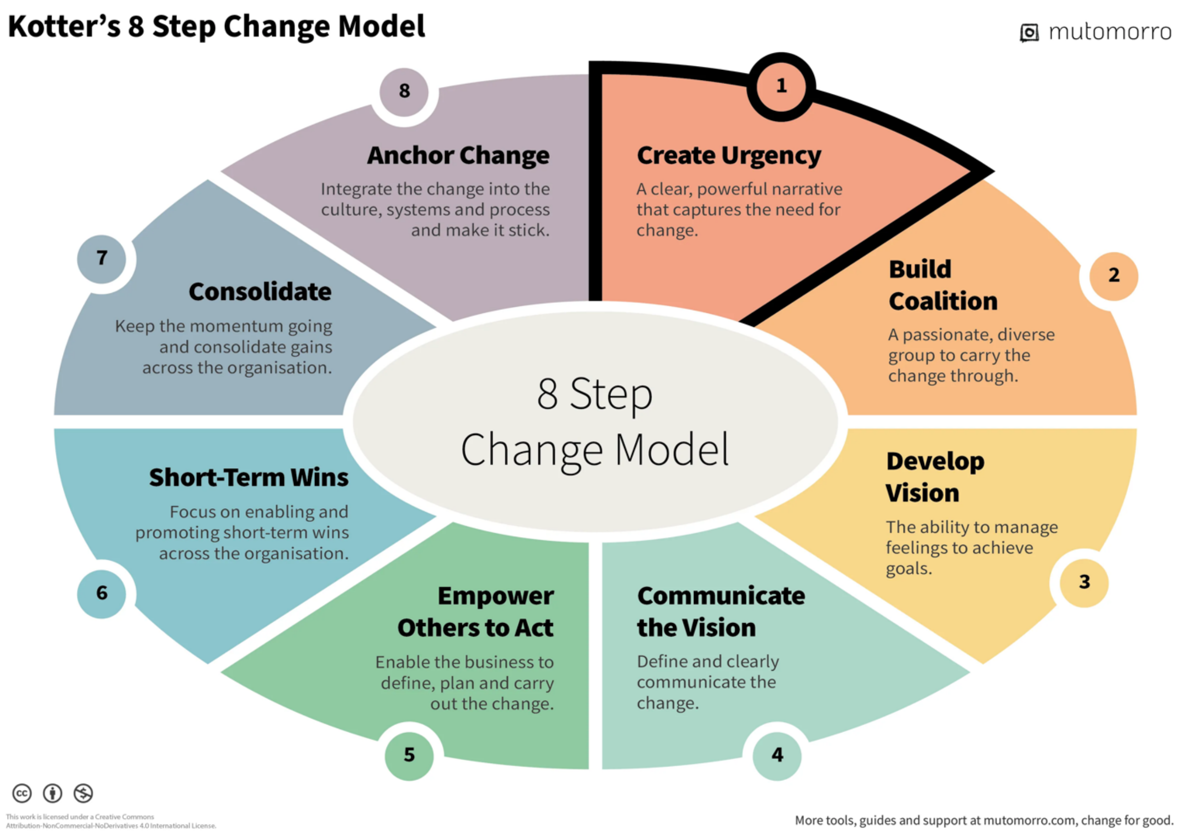
6. **Revise Admission Criteria**: This is crucial for removing barriers at the point of entry. For example, instead of requiring specific AP courses, admissions could consider a broader range of preparatory experiences, including project work, internships, or self-study in relevant areas.

Implementation challenges may include resistance from faculty accustomed to traditional curricula, ensuring that flexible pathways still meet accreditation standards, and managing the increased complexity of course scheduling and advising. Additionally, clear communication with prospective employers would be necessary to ensure they understand and value students' diverse pathways.

A Framework to Support Mindset Shifts

To successfully change mindsets, it is crucial to lead by example, communicate the importance of a growth mindset, create opportunities for small wins, encourage reflection, provide training and resources, foster psychological safety, celebrate progress, use storytelling, address resistance, be patient and persistent, create supportive peer networks, align systems and processes, measure and track progress, personalize the approach, and address underlying beliefs. By implementing these strategies, we can cultivate a more growth-oriented and inclusive engineering culture that is better equipped to address the complex challenges of our time.

Kotter's 8-step model of change is one widely recognized framework that can be applied to large-scale organizational transformations. Its focus on creating urgency, building a coalition, developing a vision, communicating the vision, empowering action, creating short-term wins, consolidating gains, and anchoring changes makes it a viable approach for fostering an inclusive engineering mindset. This approach, coupled with social network theory and self-determination theory, provides a powerful framework to guide this work.



1. **Create Urgency**
    a. Highlight the need for change: Emphasize the societal and economic benefits of diversity in engineering.
    b. Identify the risks of inaction: Discuss the potential negative consequences of maintaining a status quo that excludes certain groups.
2. **Build a Coalition**
    a. Assemble a diverse team: Include faculty, students, administrators, and industry partners from various backgrounds to represent different perspectives.
    b. Gain Support: Build consensus among key stakeholders to drive the change initiative.
3. **Develop a Vision**
    a. Define the desired future state: Clearly articulate the vision of an inclusive engineering mindset, emphasizing diversity, equity, and belonging.

   b. Create a shared purpose: Inspire others to embrace the vision and work toward a common goal.
4. **Communicate the Vision**
   a. Use multiple channels: Communicate the vision through various channels, including workshops, presentations, and online platforms.
   b. Tailor messages: Adapt communication to different audiences to ensure understanding and engagement.
5. **Empower Action**
   a. Remove barriers: Identify and remove obstacles that hinder progress toward the inclusive mindset.
   b. Delegate authority: Empower individuals and teams to take ownership of the change process.
6. **Create Short-Term Wins**
   a. Celebrate small successes: Recognize and reward early achievements to maintain momentum.
   b. Build confidence: Reinforce the belief that the vision is achievable.
7. **Consolidate Gains**
   a. Capitalize on momentum: Leverage short-term wins to drive further change.
   b. Implement new systems: Establish policies and procedures that support the inclusive mindset.
8. **Anchor Changes**
   a. Integrate new behaviors: Make the inclusive mindset a part of the organization's culture.
   b. Celebrate progress: Continue to recognize and reward positive changes.

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Section 6: A Framework for Transformational Change

Organizational Change

Change is never easy, especially at the scale proposed in this report. Transformational change can be accomplished through the thoughtful application of successful change models and the evaluation of best practices. Incremental change over a short period of time will lead to transformational change.

Organizational change, especially when involving thousands of people, often requires a systematic and pragmatic approach to ensure successful implementation. Kotter's Eight-Step Model and the Satir Change Model are two prominent models that address this challenge and can be used for guidance. Kotter's model emphasizes a structured progression through stages, beginning with creating a sense of urgency and building a guiding coalition to drive change. Communication, empowerment, and short-term wins are crucial to maintain momentum as the process advances. The model culminates in solidifying new approaches to the organization's culture. This approach aligns well with the *innovator adoption concept*, as outlined by Everett Rogers. Early innovators, characterized by their willingness to take risks, resonate with Kotter's emphasis on urgency and coalition-building, while early adopters align with the stages of empowerment and communication, embracing new ideas. We believe that the actual blueprint for implementing the report's ideas on the mindset change needed for institutions and organizations serving the engineering and related fields, as well as the education sector, will involve developing a pragmatic plan using Kotter's or a similar model for change.

On the other hand, the Satir Change Model, developed by Virginia Satir, focuses on addressing human aspects during change. This model acknowledges the emotional impact of change and highlights the importance of enabling individuals to navigate through this process. The stages in the Satir Model include status quo, foreign elements, chaos, practice, and integration. This model is also deeply connected to Rogers' diffusion of innovations theory. Early innovators, driven by curiosity and openness, relate to introducing the "foreign element" and subsequent "chaos" stages. Early adopters resonate with the "practice" phase, where they actively engage and experiment with new practices. Late adopters parallel the "integration" stage, where the change becomes a part of the organizational culture, albeit after a more gradual acceptance. This model will be essential in considering the desired change for educators and supporters in engineering and related fields.

Incorporating these models and the concept of innovator adoption provides organizations with a comprehensive framework for managing change effectively, catering to the diverse mindsets and preferences of individuals within the organization. Appendix 3 describes one possible framework for managing change at the scale necessary to implement the recommendations from the Mindset Report. Appendix 4 summarizes current NSF programs that can support the implementation of the recommendations in the Mindset Report. Appendix 5 provides a summary of the foundations that can support the implementation of the Mindset Report's recommendations.

