

# Rigor in Data Science

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Professor of Mathematics

NC State University

# A little about my career trajectory and “why”

K-12 and High School Dean, Teacher Ed,  
Software, Inst Design, Applied Math,  
Professoriate, Assoc. Dean, SIAM VP Ed, MAA  
Dep. Director, Legislative Assistant, Data  
Science Exec Director.

Why? To grow educational environments  
that empower learners and benefit society.

# NC State Data Science Academy



At NC State, an academy identifies a true university-wide effort involving all 10 colleges. It encompasses multiple departments, centers and institutes and addresses all three pillars of the university's land-grant mission: education, research and service to the state of North Carolina.

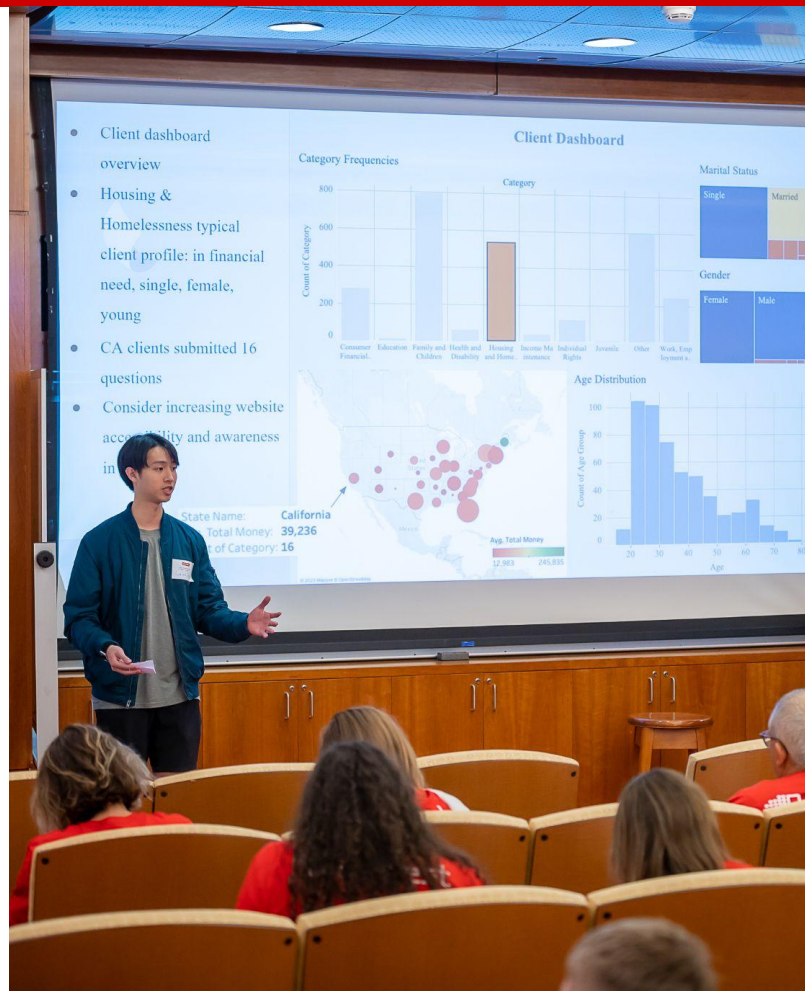
# ABOUT

First NC State Academy  
Launched July 2021

**Mission:** The DSA empowers people to use data ethically, effectively and accessibly.

**Vision:** The DSA connects people with ideas to make data and technology work for everyone.

**Goal:** Operationalize the idea that Data Science is for EVERYONE!



# ABOUT - The DSA Offers



COURSES (DSC)



INTERNSHIPS



SEED GRANTS



PROGRAMS



COLLABORATIVE  
CONSULTING



K-12  
OUTREACH



# COURSES

The DSA offers 1-credit hour, project-based courses at three levels ensuring we reach all interested learners.



