



Data Science National Landscape

Implementation Throughout The States



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Our Team

Zarek Drozda

Executive Director



Zarek helped launch DS4E in 2019, co-organizing a coalition of now 1000+ education leaders to advance data science and data literacy education in K-12 schools. Zarek has worked at the intersection of applied research, data, and policy. He served as a Data Science Fellow for the U.S. Department of Education's Institute of Education Sciences (IES), where he led research on data science, artificial intelligence, blockchain, and other emerging technology education. While working at the Federal level, Zarek also advised the national COVID response, coordinating data analytics for an inter-agency team between the White House, Department of Education, and Center for Disease Control (CDC). Prior to Federal service, Zarek helped build a social impact incubator (the Center for RISC) with economist and Freakonomics co-author Steven Levitt. Zarek earned a Bachelor's degree in Economics from the University of Chicago, and loves using data to tackle complex social problems.

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Lee Ellen Harmer

Samantha Leav

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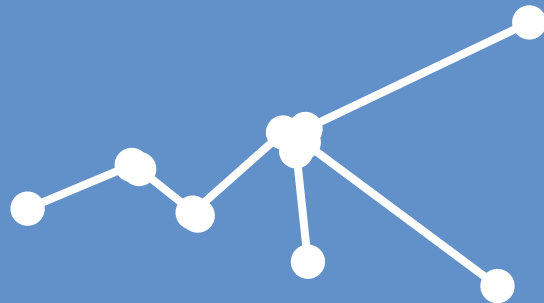
About Data Science 4 Everyone



A joint team of classroom teachers, researchers, industry, and policy folks.

Data Science 4 Everyone is a national initiative, coalition, and community based at The University of Chicago, working to catalyze the adoption of data science and data literacy as a fundamental component of K-12 education. Incubated at the [UChicago Center for RISC](#) and popularized by the 2019 Freakonomics podcast "[America's Math Curriculum Doesn't Add Up](#)," DS4E is striving to incorporate data science across school subjects and grade-levels.