Framing for the Blueprint for the Engineering Education New Mindset Movement

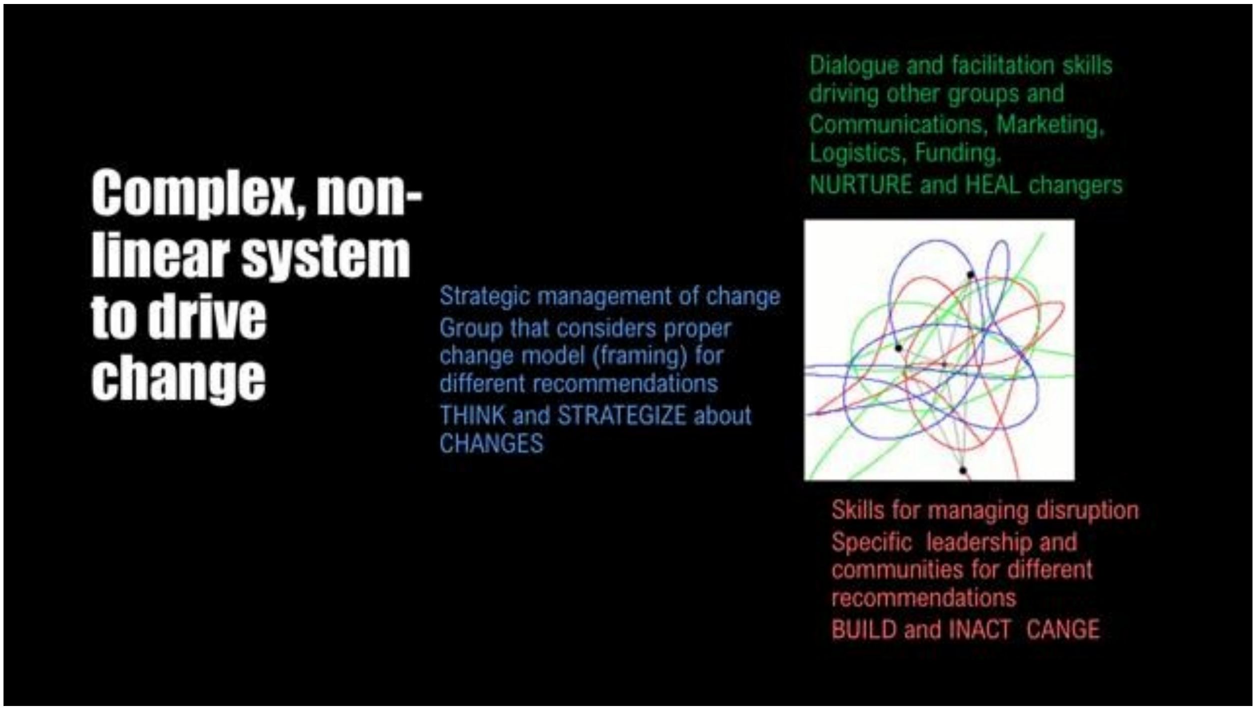
By Karan Watson and Kristi Shryock

We are at a crossroads in engineering education, and frankly, throughout all of higher education, where we can either continue to incrementally improve a system handed to us by our past or design a new system that addresses the challenges we face. We need a shared commitment through a movement to create a new future for engineering education in our nation. We call for conditions in which engineering education programs can invent and demonstrate new teaching and learning systems where we admit a more inclusive and diverse student population and realize the full potential of every student. The challenges society and humanity face require the contribution of every person. It requires an engineering education system that leads to self-directed and lifelong learners who can collaborate, solve problems, and communicate in varied contexts and with people from varied backgrounds and life experiences. (Mindset Report, 2024)

While various engineers can accomplish many of the envisioned tasks, we need a systematic change so that these things become the norm for students graduating from engineering programs. This requires a very long-term perspective in which (1) short-term changes are interdependent with each other and the long-term changes desired; (2) broad national and professional changes are interdependent with institutional and programmatic changes; and (3) systems, structures, and processes are interdependent with individuals' behavioral changes. In other words, a complex and nonlinear accumulation of actions is necessary to achieve a major systemic change.

To make the changes desired, we will need to launch a fleet of changes, not merely one type of change. This fleet will require engagement at various levels, including federal and State levels for higher education, professional and employer levels, accreditation levels, institutional and program levels, and individual levels. Some of these changes will require the engagement of large crews and may take years to implement, while others can be carried out by small crews in a relatively short period of time. Many of these ships, if not all of them, are already out there. We just need to better align them for the movement to which we aspire.

To manage this fleet, we envision groups at all levels (across all ships) that will keep things focused on continuous adaptation, rather than one-time fixes. This continuous awareness and adaptation of pathways, accessibility, curricular content, pedagogy, and structure, moving from one disruption to another, requires that groups constantly focus attention on the *head* (blue), *hand* (red), and *heart* (green) required to manage complex change. All of the groups are equally important.



Blue Groups – the thinkers and planners: HEADS

These groups will consider and prioritize levers that move changes forward by discerning the nature of the changes to better strategize on the models for change most likely to succeed. Why does knowing the nature of the change you are dealing with matter? *The Art of War* by Sun Tzu answers this question (summarized in three sentences by James Clear):

> Know when to fight and when not to fight: avoid what is strong and strike at what is weak. Know how to deceive the enemy: appear weak when you are strong, and strong when you are weak. Know your strengths and weaknesses: if you know the enemy and know yourself, you need not fear the result of a hundred battles.

Change is rarely a war. However, the mindset for preparing to engage in and manage a successful change process is crucial. When change managers do not thoroughly understand the nature of the desired change, as well as the strengths and weaknesses of the assets at their disposal, along with the expected resistance, they cannot truly prepare for the change process. The process is more than a strategic plan. It requires continuous planning, evaluating, and adapting. Thus, those in a position to nurture the change must understand how to assess the change outcomes with various systemic lag times and deploy resources appropriately to achieve both short- and long-term gains.

First, to understand and engage in the change process, agents must assess the type of change being undertaken. We must recognize that a change may be composed of many sub-changes, and that the overarching change and sub-changes are not necessarily the same type. The descriptions in numbers 1 and 2 below are the authors' understanding and summary of some of the work found in:

Kezar, Adrianna. (2018). *How Colleges Change: Understanding, Leading, and Enacting Change*. Routledge. 10.4324/9781315121178.

Number 3 below adapts the Mindset Report's ideas to the authors' previous work found in:

Developing a Model to Assist Faculty with Taming the Next Disruptive Boogeyman. K Shryock, K Watson, L White, T Balart. - Available at SSRN 4699941, 2024

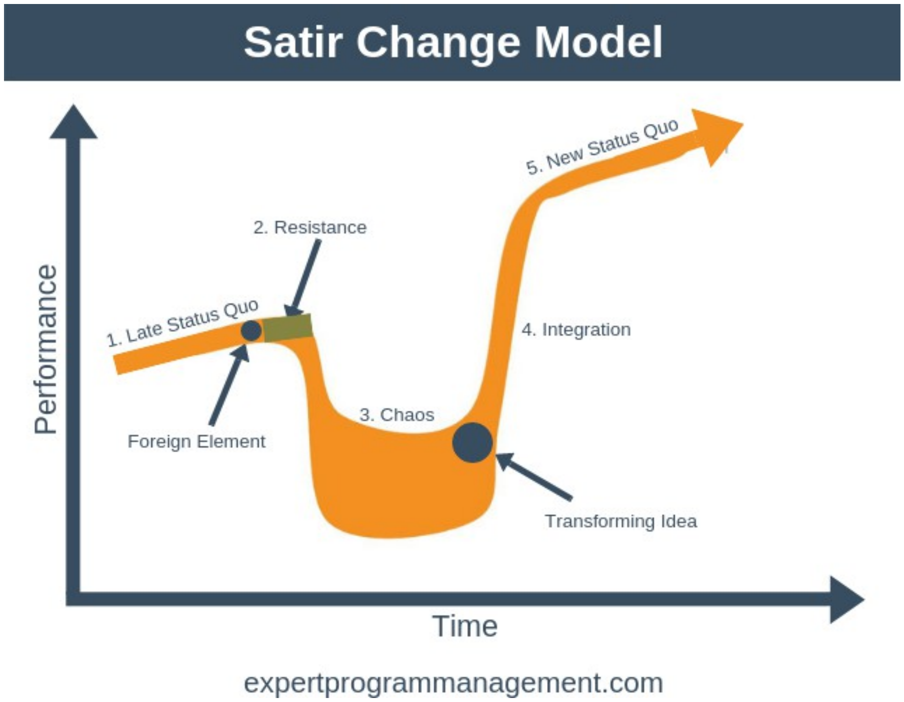
1. **Essential elements to determine the type of change:**
   a. Order: first order works within existing structures, such as mindset (beliefs, values, expectations). A second-order example would be seeing with a different mindset. Thus, the change is discontinuous, transformative, or disruptive.
   b. Level: international, national, professional, state, institutional, sub-institutional, or individual.
   c. Force or source of change: internal goal or strategic improvements, evolving external pressure or competition, dialectic tensions (the need to resolve differing values or goals), cognitive dissonance, altered social norms, realignment of internal norms to external forces.
2. **Taxonomy of change types:**
   a. Scientific management changes tend to be linear improvements or modifications of the first order, which are decided upon internally in an organization and can be accomplished in a relatively short time frame (although for business, a time frame cycle may be months, whereas for academic units it may be a student cycle, or 4 years).
   b. Evolutionary responses are usually first-order responses that slowly evolve due to external realities. Academic examples include:
      - The change in demographics of potential students.
      - The decision by many states to fund higher education as a private good for those who attend, rather than a public good.
      - The consequences of a magazine ranking schools in a way that urges all to become more focused on research.
   c. Political changes are initially first-order, but may become second-order, involving compromises between opposing tensions or values. Examples include:
      - Mandating increased tuition for students who take too many hours before graduating.
      - Funding based on speed to graduation.
      - Complaining about the cost to attend, but insisting that students help pay for sports facilities.
      - Empowering some students(but not all) to file complaints with the state if a faculty member teaches a topic in a way that makes the student uncomfortable with their identity.
   d. Social cognition changes prompt individuals within the entity to confront the cognitive dissonance that their view of the entity's processes, practices, and values can be viewed from a different mindset or perspective. Examples include:
      - A regional institution focused on national ranking or serving regional economic and human needs.
      - Promotion and tenure practices having widely varying instantiations of excellence.
      - Pathways to a degree are widely diverse.
      - Evaluating student mastery with options the student chooses.
   e. Cultural changes are second-order. These changes are focused on multiple levels within an entity, often evolve slowly, and are concerned with human interactions with the entity. The