Project-based Learning | 10 Common Learning Elements | Identity-conscious Choices

# ADAPT

All-campus Data science through Accessible Project-based Teaching and learning model

The Data Science Academy designs and delivers instruction through the ADAPT model:  
**All-campus Data science**  
 through **Accessible Project-based Teaching and learning.**

## ADAPT course levels

All-campus Data science Accessible Project-based Teaching and learning

### Research Ready

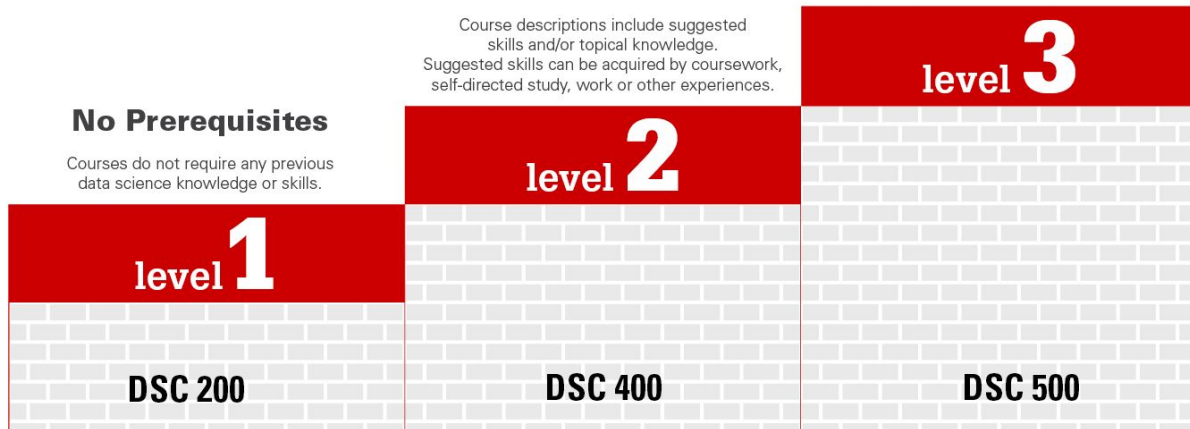
Students are invited to use their own research data to complete course activities. Courses may focus on 'hot topics' for academic, industry, non-profit or community-based research.

### Suggested Skills

Course descriptions include suggested skills and/or topical knowledge. Suggested skills can be acquired by coursework, self-directed study, work or other experiences.

### No Prerequisites

Courses do not require any previous data science knowledge or skills.



# ADAPT Model Share Fair!

Virtual, free and open to the public.

- Date: May 1, 2024
- Time: 12pm to 3:30pm
- Registration Link available [here](#)

<https://datascienceacademy.ncsu.edu/courses/course-model/ds-edu-share-fair/>

Rigor



What comes to mind when you think  
of rigor in your work and life?

# Contexts for Rigor

Etymology

Disciplinary views

Mathematics

Mathematics Education

Data Science

# Etymology of the word Rigor

Definitions from [Oxford Languages](#) · [Learn more](#)



rig·or<sup>1</sup>

/ˈrɪɡər/

## Origin



late Middle English: from Latin, literally 'stiffness', from *rigere* 'be stiff'.

**rig·or**<sup>2</sup>

/'rɪgər/

*noun*noun: **rigor**; noun: **rigour**

the quality of being extremely thorough, exhaustive, or accurate.

"his analysis is lacking in rigor"

- severity or strictness.  
"the full rigor of the law"
- demanding, difficult, or extreme conditions.

plural noun: **rigors**; plural noun: **rigours**

"the rigors of a harsh winter"

## Origin

LATIN

OLD FRENCH

rigor

→ rigour

→ rigor

*late Middle English*

stiffness

late Middle English: from Old French *rigour* from Latin *rigor* 'stiffness'.



