Primary to Secondary Engineering Learning:
A Framework for International Consideration

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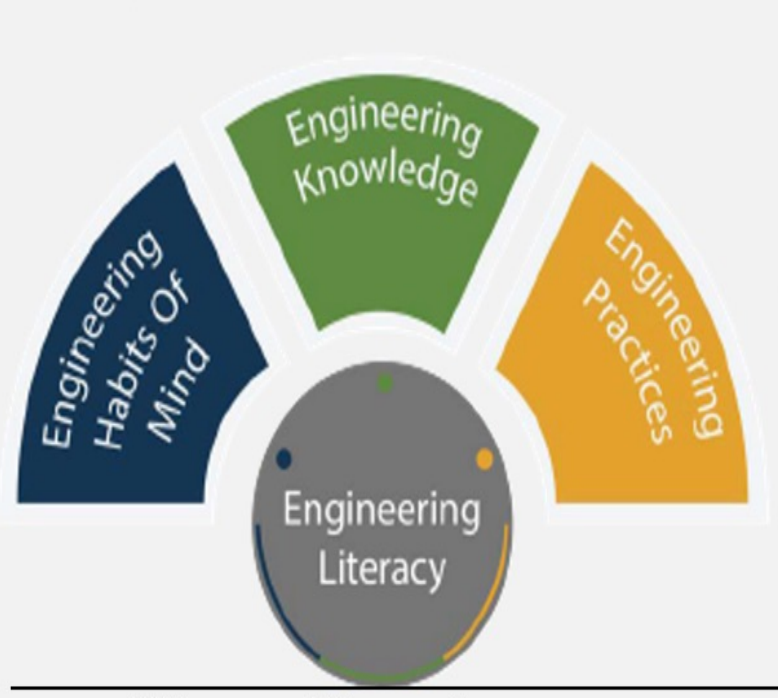
FRAMEWORK

P-12 Engineering Learning



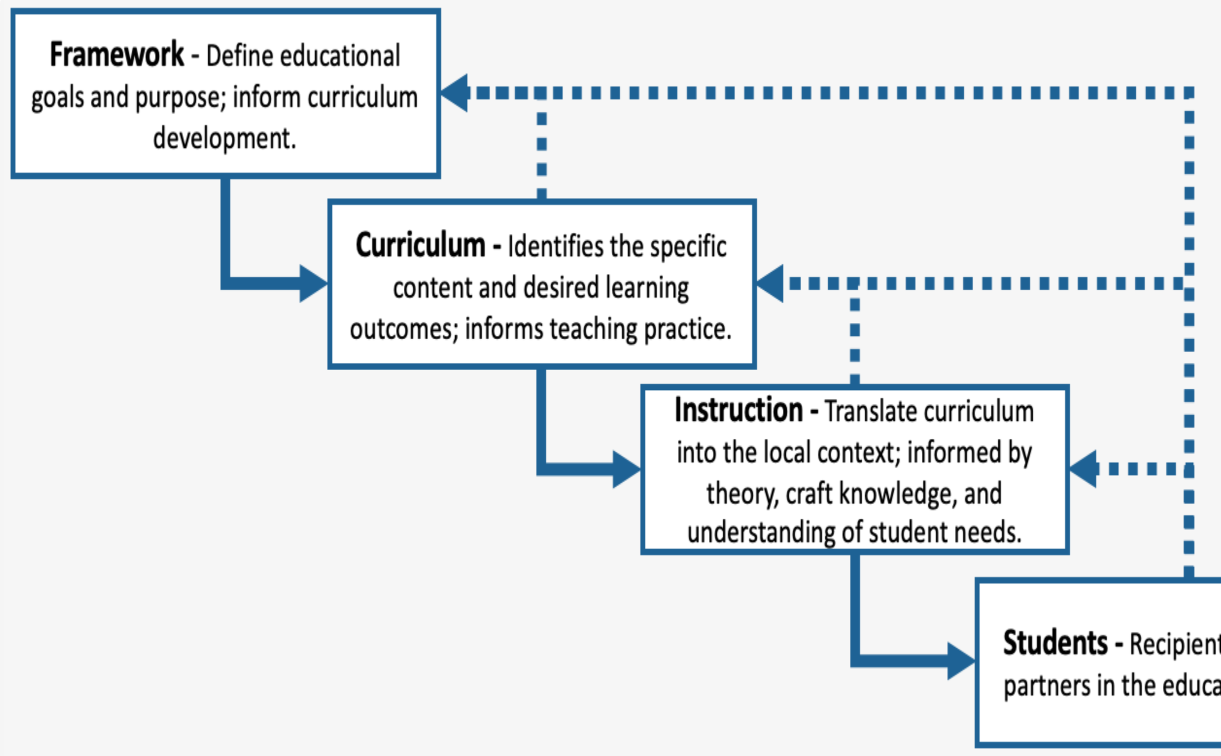
1. ***Engineering Habits of Mind*** that students should develop over time through repetition and conditioning,
2. ***Engineering Practices*** in which students should become competent, and
3. ***Engineering Knowledge*** that students should be able to recognize and access to inform their engineering practice.