change occurs when the entity focuses on understanding the gaps between the espoused values and artifacts of the entity, compared to the underlying assumptions that often reveal unespoused values. Examples include:

- Forcing course grades to fit a curve instead of competency mastery.
- Eminent status based on metrics other than national acclaim.
- Admissions based on parent resources rather than individual effort.
- Course material needs to be free.

f. Institutional or neo-institutional changes buffer the entity from external pressures. Examples include:
- Universities, restaurants, and airports adapting to COVID.
- Entities adapting to recessions.
- NSF adapting to the political party in power.

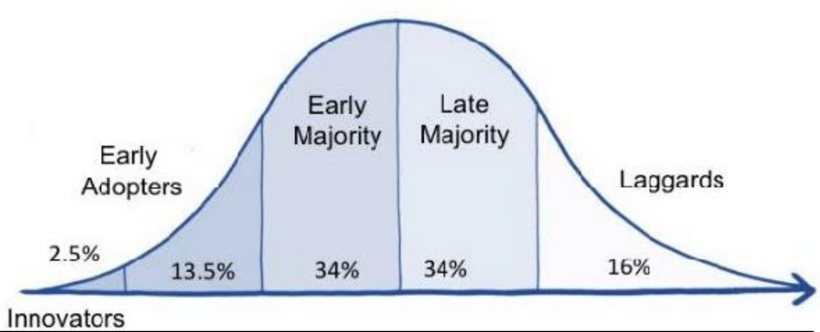
3. **Selection of a change model:** Rarely will a change model fit perfectly to guide all the nuances of a meaningful change; however, various models do aid in considering what leverages progress and what attenuates the resistance likely to inhibit the changes. The levers that change agents can consider are numerous, and prioritizing which are most effective is important.
   a. Possible levers for the changes envisioned in the mindset report, some of which may also contribute to resistance, include:
      i. A culture of exclusivity based on eminence in modeling and designing that is fostered by the profession of engineering.
      ii. A culture of professional engagement in societies organized along specific fields, as well as partnerships among these societies.
      iii. Regular interactions between engineering and related practitioners, faculty, and students.
      iv. Accreditation and licensure.
      v. States' desire for higher education to minimize unnecessary redundancy, dependent on students' pathways to a degree or certification.
      vi. Espoused values of higher education and professions to at least not discriminate and, at best, foster belonging and inclusion so that people of all backgrounds and identities can thrive.
      vii. Innovators in education for better and deeper learning and for developing new programs for emerging needs in expertise.
      viii. The fact that competition or prestige can often depend on collaboration. It should be obvious that sometimes these levers can work in opposition to each other and to the ultimate goals of the desired mindset shift.
   b. While all changes ultimately require individuals to change their attitudes, interests, values, beliefs, or at least some behavioral aspects, the models for a change process seem to be drawn from an institutional, group, or individual perspective. Examples of these found in the literature include:
      i. Institutionally driven changes, such as: Kotter's change model (see Section 5, Figure and description above in Section 6: Organizational Change)
      ii. Individual change models, such as the Satir model (see description above in Section 6).



Red Groups- the passionate builders: HANDS

Regardless of the model chosen for change, the actual implementers of the change must design a process, within the model they are given, that utilizes the levers and steps discussed above. Red group members can be called to serve because of the levers they can help with. They can win in a competition to be engaged; they can volunteer because of their interests and experiences. In most change processes, they become the passionate believers, the zealots for urgency. They should include some converts: those who were initially a bit skeptical but are willing to try.

A Red group's composition in the Rogers model should include the innovators and early adopters:



Rogers adoption/innovation curve. Adapted from Rogers, E. (2003). The Diffusion of Innovations. Fifth Edition. The Free Press, New York

Possible Dimensions to consider when forming a Red Change group are the following:

1. Status in the population to ultimately change
2. History of manifesting followers in the unit to change
3. Knowledge and skills related to practices and specifics to be changed
4. Interest and passion for change (at least 3:1 positive toward change)
5. An existing or created shared vision for the change among the group:
   - Communication.
   - Listen and sample.
   - Do not mislead and avoid overburdening with surveys.
   - Iterate on how to best communicate the need, urgency, and landing spot.
   - Create a clear message on need, process, timeline, metrics, and goals.
6. Prediction and assessment of the resistance:
   - What will be perceived to be lost or undervalued?
   - What will adopters fear about their future performance?
   - Who is cynical and why?
   - Who wins?

The design process for the Red Group utilizes change theory, or logic models, within a typical design process.

The Green Group- the unifiers and nurturers: HEARTS

The purpose of the green group is to bridge the strategists of the blue groups to the practitioners of the red groups. The green group must assist with the design and facilitate the implementation of activities that unify and focus the success and change of the blue and red groups, inspiring storytelling. The green group must involve people who are prepared to facilitate understanding and dialogues that can engage cognitive ideas, individuals' beliefs and values, and people's emotions and reactions. The green group must be skilled and help the red group grow in skills to understand what people are thinking and feeling. It must predict formats for red group activities that will nurture the desired change and mitigate resistance.

In particular, the green group must sort out and help determine the nature of conflicts that arise as people are asked to change their behaviors. Based upon the nature of a conflict, defined as when one or more people determine their interests, needs, beliefs, or values are not being met. A conflict exists even if only one person is aware of it. A conflict exists when one person wants a change and others do not, or when one person believes they know how to motivate change in others, but others disagree. Additional ideas on conflict management and dialogue in higher education are found in:

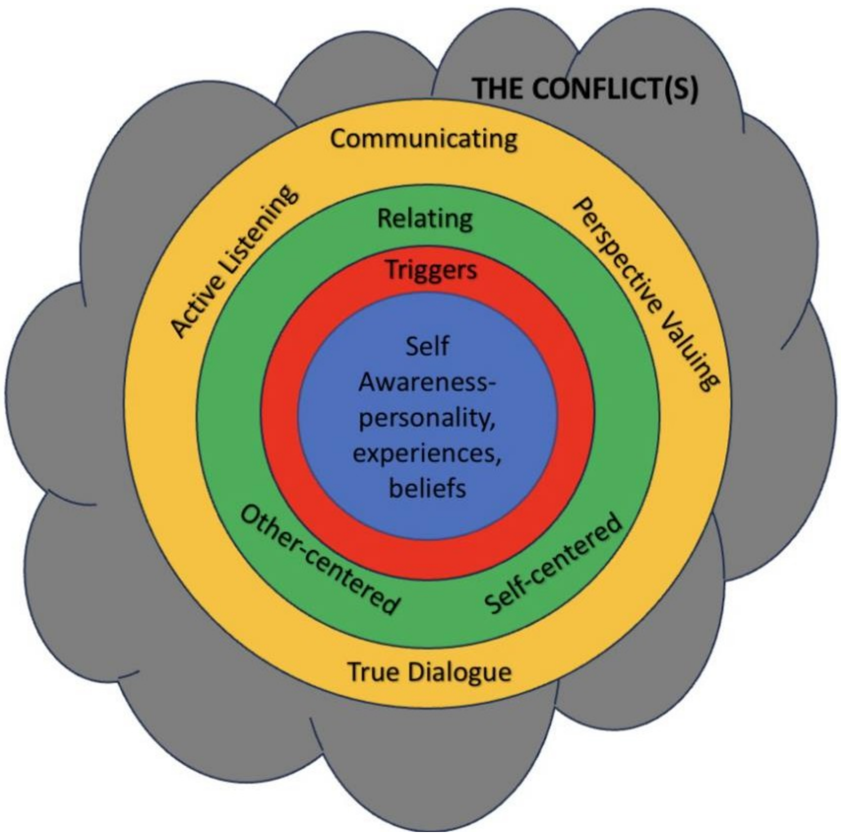
> Watson NT, Watson KL, Stanley CA (2017) *Conflict management and dialogue in higher education: a global perspective*. IAP

Helpful guides to the nature of conflicts are conflicts based on:

- Data: where missing or contradictory data is dominant.
- Interest: where diverse interests or goals are dominant.
- Structure: where conflicts are dominated by 'turf wars' or responsibility or control are dominant.