Merriam-Webster

<https://www.merriam-webster.com> › dictionary › rigor ⋮

## Rigor Definition & Meaning

8 days ago — The meaning of RIGOR is **harsh inflexibility in opinion, temper, or judgment : severity**. How to use rigor in a sentence.



Cambridge Dictionary

<https://dictionary.cambridge.org> › dictionary › rigor ⋮

## Meaning of rigor in English - Cambridge Dictionary

rigor noun [U] (CARE). formal approving. **the quality of being detailed, careful, and complete**:  
Her arguments lacked intellectual rigor.



Vocabulary.com

<https://www.vocabulary.com> › dictionary › rigor ⋮

## Rigor - Definition, Meaning & Synonyms

Rigor means **thoroughness and exhaustiveness** — the gold standard for a good teacher. You may have heard of "rigor mortis" — which is a medical term describing ...

# Use of the word rigor (not rigorous)

Use over time for: rigor



rigor

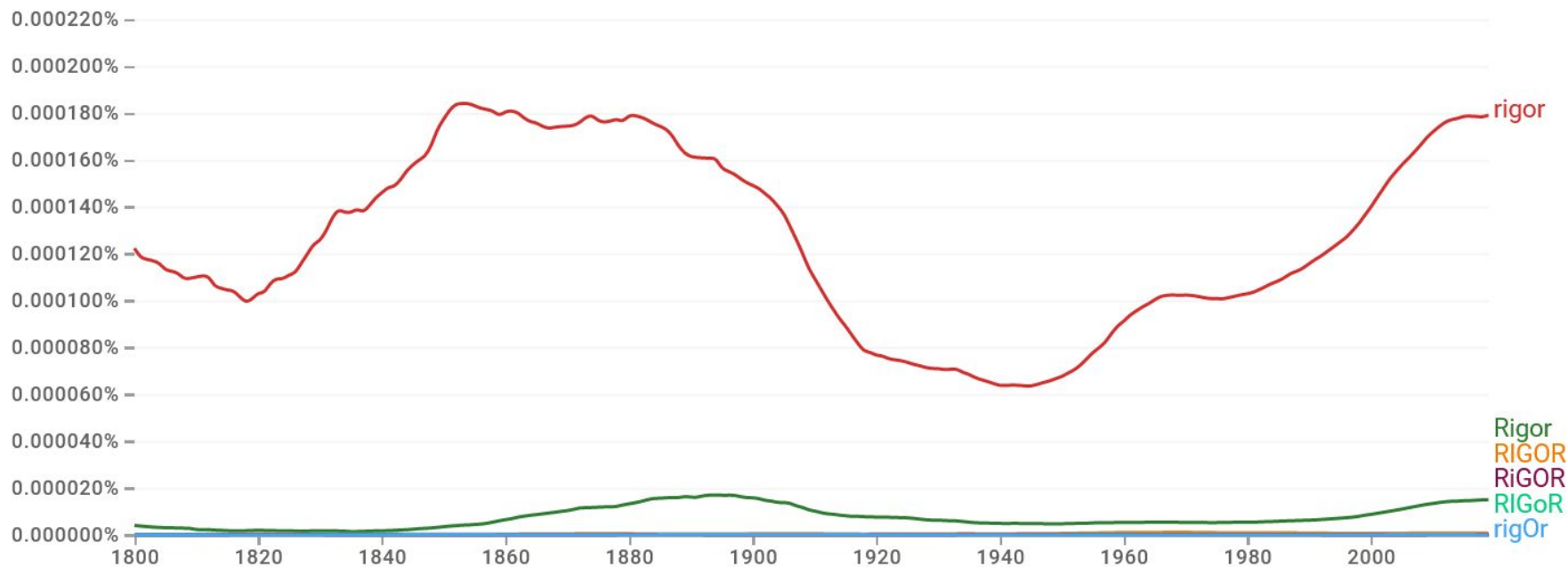
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1800 - 2019

English (2019)

