



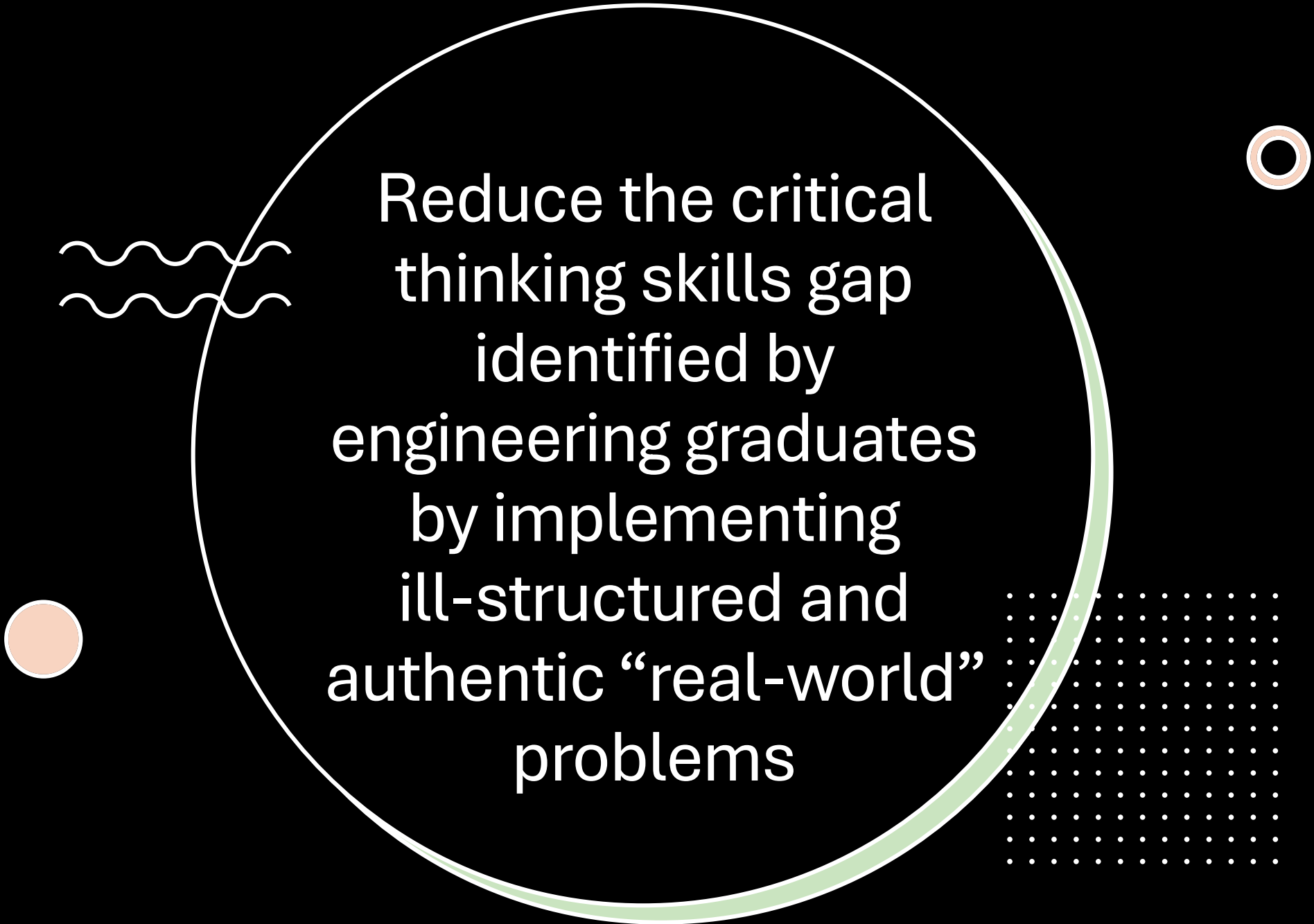
Closing the critical thinking skills gap identified by engineering graduates

Dr. Scott Ferguson

NC State University

Department of Mechanical and Aerospace Engineering

smfergu2@ncsu.edu




Reduce the critical
thinking skills gap
identified by
engineering graduates
by implementing
ill-structured and
authentic “real-world”
problems

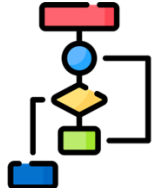
	Hard sciences and engineering science fundamentals	Critical thinking
Very prepared	44%	20%
Somewhat prepared	44%	16%
Very little preparation	7%	12%
Not prepared at all	1%	48%
Gained skill after graduation	4%	3%

2020 Survey For Skills Gaps in Recent Engineering Graduates, ASEE Corporate Member Council

Engineering graduates believe that their critical thinking skills are underdeveloped