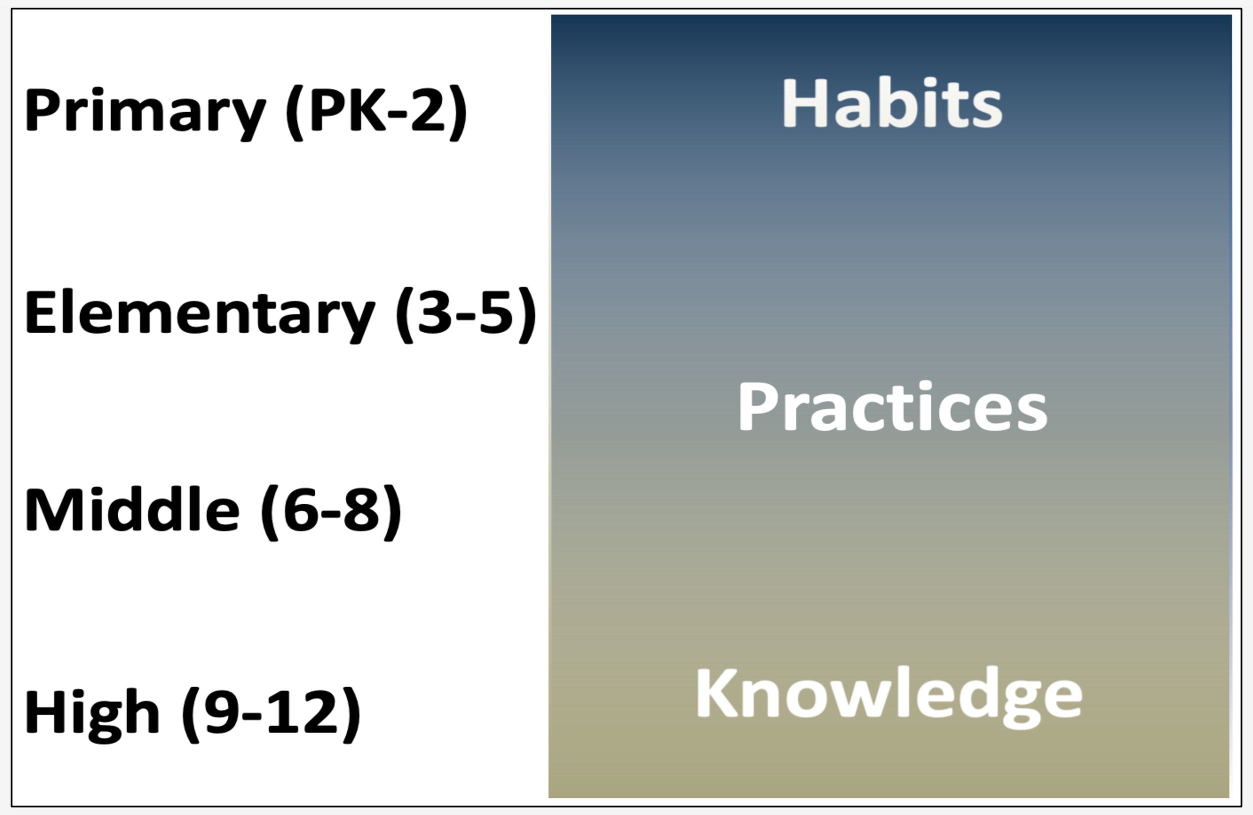
Literacy Dimensions	Main Components	
Engineering Habits of Mind	Optimism Persistence Conscientiousness	Systems Thinking Creativity Collaboration
Engineering Practices	Engineering Design Material Processing	Quantitative Analysis Professionalism
Engineering Knowledge Domains	Engineering Sciences Engineering Mathematics	Engineering Technical Applications

SYNOPSIS

The teaching of engineering has made its entrance into the subject of *Design & Technology Education* (DTE) around the world over the past few decades. This inclusion has been particularly true for the United States which refers to its DTE-related subject as *Technology & Engineering Education*. The inclusion of engineering has likely been due to the closely aligned epistemologies and classroom practices between engineering and DTE. But, while engineering has been emphasized in primary and secondary schooling, there has also been limited guidance for articulating how engineering could/should be taught, both authentically and equitably, across the years of school and how it is connected with other school subjects. To aid in this effort, a *Framework for P-12 Engineering Learning* was formed through over 3 years of iterative research and development work and published by the American Society of Engineering Education (2020). This framework was created to help provide a unifying vision and guidebook to inform decisions for improving the coherency and equity of engineering teaching and learning across the country. In addition, throughout this process, *Engineering Performance Matrices* (EPMs) were generated to offer sample blueprints of how the engineering concepts and sub-concepts identified within the framework could build upon each other to support teachers in creating authentic learning experiences that increase in sophistication over time—enabling students to achieve any designated engineering-related performance tasks or achievement or any standards related to engineering/tech.