Case-Insensitive

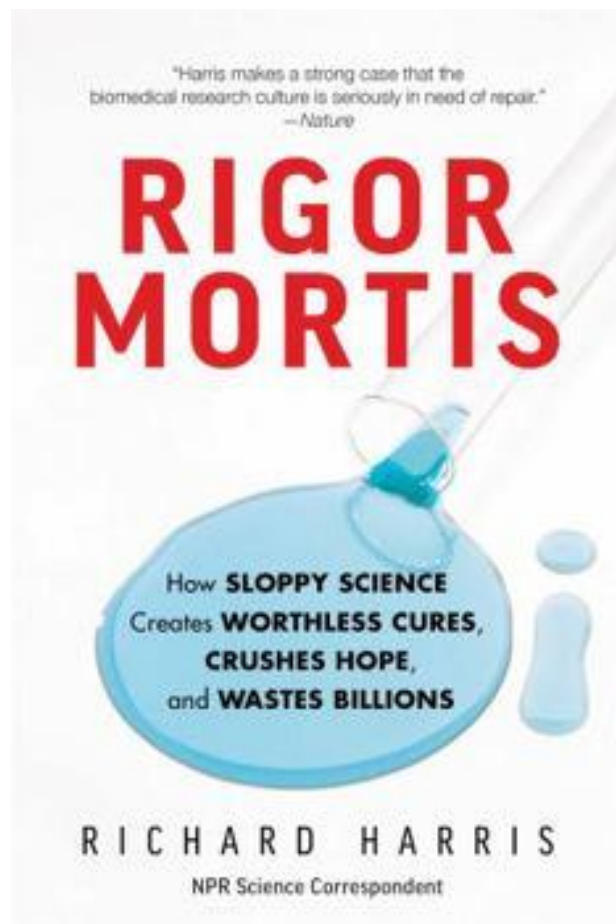
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What constitutes rigorous writing?

What constitutes rigorous science?



# What Constitutes Rigor in Mathematics?

# What Constitutes Rigor in Applied Mathematics?

# Are there parallels between rigor in pure and applied mathematics?

<b>Applied Mathematics</b>	<b>Pure Mathematics</b>	<b>Commonality</b>
Assumptions	Axioms	Assumed to be true

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Data	Lemmas	Useful information

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Model	Proof	Logical argument, techniques



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Recommendation	Theorem	Useful conclusion

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# What Constitutes Rigor in Mathematics Education?

# Rigor in Algebra I, II, Precalc, Calc, Diffeq

Ability to explain a concept from multiple perspectives:

- Symbols (such as functions)
- Graphs (other representations)
- Language (formal and informal)
- Relationships (between ideas or variables)
- Connections (with other concepts and applications)

Would you know a \_\_\_\_\_ if you met it “on the street?”

Rigor means more than correct.

(Guesses can be correct and determined through faulty logic or none at all.)