Well-structured



Algorithmic

< 3% require
a qualitative
response

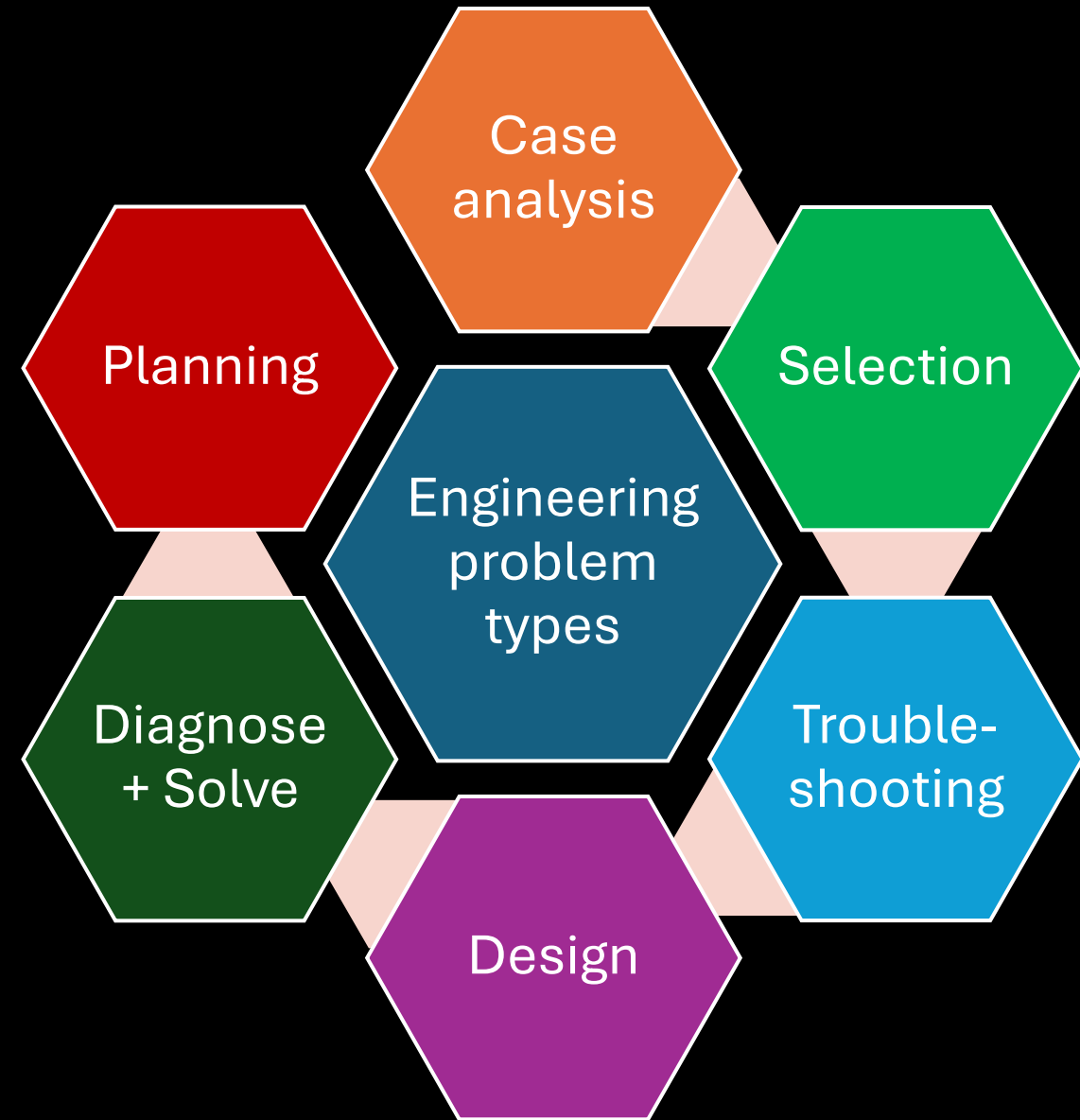
Quantitative

There are at least six problem types that are representative of the engineering discipline

D. H. Jonassen, 2000, "Toward a Design Theory of Problem Solving," Educational Technology Research and Development, 48(4): 63–85.

Creating effective and authentic ill-structured problems is challenging

Akinci-Ceylan et al., 2021, "Engineering Faculty's Beliefs About Teaching and Solving Ill-structured Problems" ASEE Annual Conf.



Problem typology frameworks

Mapping of knowledge types

Hierarchical problem analysis



Creating a network of industry “problem partners” will help us overcome the challenges of problem development

Roadmap and key milestones



Spring 2024:

- Formalized “Problem development toolkit”

Fall 2024:

- Developed airfoil selection problem with racing-sector industry partner
- Implemented problem with 120 students

Spring 2025:

- Connect with members of department industrial advisory and young alumni boards
- Develop various problems with industry partners

Time, perspective,
and data/modeling
advice define your
engagement as a
“problem partner”



Help us
revolutionize
how students
experience
learning and
applied
problem solving
throughout the
curriculum



One ill-structured and
complex problem in
every engineering
course

Facilitate workplace
transfer of critical
thinking skills



Closing the critical thinking skills gap identified by engineering graduates

Dr. Scott Ferguson

NC State University

Department of Mechanical and Aerospace Engineering

smfergu2@ncsu.edu