- Values: where deep-seated beliefs or personal values differ greatly.
- Relationships: where historical interactions dominate.

To engage effectively in any of the intervention approaches or a genuine dialogue, the green group must have the skills to manage themselves and understand the disputants. This entails skills depicted below:



Appendix 1: Faculty Professional Development

Here is a faculty development plan designed to prepare engineering faculty to implement the curriculum changes described in the comprehensive set of recommendations from the Mindset Report. This plan is organized into three key pillars aligned with the framework: Curricular Innovation, Pedagogical Transformation, and Institutional Support.

Faculty Development Plan: Preparing Faculty for Transformative Engineering Education

I. Goals

Equip engineering faculty with the knowledge, skills, and institutional support needed to:

- Design and implement flexible, modular, and inclusive curricula.
- Shift toward student-centered, evidence-based teaching practices.
- Engage in scholarly teaching and continuous improvement.

II. Structure

The plan unfolds over a 3-year rolling cycle, ensuring all faculty are engaged in development activities while allowing for continuity and depth.

Year, Focus Area, Key Activities

- Year 1, Awareness & Buy-In- Institute-wide workshops, community building, early adopters pilot
- Year 2, Practice & Pilot- Learning communities, curriculum design studios, classroom pilots
- Year 3, Institutionalization- Evaluation, tenure/promotion alignment, scalability strategies

III. Core Development Themes & Activities

1. Curricular Innovation & Flexibility
Supports Recommendations 1.1 – 1.6, 4.2, 4.3, 6.2

Workshops & Activities:

- Curriculum Studio Labs: Faculty collaborate to modularize courses, embed in-context mathematics, and map flexible learning pathways.
- Competency-Based Design Institutes: Training on mastery-based models, ungrading techniques, and aligning assessments with learning outcomes.
- Internship Integration Forums: Industry partners and faculty co-design curriculum-integrated co-op models.
- Articulation Bridge Building: Cross-departmental or university collaborations to streamline pathways between engineering technology and engineering degrees.

2. Pedagogical Transformation
Supports Recommendations 2.1 –2.5, 3.4, 3.5

Workshops & Activities:

- Hands-on & Collaborative Teaching Bootcamp: Application of PBL, maker-based learning, and team-based learning.
- Formative Feedback & Ungrading Series: Techniques for inclusive evaluation and feedback mechanisms.
- EdTech Sandbox: Exploration and prototyping of digital platforms that support personalized and competency-based learning.

3. Inclusive & Human-Centered Teaching
Supports Recommendations 3.1 – 3.9, 6.1

Workshops & Activities:

- Engineering & Society Seminar Series: Engaging with the historical and social impact of engineering to embed socio-technical perspectives.
- Student Experience Roundtables: Faculty dialogue with students from minoritized backgrounds to co-develop better classroom cultures.
- Whole Student Design Labs: Rethinking learning spaces and advising models to reflect student-centered principles.

4. Institutional Alignment & Culture Change
Supports Recommendations 4.1–4.6, 5.1–5.6

Workshops & Activities:

- Scholarly Teaching & SoTL Training: Support for faculty researching their innovations in curriculum and pedagogy.
- Promotion & Tenure Policy Working Groups: Aligning evaluation with innovation, inclusiveness, and teaching excellence.
- Data & Equity Literacy Sessions: Training faculty to use meaningful student data for continuous improvement.
- Partnership & Policy Dialogues: Forums that connect faculty with industry, accreditation bodies, and K-12 systems to co-design solutions.

IV. **Supports & Incentives**

- Teaching innovation fellowships (course releases, stipends)
- Microgrants for curricular redesign
- Recognition through awards, tenure consideration, and publications
- Cross-disciplinary learning communities (cohorts by theme or topic)

V**. Evaluation & Continuous Improvement**

- Annual feedback loops with faculty and students
- Portfolio submissions documenting pedagogical shifts and curriculum innovations
- Longitudinal tracking of student outcomes, particularly for underserved groups
- Public reporting to celebrate successes and refine approaches

Professional Development Plan for Engineering Faculty

Goal:
Equip faculty with the skills, tools, and mindset needed to effectively revise and deliver an innovative undergraduate engineering curriculum.

Phase 1: Needs Assessment & Goal Setting (Month 1)

Activities:

- Conduct surveys, interviews, and focus groups with faculty, students, alumni, and industry partners.
- Analyze current curriculum gaps (e.g., interdisciplinary skills, sustainability, ethics, AI/ML integration).
- Define shared vision and specific objectives for the new curriculum.

Deliverables:

- Summary report on current gaps and future needs.
- List of competencies and topics to be included (e.g., experiential learning, integrated math, data literacy).

Phase 2: Core Faculty Development Modules (Months 2–4)

1. Curriculum Design & Backward Planning
    - Outcomes-based education (OBE)
    - Course mapping and integration strategies

2. Active & Inclusive Teaching Pedagogies
    - Problem-based and project-based learning (PBL)
    - Inclusive and culturally responsive teaching practices

3. Assessment & Feedback Innovation
    - Authentic assessment methods
    - Formative assessment and feedback loops

4. Technology in Engineering Education
    - Use of simulation tools, AR/VR, coding platforms
    - Hybrid and online course design principles

5. Interdisciplinary & Industry-Relevant Teaching
    - Cross-department collaboration models
    - Guest lectures, case studies, and real-world challenges

Format:

- Workshops (2–3 hours/week)
- Online modules and asynchronous content
- Teaching demonstrations and peer feedback

Phase 3: Practice, Mentorship & Collaboration (Months 5–7)

Activities:

- Pilot revised course components in select courses.
- Establish faculty learning communities for ongoing dialogue.
- Pair faculty with teaching mentors or industry advisors.
- Encourage interdisciplinary team-teaching experiments.

Deliverables:

- Revised syllabi and lesson plans.
- Reflections on pilot implementations.
- Case studies of effective practice.

Phase 4: Curriculum Integration & Continuous Improvement (Months 8–12)

Activities:

- Host a Curriculum Retreat to finalize integrated curriculum proposals.
- Develop a curriculum change proposal for review by academic committees.
- Set up feedback mechanisms (e.g., student focus groups, teaching portfolios).
- Launch a curriculum innovation hub for ongoing support and experimentation.

Sustainability Measures:

- Annual Innovation in Engineering Education Conference (internal or regional)
- Faculty mini-grants for course innovation
- Recognition and rewards (teaching awards, promotion criteria adjustments)
- Ongoing PD Series (e.g., monthly workshops, guest speakers)

Success Metrics:

- % of faculty completing training modules
- # of courses redesigned or piloted
- Student engagement and learning outcomes (via surveys and grades)
- Faculty satisfaction and self-efficacy
- Employer feedback on curriculum relevance

Engineering Mindset Development Plan for Key Stakeholders

Faculty Members

Focus: **Empower faculty to become change agents in curriculum innovation and inclusive pedagogy.**

What It Means for You:

- Professional Growth: Gain new skills in modular course design, hands-on pedagogy, and inclusive teaching.
- Recognition & Rewards: Opportunities for fellowships, leadership roles, and recognition in tenure/promotion.
- Support Structures: Access to curriculum studios, pedagogy workshops, microgrants, and peer learning communities.

What You'll Do:

- Participate in curriculum redesign labs.
- Pilot ungrading or competency-based models.
- Collaborate with industry and students to reimagine learning experiences.

Department Chairs & Academic Leaders

Focus: Create departmental conditions that support and sustain innovation.

What It Means for You:

- Strategic Alignment: Align curriculum and faculty development with departmental goals and societal needs.
- Faculty Empowerment: Encourage experimentation by providing time, space, and incentives.
- Cultural Shift: Foster a student-centered department identity, focusing on access and success.