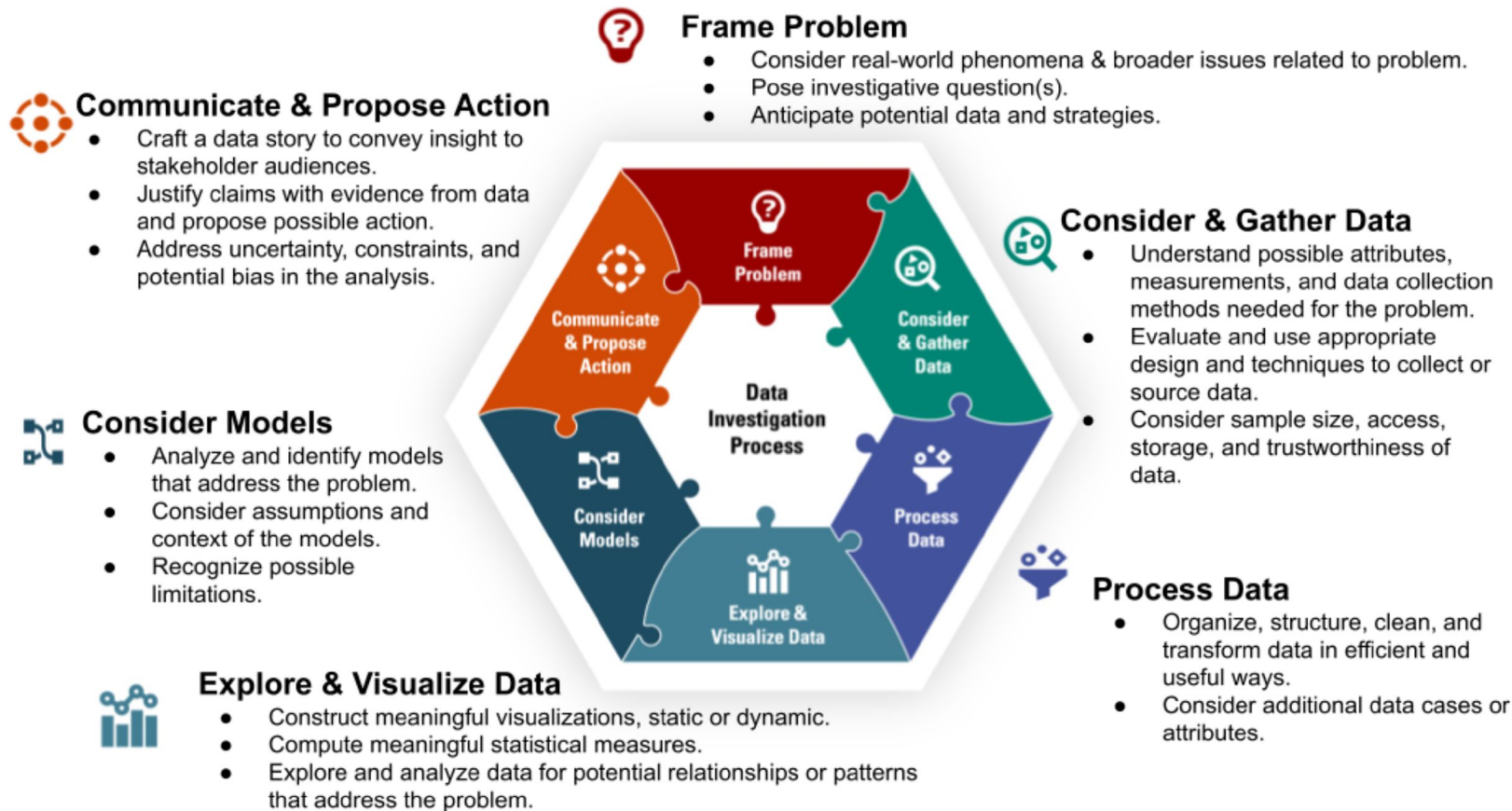
# Can something be rigorous and easy?

I think about all of the Geometry Proofs in grade school...

They seemed obvious... but they were probably also rigorous.

# What Constitutes Rigor in Data Science (Education)?





# What are hard parts of data science?

Explainability

Uncertainty quantification

Bias identification

Complexity

Transparency

Policy

# Rigor AND Relevance

## Ties into the “why”:

Why? To grow educational environments that empower learners and benefit society.

How?

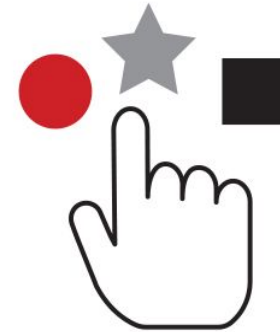
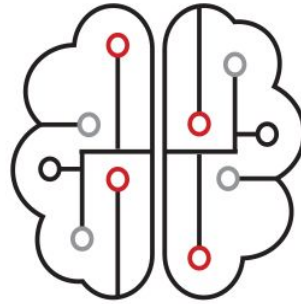
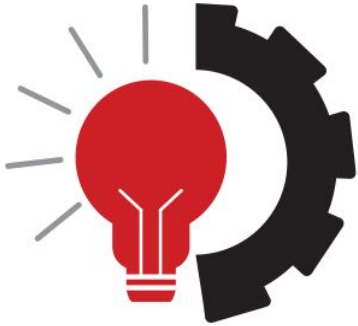