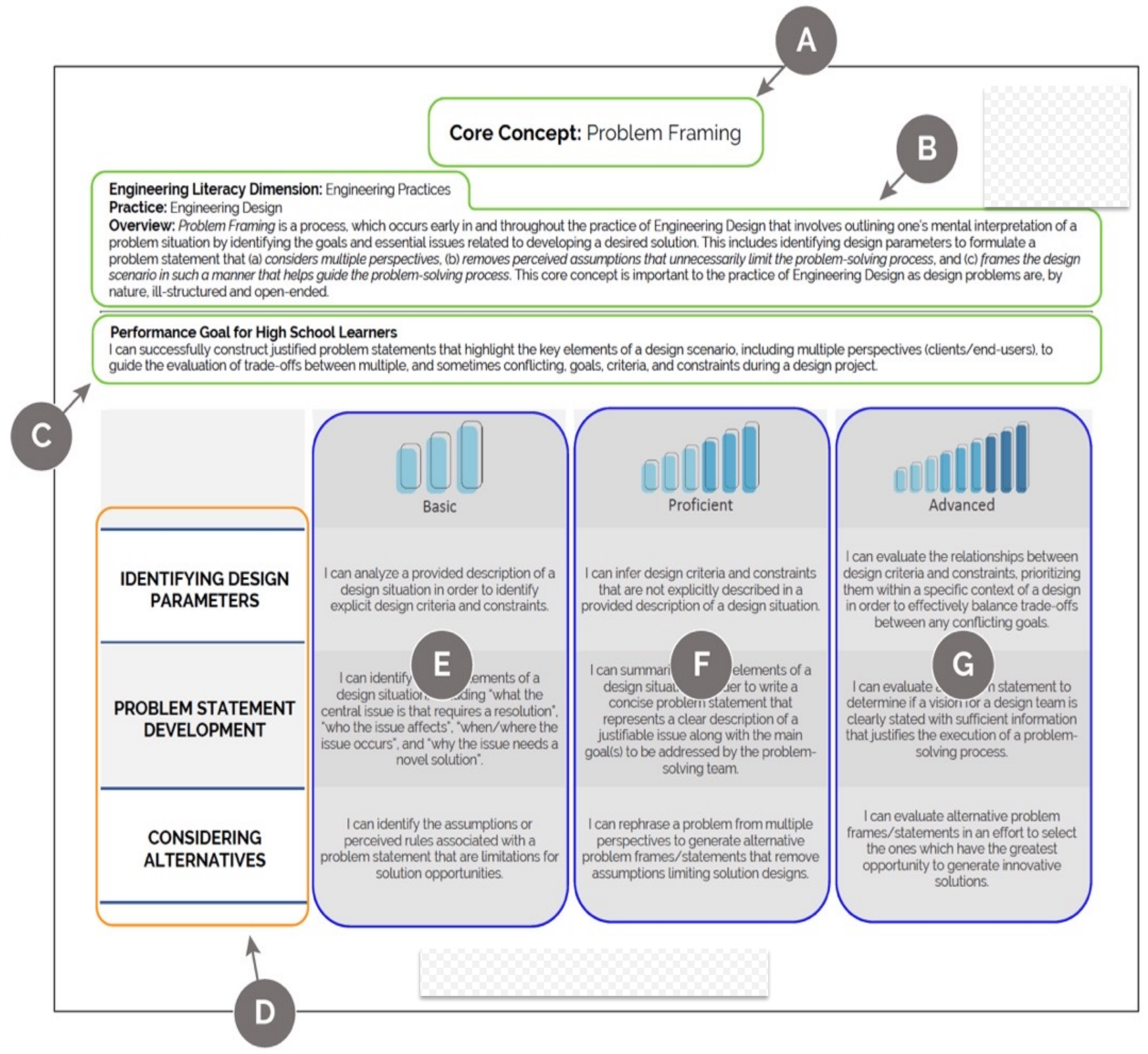
RESEARCH & DEVELOPMENT





Engineering Performance Matrices

A. Core or Auxiliary Concept
Identifies the domain or practice's concept of focus.
B. Engineering Literacy Dimension Bar
Identifies Engineering Habits of Mind, Knowledge, or Practice (if applicable); and the Overview, which defines the concept and its importance to Engineering Literacy.
C. Performance Goal for High School Learners
Indicates mastery of the domain through core concept application.
D. Columns for Sub-Concepts
E. Basic Column
Denotes partial mastery of prerequisite knowledge and skills that are fundamental for proficient work.
F. Proficient Column
Represents solid academic performance.
G. Advanced Column
Demonstrates competency over challenging subject matter, including subject-matter knowledge, application of such knowledge to real-world situations, and analytical skills appropriate to the subject matter.



IMPLEMENTATION EXAMPLES