What You'll Do:

- Lead tenure/promotion reform discussions.
- Advocate for flexible course scheduling and modular pathways.
- Facilitate cross-functional curriculum teams.
- Provide resources for faculty attending development programs.

Deans & Senior Administrators

Focus: Lead institutional transformation and advocate for systemic change.

What It Means for You:

- Institutional Leadership: Position the college as a national model for student-centered engineering education.
- Sustainable Change: Connect innovations to resource planning, accreditation, and policy reform.
- External Engagement: Strengthen partnerships with industry, accreditation bodies, and K-12 systems.

What You'll Do:

- Invest in long-term faculty development infrastructure.
- Align resource allocation with innovation priorities.
- Launch innovation funds and public-facing annual impact reports.
- Lead state/federal advocacy for flexible financial aid and accreditation modernization.

Industry Partners & Advisory Boards

Focus: Co-design curriculum elements that reflect emerging needs and real-world contexts.

What It Means for You:

- Talent Pipeline: Help shape students' learning to better match 21st-century engineering work.
- Mutual Benefit: Build robust internship and co-op programs integrated into curricula.

What You'll Do:

- Participate in internship integration forums and curriculum co-design studios.
- Host faculty externships or sabbaticals.

- Provide feedback on competencies needed for success in evolving technical roles.

Students & Student Affairs

Focus: Partner with students in shaping the future of engineering education.

What It Means for You:

- Agency & Belonging: Be seen, heard, and valued in designing your educational experience.
- Real-World Readiness: Experience integrated internships and flexible learning pathways.
- Supportive Environment: Engage with faculty.

What You'll Do:

- Join faculty in co-creating student-centered environments.
- Participate in focus groups, design sessions, and peer mentoring networks.
- Help define what success and flexibility should look like in practice.

Community College Partners

Focus: Collaborate on seamless transitions, articulation, and student success pathways.

What It Means for You:

- Pipeline Strengthening: Expand access and readiness for 4-year engineering programs.
- Equity in Action: Co-design programs that support underrepresented and nontraditional learners.
- Shared Innovation: Bring modular models to both 2-year and 4-year campuses.

What You'll Do:

- Partner in bridge-building initiatives and transfer articulation planning.
- Share and co-develop course modules and faculty training models.
- Collaborate on data collection and student success tracking across institutions.

Appendix 2: Current NSF Programs

The following outlines existing programs at the NSF, as well as those of other funding agencies and foundations, that could support the mindset recommendations and the institutions that choose to implement them.

NSF Programs

Recommendation	1	2	3	4	5
	Program Flexibility	Evidence-based Pedagogy	Inclusive Diverse learning	Campus Student Centered Ed	Leverage Partnerships
NSF PROGRAM					
	N- no, Y-yes, P - possibly				
ENG EEC					
1. Engineering Research Centers (ERC)					
To establish large-scale, interdisciplinary research centers that combine engineering research, education, and industrial collaboration. ERCs address complex engineering challenges and train the next generation of engineers by fostering partnerships between academia, industry, and government.					
	N	P	P	N	Y
2. Research Experiences for Undergraduates (REU)					
To support active research participation by undergraduate students in ongoing NSF-funded research projects. REU programs provide opportunities for students to work with experienced researchers, promoting interest in STEM fields and preparing them for future research careers.					
	N	Y	P	N	P
3. Research Experiences for Teachers (RET)					
To enhance K-12 STEM education by involving teachers and community college faculty in engineering research. The program provides educators with hands-on research experience, equipping them to bring real-world engineering concepts into their classrooms.					
	N	Y	P	N	Y
4. Revolutionizing Engineering Departments (RED)					
To catalyze transformative changes in engineering departments by encouraging innovative, evidence-based approaches to engineering education. The program aims to create more inclusive, adaptive, and interdisciplinary engineering education systems.					
	Y	Y	Y	P	P
5. Engineering Education Research (EER)					
To support fundamental research on how engineering is learned and taught. This program focuses on improving engineering education by investigating educational methodologies, cognitive processes in learning engineering concepts, and effective teaching practices.					
	P	Y	Y	P	P
6. Graduate Research Fellowship Program (GRFP) – Engineering					

To support outstanding graduate students pursuing research-based master's and doctoral degrees in engineering. The program provides three years of financial support and aims to develop the nation's future science and engineering leaders.					
	N	N	P	P	N
7. Industry-University Cooperative Research Centers (IUCRC)					
To foster collaboration between industry and universities through cooperative research centers. IUCRCs focus on advancing research that is relevant to industry needs while preparing students for industrial careers through real-world problem-solving.					
	P	P	Y		Y
8. Engineering Research Visioning Alliance (ERVA)					
To bring together stakeholders from academia, industry, and government to identify and prioritize future directions for engineering research. ERVA helps create a vision for high-impact, transformative research initiatives that can address national and global challenges.					
	N	N	N	N	P
9. Engineering Education Postdoctoral Fellowship Program					
To support postdoctoral researchers focused on advancing engineering education research and practice. This fellowship aims to prepare the next generation of educators and researchers to drive innovation in how engineering is taught and learned.					
	P	Y	Y	P	P
10. DUE-HER - Improving Undergraduate STEM Education (IUSE: EHR)					
Focuses on projects that aim to enhance undergraduate STEM learning and teaching by developing new degree structures, interdisciplinary programs, flexible learning pathways, and innovative pedagogies					
	Y	Y	Y	P	P
11. Research on Emerging Technologies for Teaching and Learning (RETTL)					
Funds research that explores the integration of innovative, evidence-based technologies into education to improve teaching and learning outcomes.					
	P	Y	Y	P	P
12. Broadening Participation in Engineering (BPE)					
Targets efforts to create inclusive environments and to broaden participation of underrepresented groups in engineering.					
	P	Y	Y	P	P
13. Innovative Technology Experiences for Students and Teachers (ITEST)					
Aims to increase students' interest in STEM careers through partnerships with K-12 institutions and industry.					
	N	P	Y	P	Y
14. NSF TIP - Partnerships for Innovation (PFI)					
Focuses on partnerships between academic institutions and industry to accelerate innovations derived from NSF-funded research.					
	P	P	P	P	Y

Appendix 3: Foundations that Support Innovation in Education

This section describes foundations in the U.S. that fund education innovation and can be used as a guide for those engineering programs seeking funding to support their efforts.

Foundation Name: Charles Koch Foundation

Mission: The Charles Koch Foundation supports innovative education and the study of the institutions that enable a society of mutual benefit, where people succeed by helping others improve their lives.
Priority areas: Business, Postsecondary education
Geographic region they fund: USA
Average grant size (Higher Education in the past 3 years): $ 67,128,414

- Grant duration: Same duration as research/project

Total giving for the last 3 years:

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 62,831,279
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 92,988,357

Total giving to higher ed by year for the last 3 years:

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 52,556,829 (Source)
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): ~$ 81,700,000 (Source)

Most closely aligned funded projects in the last 3 years:

- https://charleskochfoundation.org/news/new- asu-initiative-will-share-innovations-help-other-universities-better-serve-students/
- Arizona State University, $ 10,000,000
- Agent Learner Initiative: University Design Institute(ASU), Trusted Learner Network, Learning Asset Manager, Digital & scalable self-directed secondary education alternatives & exploration tools (Source)

Types of support provided: Grants to Universities & Nonprofits, Sharing network & knowledge, Research. Accepted proposals may also receive support to disseminate the research.
Summary of grantmaking process:

- 1–3-page abstract which explains how the project will advance inquiry on a pressing challenge, CV or Resume, Brief itemized budget [Vision, Quality, Impact, Sustainability]
- No proposal due dates –rolling basis.
- Funding process: Open rolling application process

Program officers:

- Brennan Brown: Director of Educational Partnerships
- Email- brennan.brown@charleskochfoundation.org; LinkedIn: https://www.linkedin.com/in/brennan- brown-4772595/

Strategic partnership development in academic programs:

- Vada Harbour: Program manager
- LinkedIn: https://www.linkedin.com/in/vada-harbour-pmp-a642b555/
- Grant disbursement role; helped reduce grant processing time from 60 to 15 days.