Project-based Learning | 10 Common Learning Elements | Identity-conscious Choices

# ADAPT

All-campus Data science through Accessible Project-based Teaching and learning model

# Three components of the ADAPT model



Project-based Learning | 10 Common Learning Elements | Identity-conscious Choices

# Example Course: Predictive Analytics for Improving Services

by Kristin Porter, Ph.D.

Kristin: Going back to my work experience ...

- Have we scoped this thoughtfully?
- Have we been really careful about data preparation?
- What data prerequisites are there for this to even work?
- What are all the ethical considerations?
- Who are all the stakeholders
- How are we going to explain this all?
- What is the value of what we're trying to do here?
- What are the limitations of how results are going to be used?
- How might results be used in a different way than we intended?

# Predictive Analytics for Improving Services

**Milestone 1:**  
Code of Ethics

1

**Milestone 2:**  
Data  
Summary

2

**Milestone 4:**  
Learner Specification

4

**Milestone 5:**  
Training and Validation

5

**Milestone 7:**  
Communication Plan

7

6

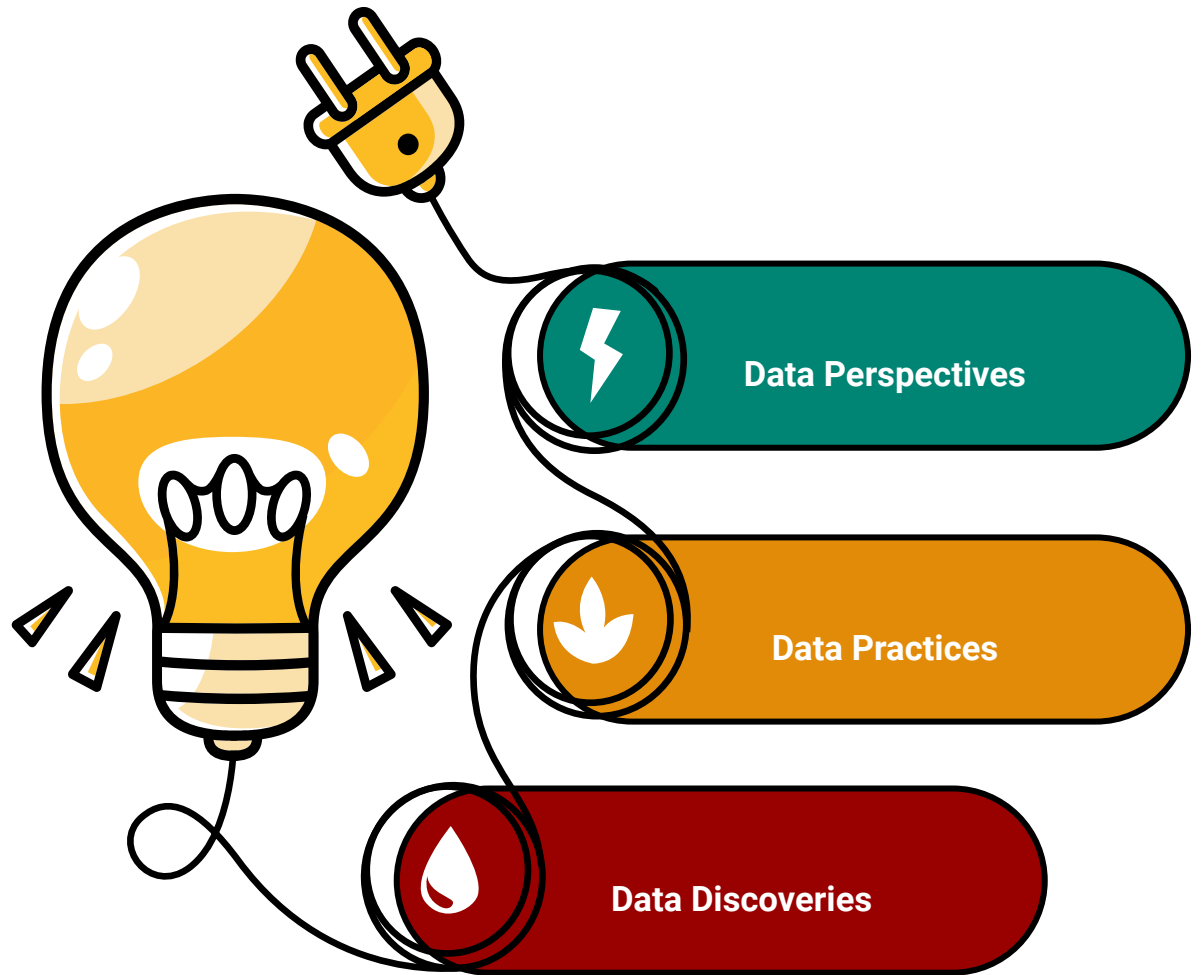
**Milestone 6:**  
Testing

**Milestone 3:**  
Data  
Preparation

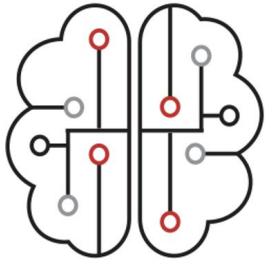
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What is the **workflow** of predictive analytic projects?

# ADAPT 10 Common Learning Elements



# 10 Common Learning Elements

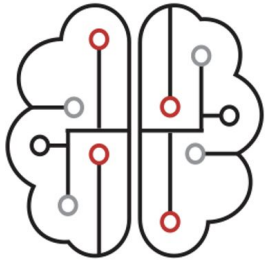


## Data Perspectives

1. Recognizing **data as information - not truth** - with error, variability, and degrees of inclusion/exclusion.
2. Explaining **what it means to be a data scientist** and data-enabled