Funding eligibility
What they DO NOT fund

- Percentage-based overhead costs

- Applied research & development
- Community development
- Infrastructure
- Cultural exchange problems
- Economic development
- Medical treatment
- Political activity
- Lobbying activity

Sample grant template: https://charleskochfoundation.org/app/uploads/2021/04/CKF-Grant-Agreement.pdf

Foundation Name: ECMC Foundation

Mission: To improve higher education for career success among underserved populations through evidence-based innovation.
Priority areas: Career & Technical Education Leadership, Men of Color, Rural Impact, Single Mother Student Success, Basic Needs Initiative
Geographic region they fund: USA (Most Funded States: CA ~$40 mil, MN ~ 28 mil, TX ~ 14 mil, NY ~ 14 mil, IL ~ 8 mil) – Total funding for IN since inception - $ 1,495,725
Average grant size: $ 500,000
Grant duration: DID NOT FIND
Total giving for the last 3 years:

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): $ 35,675,387
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 41,852,323
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 43,705,574

Total giving to higher ed by year for the last 3 years: (Considering College Success & Career Readiness initiatives in Higher Ed)

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): ~ $ 28,000,000
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): ~ $ 29,500,000

Most closely aligned funded projects in the last 3 years:

- FAME Academy – The Manufacturing Institute, $ 1,500,000
  The manufacturing institute received funding to create the FAME Academy, design online delivery methods, help launch up to 30 new chapters through the stages of FAME, and subsequently support students through new chapters. The goal is to bring the FAME model to new communities and reach more students through a network of community and technical colleges, employers, and community-based organizations by scaling the program through the Academy.

Types of support provided: Strategic grantmaking, program-related investment, strengthening capacity of higher education institutions, supporting large-scale cross-sector collaboration and innovation
Summary of grantmaking process:

- Rolling basis; letter of Inquiry submission via online system. LOIs should consist of the following details:
  - Point of contact, Name, Title, email address, phone number – at organizational level. No personal details
  - Organization information: Name, address, website, EIN number, organization type, budget, and background for submitting organization.

  - Budget & Timeline, including amount requested from ECMC, total project budget & complete timeline.
  - Concept overview, project summary, intended goals & expected outcomes
  - Categories & Demographics – populations served via proposed project
  - Strategic priorities: demonstrate how project aligns with at least one strategic priority of the ECMC Foundation
  - Leadership composition of submitting organization, including demographic information about Board and executive leadership.
- LOIs most aligned with ECMC's goals will be invited to submit a Full Grant Proposal.
- Funding process: LOI submission -> Invitation to submit Full Grant Proposal -> Grant Assessment (few months) -> Grant approval.

Program officers:

- Bryan Fahrbach: Associate Program Officer (IUB Alumnus) Email: bfahrbach@ecmc.org; LinkedIn: https://www.linkedin.com/in/bryan-fahrbach-9560317b/
  Reviewing Grant proposals and reports (Meeting with potential applicants)
  Managing foundation's employee engagement grantmaking process
- Laura Boche, PhD: Program Officer – Email: lboche@ecmc.org; LinkedIn: https://www.linkedin.com/in/leschmidt/
  Strategically responsive portfolio of grants
  Previously at Minnesota State system office as Coordinator of Strategic Initiatives; Interim Dean of Liberal Arts.
- Anna Fontus: Program Officer – Email: afontus@ecmc.org; LinkedIn: https://www.linkedin.com/in/anna-fontus-06a0b942/
  Oversees portfolio of grants for improving postsecondary career and technical education outcomes for underserved backgrounds.
  Previously Senior Program Director at Capitol Impact, addressing systemic challenges in education-to-employment ecosystems.

Funding eligibility:

- Eligible organizations:
  Nonprofits registered as US 501©(3) OR (US 509(a)(1), (2), (3) of IRC.
  Government entities
  Postsecondary Institutions and systems, OR their affiliated foundations

What they DO NOT fund

- Solicitations from individuals & requests for scholarships
- Endowment funds, political activities/lobbying, capital campaigns, fundraising activities
- Entities outside of the United States
- Requests from organizations not aligning with ECMC Foundation's mission

What projects are GENERALLY NOT funded

- Supporting K-12/youth development/summer bridge/general career preparation
- Projects impacting limited number of students/failing to serve underserved backgrounds
- Ongoing programs
- Job placements/Internships without direct connection to postsecondary degree completion
- Adult basic education/GED/high school equivalency

Foundation Name: Smith Richardson Foundation

Mission: The mission of the Smith Richardson Foundation is to contribute to important public debates and to address serious public policy challenges facing the United States. The Foundation seeks to help ensure the vitality of our social, economic, and governmental institutions. It also seeks to assist with the development of effective policies to compete internationally and to advance U.S. interests and values abroad.

Priority areas:

- International Security
- Foreign Policy Program
- Domestic Public Policy Program – Key Areas: Education, Criminal Justice

Geographic region they fund: USA

Average grant size (Higher Ed): $ 200,000 for educational institutions; $100,000 for Labs

Grant duration: Based on Research plan/project

Total giving for the last 3 years:

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 10,433,711
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 5,206,263
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): $ 22,450,943

Total giving to higher ed by year for the last 3 years (Only considering Academic institutions from 'Domestic Public Policy' Section):

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 4,576,337 (Source)
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 3,139,534 (Source)
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): $ 3,103,252 (Source)

Most closely aligned funded projects in the last 3 years:

- MIT Initiative on Technology and Future of Labor, $ 266,385, https://www.srf.org/grants/mit-initiative-on-technology-and-the-future-of-labor-3/

Types of support provided: Research and Evaluation of existing public policies; projects to inject new ideas into public debates; direct funding to Labs of universities

Summary of grantmaking process:

- Concept Paper Template: https://www.srf.org/wp-content/uploads/2024/08/Concept-Paper-Template-for-Website.pdf
- Estimated Grant request amount
- Estimated project schedule and Grant Term
- Principal Investigator's name & details
- Co-Investigator's name & Details
- Description of Issue
- Products to be produced during project
- Full-Proposal Template: https://www.srf.org/wp-content/uploads/2024/08/SRF-Proposal-Template.pdf
- Cover Letter
- Executive Summary
- Issue
- Background
- Methods

- Products
- Dissemination
- Policy Implications
- Budget
- One-Year Budget Template: https://www.srf.org/wp-content/uploads/2024/08/3-One-Year-
- Budget-Template.xlsx
- Two-Year Budget Template: https://www.srf.org/wp-content/uploads/2024/08/4-Two-Year-Budget-Template.xlsx

Funding process: Submit Concept Paper (not more than 6 pages) -> Submit Full proposal if concept paper accepted (Full proposal should include One-Year OR Two-Year budget).

Program officers:

- Mark Steinmeyer: Senior Program Officer (Domestic Public Policy): No contact available Conversation with Mark Steinmeyer: Understanding grant process and requirements for domestic policy projects: https://www.aeaweb.org/content/file?id=15824
- Jennifer Momplaisir: Administrative Associate (Domestic Public Policy): No contact available.

Foundation Name: Fidelity Foundation

Mission: Strengthening non-profit organizations; approaching grants as investments; leveraging resources; commitment to excellence & innovation

Priority areas:

- Arts & Culture
- Conservation
- Education
- Health
- Social & Economic Activity

Geographic region they fund:

- Albuquerque, NM
- Boston, MA
- Raleigh/Durham, NC
- Convington, KC/Cincinnati, OH
- Dallas/Ft. Worth, TX
- Denver, CO
- Jacksonville, FL
- Jersey City, NJ
- Merrimack, NH
- Smithfield, RI
- Salt Lake City, UT
- Organizations of national importance and high-impact projects with potential to inform the nonprofit sector are also of interest.

Total giving for the last 3 years (From Form 990-PF):

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 160,823,752
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 88,395,665
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): $ 72,059,567

Total giving to higher ed by year for the last 3 years:

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available

- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): To be calculated manually
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): To be calculated manually
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): To be calculated manually

Most closely aligned funded projects in the last 3 years:

- No project/previous grants declared
- Nearest aligned project includes - My Education (ME)™: providing access to education and support to historically underserved students – Self-initiated project for Fidelity Investments.

Types of support provided:

- Capital Investment: These are large-scale projects central to the overall health and sustainability of the applicant, such as new construction, renovations, expansions, and other initiatives that support the organization's strategic vision.
- Planning Initiatives: This includes funding for project consultants to develop strategic, business, feasibility, technology, and other types of plans.
- Technology Projects: These are high-impact technology initiatives that can substantially improve online functionality, financial accounting, inventory management, point-of-sale, and other business systems.

Summary of grantmaking process:

- Letter of Inquiry through online portal
- Invitation to submit full proposal if eligibility matches through Letter of Inquiry
- Assessment of Organization
- Financial History
- Strength of Balance Sheet
- Senior Management terms & tenure
- Strategic direction
- Key success criteria
- Institutional commitment toward project
- Realistic project budget
- Thorough implementation plan
- Performance measurement plan
- Post-implementation operating projections
- 3-6 months to review full proposal
- Meeting University team and site visits for additional information
- Grants approved at discretion of foundation trustees

Funding process: LOI submission -> LOI Review -> Invitation for Full Proposal -> Grant proposal submission. -> Review from Board of Trustees -> Grant approval -> Post-Grant report/Progress report

Program Officers:

- Anthony Britt: Program Officer, Education – Email: anthony.britt@fidelityfoundation.org; LinkedIn: https://www.linkedin.com/in/anthonybritt/
  Responsible for developing, managing, and evaluating philanthropic investments to education-focused organizations
  Previous Director of Strategies at Commonwealth Corporation
  Partnered with Office of Labor and Workforce Development
- Maya Lindberg: Associate Program Officer, Education – Email: maya.lindberg@fidelityfoundation.org; LinkedIn: https://www.linkedin.com/in/maya- lindberg/
  Develop grant opportunities aligning toward capacity-building approach in education sector
- Caroline Nolan: Program Director, Education – Email: caroline.nolan@fidelityfoundation.org; LinkedIn: https://www.linkedin.com/in/caroline- nolan-44178564/

Funding eligibility:

- What all grant applicants MUST have:
- Current 501 © (3) public charity status
- Operating Budget of $1 mil or more
- Proposed Project budget at $100,000 or more

What they DO NOT fund:

- Start-Ups
- Sectarian/Civic organizations
- Disease-Specific Associations
- Operational Support
- Sponsorships
- Galas/benefits
- Scholarships
- Corporate Memberships
- Video/Film Projects
- Capital Campaigns from scratch (will donate to capital campaigns if campaigns have demonstrated significant community support and have a proven track record)
- Emergency/Immediate funding
- Successive/multi-year grants

Foundation Name: Charles Stewart Mott Foundation

Mission: Philosophy/mission can be boiled down to one word – people.
Priority areas: Civil Society, Education, Environment
Geographic region they fund: USA
Average grant size: $ 250,000 - $ 350,000 (Few general-purpose education grants range from $1 Mil to $3 Mil)
Average grant duration: 2 years
Total giving for the last 3 years:

- Calendar Year 2024 (Jan 1, 2024 – Oct 11, 2024): Not Available
- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): $ 29,359,000
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 37,683,445
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): $ 23,751,954

Total giving to higher ed by year for the last 3 years:

- Calendar Year 2024 (Jan 1, 2024 – Oct 11, 2024): $ 13,913,434 (granted generally for a 2-year term from 2024-2026) (Source)
- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): $ 28,708,704 (Source)
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 22,470,597 (Source)
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 21,651,300 (Source)

Most closely aligned funded projects in the last 3 years:

- Afterschool Alliance, General Purposes grant - $2,400,000
- Fulfill needs of young people post-pandemic, serve as information source for afterschool programs, expand quality of afterschool programs and innovative models, and increase access to research and data

Summary of grantmaking process:

- Using online Letter of Intent/Mail Letter of Intent to:
- Office of Proposal Entry

- Charles Stewart Mott Foundation Mott Foundation Building
- 503 S. Saginaw Street, Suite 1200
- Flint, MI 48502-1851 U.S.A.
- Information required in LOI:
- Contact Information
- Organization Information (EIN/BRIDGE ID)
- Project Description
- Organization Description

Funding process: Make online profile -> LOI submission -> LOI Review -> access full application form -> Grant proposal submission.

Program Officers:

- Benita Melton: Program Director – Education; Email - bmelton@mott.org; LinkedIn: https://www.linkedin.com/in/benita-melton-07244413/
  Has primarily worked on federal & state budget and tax policy issues
  Strategies to help low-medium income families to save money and build assets.
- Gwynn Hughes: Senior Program Officer – Email: ghughes@mott.org; LinkedIn: https://www.linkedin.com/in/gwynn-hughes-755383262/
- Manages the foundation's largest grantmaking portfolio – Advancing Afterschool – connected to 50 statewide afterschool networks
  Previously executive director of Massachusetts Afterschool Partnerships.
- Arielle Milton: Program Officer – Email: amilton@mott.org; LinkedIn: https://www.linkedin.com/in/ariellemilton/

Funding eligibility:

What they DO NOT fund:

- Individual applicants
- Capital Development
- Local projects, except Mott-planned national demonstration
- Duplicate/overlapping projects
- Film and video projects

Foundation Name: Bill and Melinda Gates Foundation

Mission: To reduce inequities and improve lives around the world, ensuring every person has the chance to live a healthy, productive life.

Priority areas:

- Gender Equality
- Adolescents & Social Norms
- Digital Connectivity
- Family Planning
- Gender Data & Insight
- Gender Integration
- Maternal, Newborn, Child Nutrition & Health
- Women in Leadership
- Women's Economic Empowerment
- Women's Health Innovations
- Global Development
- Emergency Response

- Polio
- Global health agencies and Funds
- Primary health care
- Immunization
- Global Growth & Opportunity
- Agricultural Development
- Digital Public Infrastructure
- Global Educational Program
- Inclusive Financial Systems
- Nutrition
- Water, Sanitation & Hygiene
- Global Health
- Accelerator
- Discovery & Translational Sciences
- Enteric & Diarrheal diseases
- HIV
- Institute of Disease Modeling
- Integrated Development
- Malaria
- Neglected Tropical Diseases
- Pneumonia
- Tuberculosis
- Vaccine Development & Surveillance
- Global Policy & advocacy
- Development Policy & Finance
- Philanthropic Partnerships
- Global media partnerships
- Tobacco Control
- U.S. Program
- Data
- Early Learning Solutions
- Economic Mobility & Opportunity
- K-12 Education
- Pathways
- Postsecondary Success
- Washington State

Geographic region they fund:

- Africa
- China
- East Asia
- Europe
- India
- Middle East
- North America

Average grant size: $800,000 -$1,500,000 (grants for more than $10,000,000 have also been issued, depending on purpose)

Average Grant duration: 24–30 Months based on above grant size. The larger the grant size, the longer the duration.

Total giving for the last 3 years (Only in U.S. Program, grants provided on U.S. mainland ONLY):

- Calendar Year 2024 (Jan 1, 2024 – Oct 1, 2024): $ 383,923,205
- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): $ 605,795,393
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 501,372,110
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 611,915,570

Total giving to higher ed by year for the last 3 years (Calculated from limited Project types related to postsecondary education in 'U.S. Program'):

- Calendar Year 2024 (Jan 1, 2024 – Oct 1, 2024): $ 45,504,143
- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): $ 37,565,063
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 68,399,066
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 108,433,756

Most closely aligned funded projects in the last 3 years:

- Complete College America Inc.(Indianapolis, IN), $ 24,001,321; 60 Months duration
  To build organizational capacity for intermediaries to scale institutional transformation across multiple institutions that would result in improved outcomes for Black, Latino, Indigenous students, and students from low-income backgrounds
- University of Texas, Austin, TX, $3,292,353; 36 Months duration
  To implement a pathways research agenda and continue to build out the four pillars of the network.
- Arizona State University, Tempe, AZ, $ 4,583,962; 38 Months duration
  To establish a new benchmark for innovative courseware that explicitly prioritizes equity in the product design, development, and testing process, and faculty implementation and professional development for science gateway courses.

Types of support provided:

- Grants
- For organizations to achieve measurable impact
- Accounts for over 90% of giving
- Strategic Investments
- Funding entrepreneurs, companies, and other organizations to create incentives

Summary of grantmaking process: No Grantmaking process found; generally, grantees are invited

Funding process: Request for Proposals – they DO NOT make grants outside their funding opportunities – they DIRECTLY INVITE PROPOSALS BY CONTACTING ORGANIZATIONS.

Currently, No Grant opportunities available (Source)

Program Officers:

- Patrick Methvin – Director of Post Secondary Success; Email: patrick.methvin@gatesfoundation.org; LinkedIn: https://www.linkedin.com/in/patrick-methvin/
- Tafaya Ransom, Ph.D. – Deputy Director of Post Secondary Success; Email: tafaya.ransom@gatesfoundation.org; LinkedIn: https://www.linkedin.com/in/tafaya-ransom-ph-d-8245625/
- Frank Vahid – Deputy Director of Post Secondary Success; Email: frank.vahid@gatesfoundation.org; LinkedIn: https://www.linkedin.com/in/frank-vahid-80b68457/
  Bill Tucker – Senior Advisor, Pathways Program; Email: bill.tucker@gatesfoundation.org; LinkedIn: https://www.linkedin.com/in/bill-tucker-a4956/

- Alison M. Pendergast – Senior Program Officer, Digital Learning; Email: alison.pendergast@gatesfoundation.org; LinkedIn: https://www.linkedin.com/in/alisonpendergast/
- Deven Comen – Senior Strategy Office, Higher Education; Email: deven.comen@gatesfoundation.org; LinkedIn: https://www.linkedin.com/in/devencomen/
- Russell Cannon – Senior Program Officer, Postsecondary Success; Email: russell.cannon@gatesfoundation.org; LinkedIn: https://www.linkedin.com/in/russell-cannon-3a296a13/

Funding eligibility:
SHOULD HAVE U.S. 501©(3) tax-exempt status
What they DO NOT fund:

- Direct donations to individuals
- Projects addressing health problems in developed countries
- Political campaigns or lobbying activities
- Building or capital campaigns
- Projects serving religious purposes

Foundation Name: Walton Family Foundation

Mission: Walton Family Foundation is a family-led foundation that tackles tough social and environmental problems with urgency and a long-term approach to create access to opportunity for people and communities.
Priority areas: Education, Environment, Home Region – Mississippi-Arkansas Delta Region
Geographic region they fund: USA
Total giving for the last 3 years:

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): ~ $ 657,500,000
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 541,849,929
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 525,807,688
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): $ 496,202,357

Total giving to higher ed by year for the last 3 years:

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): ~ $ 282,900,000
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): Not Calculatable from available data
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): Not Calculatable from available data
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): Not Calculatable from available data

Most closely aligned funded projects in the last 3 years (From what data was accessible on the website):

- Arizona State University, $ 2,296,290 (2023) – Center on Reinventing Public Education housed within Arizona State University's Mary Lou Fulton College of Education, to execute multi-year research and thought leadership projects, and to design and run a new innovative grants program.
- Arizona State University, $ 1,715,086 (2023)
  To support improving student outcomes.
- Yale University, $ 1,072,966

 To pilot a new data service for policymakers and researchers, StaQs for Tax.