3. Observing a **diverse** collection of data scientist **role models and careers**.



# 10 Common Learning Elements



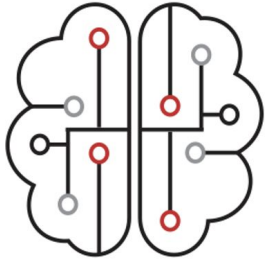
## Data Practices

4. Examining **how data are created**, and the related assumptions and collection practices.
5. Practicing during **curation, wrangling, and cleaning**.
6. Assessing **validity of data, methods, results and communication**.
7. Employing **accessibility practices**.
8. Investigating **ethical issues** and ways to approach them.

# 10 Common Learning Elements

## Data Discoveries

9. Articulating **current issues or open questions** in data science, and
10. Specifying **exciting discoveries or impacts** of data science.



# Key Ideas

## **Definitions and enactment of rigor differ by discipline.**

In some mathematical disciplines rigor focuses exactness, thoroughness and correctness.

In data science and applied mathematical sciences, it focuses on transparency, explainability, reducing error and bounding uncertainty.

# ASCD Educational Leadership (el)

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ascd  
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leadership

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www.ascd.org | \$9.95

From Math Fear to Fluency p. 28  
Teaching Climate Change Across Disciplines p. 36  
Where STEM Meets Justice p. 64



INSTRUCTIONAL STRATEGIES

## The Hidden Rigors of Data Science

Mahmoud Harding & Rachel Levy

April 1, 2024 | Volume 8 1 | Number 7

CAN STEM  
SAVE  
WORLD?  
たんえ

# THANK YOU! STAY CONNECTED

DSA Quarterly Newsletter &  
Student Opportunities Email



<https://go.ncsu.edu/dsanews>

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