Summary of grantmaking process:

- Only accepts solicited proposals. NO UNSOLICITED PROPOSALS.

- Send a Letter of Inquiry. The letter should describe the organization and proposed project, and specify its relevance to a particular funding priority/area. Also include a brief estimate of funds required/to be requested.
- Staff review of LOI.
- Invitation to submit a formal grant proposal and Budget. (Submitting formal grant does not guarantee funding.)

Program Officers:

- Romy Drucker: Director of Education Program; Email: rdrucker@wffmail.com; LinkedIn: https://www.linkedin.com/in/romy-drucker-7043555/
- Edward Hui: Deputy Director of Education Programs; Email: ehui@wffmail.com; LinkedIn: https://www.linkedin.com/in/edward-hui-pk12educmgmt/
- Brienne Bellavita: Senior Program Officer, Education program: Email: bbellavita@wffmail.com; LinkedIn: https://www.linkedin.com/in/briennebellavita/
- Fawzia Ahmed: Senior Program Officer, Education Program; Email: fahmed@wffmail.com; LinkedIn: https://www.linkedin.com/in/fawzia-ahmed-141a4a4/
- Jamie Jutila: Program Officer, Education Program; Email: jjutila@wffmail.com; LinkedIn: https://www.linkedin.com/in/jamie-jutila-2b445939/

Funding eligibility:

What they are particularly interested in funding:

- Novel School Models – New approaches to college prep, career, and technical education.
- New ways, beyond test scores, to advance long-term success, including understanding of non-cognitive attributes.

Foundation Name: Mellon Foundation

Mission: We believe that the arts and humanities are where we express our complex humanity, and we believe that everyone deserves the beauty, transcendence, and freedom to be found there. Through our grants, we seek to build just communities enriched by meaning and empowered by critical thinking, where ideas and imagination can thrive.

Priority areas:

- Arts & Culture
- Higher Learning
- Humanities in Place
- Public Knowledge
- Presidential Initiatives

Geographic region they fund:

- North America
- South America
- Europe
- Africa

Average grant size: Number of grants

- <$250,000: 161 grants
- $250,000 - $499,000: 48 grants
- $500,000 - $999,000: 112 grants
- $1,000,000 - $4,990,000: 144 grants
- >$ 5,000,000: 16 grants

Total giving for the last 3 years (In the USA. Countries outside of USA have not been considered in the calendar year figures):

- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 253,127,600
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 225,541,500
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): $ 124,565,566

Most closely aligned funded projects in the last 3 years (From what data was accessible on the website):

- Emory University, $ 1,300,000 (36 months duration)
- The Atlanta Interdisciplinary AI Network – to support an inter-institutional network of Atlanta-based researchers to develop and promote humanities-forward, justice-oriented approaches to Artificial Intelligence.
- Many other grants were focused on community-based education and representation of underserved communities.

Summary of grantmaking process:

- Accepts proposals ONLY by invitation
- Proposal Guidelines for Higher Education
- IF NOT INVITED EARLIER (steps in chronological order):
- Review grantmaking strategies
- Submit inquiry online
- Mellon staff may request a concept note
- Small number of inquiries are invited to submit a proposal
- Review program guidelines
- Complete proposal via Mellon Grants portal
- Mellon staff review proposal and may request additional information
- Submit requested additional information via Grants Portal
- Proposal finalized and reviewed for approval

Funding process: nothing specified on website

Program Officers:

- Mary Bates: Program Officer, Higher Education, Email: mcb@mellon.org; LinkedIn: https://www.linkedin.com/in/mary-bates-60774012/
- Kris Choe: Program Associate, Higher Education, Email: kmc@mellon.org; LinkedIn: https://www.linkedin.com/in/kris-choe-069a8210b/
- Maria Sachiko Cecire: Program Officer, Higher Education; Email: msc@mellon.org;
- LinkedIn: https://www.linkedin.com/in/maria-sachiko-cecire-3788a833/
- Armando I. Bengochea: Senior Program Officer, Higher Education; Email: aib@mellon.org; LinkedIn: https://www.linkedin.com/in/armando-bengochea-51791714/

Funding eligibility:

- DOES NOT CONSIDER uninvited proposals
- Welcome inquiries from U.S. Colleges, Universities, or Higher Education-related organizations, ESPECIALLY INSTITUTIONS NOT PREVIOUSLY SUPPORTED

Foundation Name: Michael and Susan Dell Foundation

Mission: Creating and accelerating human opportunities across the world.

Priority areas:

- Quality Schools

- Classroom Support
- College Success
- Jobs & Livelihoods
- Financial Services
- Health Innovation
- Jewish Community

Geographic region they fund:
- Greater Autin
- India
- Israel
- South Africa
- United States

Average grant size: ~ $500,000 - $ 1,500,000
- These values are only true for the category of 'College Success'
- One outlier grant is the Dell Scholars Program, averaging $10,000,000 per grant every year.

Total giving for the last 3 years (in the US):
- Calendar Year 2023 (Jan 1, 2023 – Dec 31, 2023): Not Available
- Calendar Year 2022 (Jan 1, 2022 – Dec 31, 2022): $ 197,574,380
- Calendar Year 2021 (Jan 1, 2021 – Dec 31, 2021): $ 176,364,795
- Calendar Year 2020 (Jan 1, 2020 – Dec 31, 2020): $ 174,668,620

Total giving to higher ed by year for the approximately last 3-5 years: $ 109,301,637
Most closely aligned funded projects in the last 3 years (From what data was accessible on the website):
- UT Austin, $ 5,537,683
  UT for me – powered by Dell Scholars. Providing persistence and completion support services to eligible UT Austin Pell students during the 2021-2022 academic year.
- iMentor, $ 1,489,346
  Scaling postsecondary success model innovations and scaling to serve more than 3K college students annually by 2022.

Types of support provided:
- Grants
- Investments

Summary of grantmaking process:
- Base requirements for grant applications:
- Project location in USA, India, or South Africa
- Focus area is Education (all locations), Health and Wellness (US Only), or Family economic stability (India, South Africa, central Texas, and Greater Boston)
- Organization should be:
  - Association/board
  - Charitable trust
  - Community foundation
  - Social enterprise
  - Direct service organization
  - Not-for-profit company
  - Government
  - Pass-through organization
  - Private foundation

- religious organization
- education organization

- The amount is more than $50,000.
- Organizations align with foundation's anti-racism, antisemitism, and anti-hate values.

Funding process:

- Apply for funding through online portal. Portal includes detailed information about application process
- Details for submitting application
  - Problem statement
  - Outcomes list/document
  - Baseline Data/Evidence
  - Grant amount asked
- Foundation team will email after online grant submission if grant has been accepted/not. Further steps of processing grant will also be communicated over email.

Program Officers:

- Nicole Aston – Senior Program Manager; Email: nichole.aston@dell.org; LinkedIn: https://www.linkedin.com/in/nichole-aston/
- Garridon Hankins – Program Officer; Email: garridon.hankins@dell.org; LinkedIn: https://www.linkedin.com/in/garridon-hankins/
- Jennifer Jendrzey – Program Manager, Email: jennifer.jendrzey@dell.org; LinkedIn: https://www.linkedin.com/in/jenniferjendrzey/

Funding eligibility:

What do they TYPICALLY FUND:

- Enterprises serving children and youth from urban low-income communities and areas.
- Areas of Education, health, and family economic stability.

What projects typically DO NOT RECEIVE FUNDING:

- Individuals
- Medical research projects
- Event fundraisers or sponsorships
- Lobbying of any kind
- Endowments
- Infrastructure
- Requests for computers, laptops, tablets, or other hardware

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