International Landscape



International Efforts are Scaling Quickly

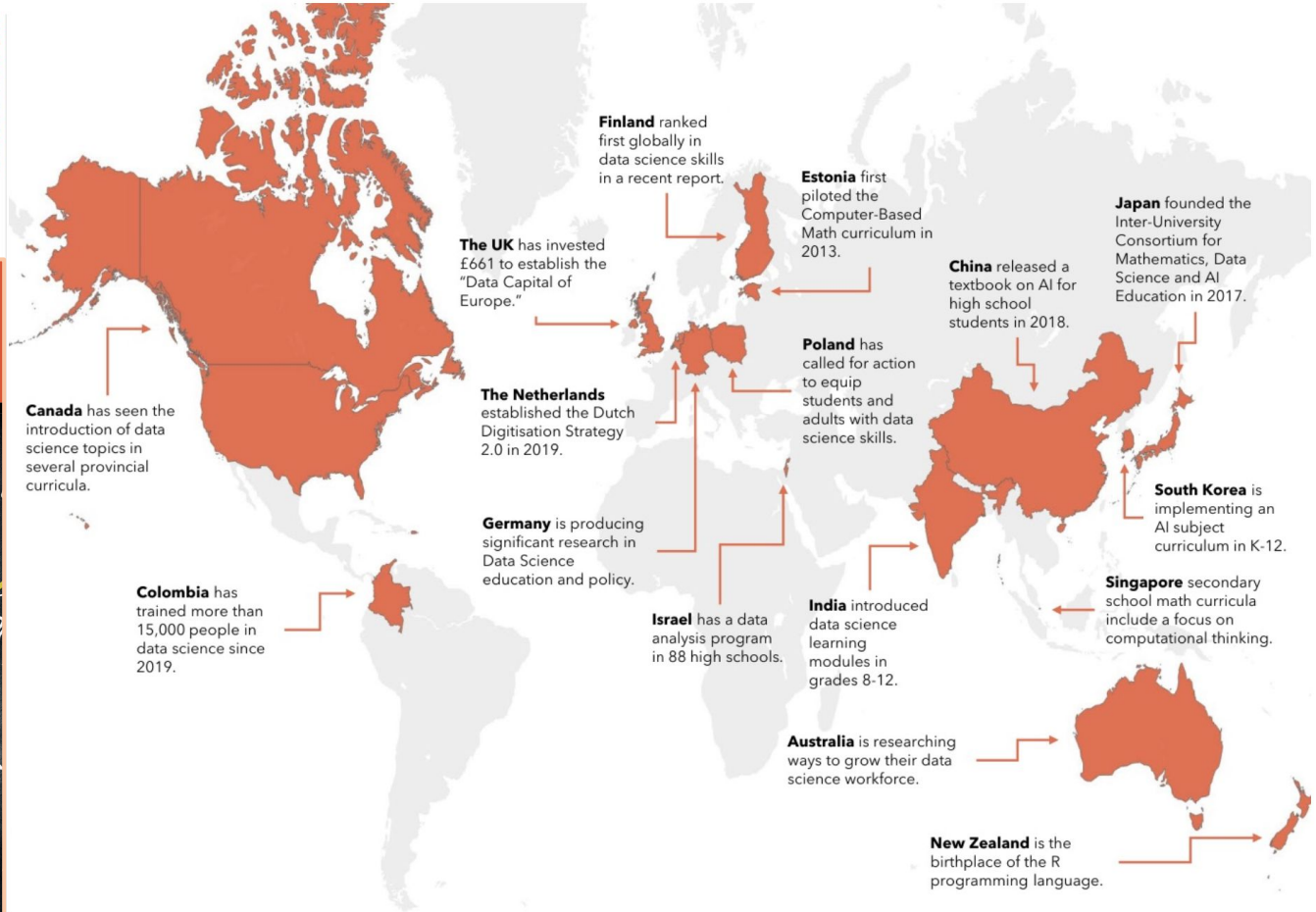
Data Science 4 Everyone

DataScience4
everyone

Beyond Borders 2024:
Primary and Secondary Data Science Education Around the World



Sean Sukol, Author
Shea Stripling, Designer
Data Science 4 Everyone



Canada



CanCode, an initiative of the 2017 Innovation and Skills Plan, funds K-12 learning and teacher professional development programs with a focus on digital skills development, including coding and data analytics.³ CanCode was extended for the second time in 2021, and by 2022, CanCode-funded programs reached over 4.5 million students and 220,000 teachers. The third iteration will distribute an additional 80 million Canadian dollars to at least 29 projects across Canadian provinces and online.⁴

Among the first recipients of CanCode funding was Kids Code Jeunesse, "a bilingual Canadian charity determined to give every Canadian child access to digital skills education, with a focus on girls and underserved communities."⁵ Kids Code Jeunesse has trained over 22,000 educators and reached more than 700,000 children through initiatives such as the Algorithm and Data Literacy Project, a partnership between the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Canadian Commission for UNESCO, and Kids Code Jeunesse's parent organization, Digital Moment.⁶ The Algorithm and Data Literacy Project's goal is to "empower kids to exercise critical thinking in how they engage online, and to become proactive, creative users and makers rather than passive consumers." Digital Moment has published a series of materials through the project to help students and educators improve their data literacy skills and understand AI. The AI Primer, Data



- evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions;
- describe specific ways to improve their investigation methods and the quality of the data
- evaluate the validity and limitations of a model or analogy in relation to the phenomenon modeled;
- demonstrate an awareness of assumptions, question information given, and identify bias in their own work and secondary sources;
- consider the changes in knowledge over time as tools and technologies have developed;
- connect scientific explorations to careers in science;
- exercise a healthy, informed skepticism, and use scientific knowledge and findings to form their own investigations and to evaluate claims in secondary sources;
- consider social, ethical, and environmental implications of the findings from their own and others' investigations; and
- critically analyze the validity of information in secondary sources and evaluate the approaches used to solve problems.

¹ Government of Canada, "Understand the Canadian education system," [Canadian Education System](#).

² Statistics Canada, "Data Science," Statistics Canada, accessed February

³ Innovation, Science and Economic Development Canada, "Canada's Innovation, Science and Economic Development Canada," February 24, 2024, [Innovation, Science and Economic Development Canada](#).

⁴ Innovation, Science and Economic Development Canada, "Funded Ca

China



Additionally, an entire semester's worth of topics related to data science was added to high school textbooks and the *Gaokao*, including an introduction to big data, distributions of discrete random variables, normal distributions, linear regression with two variables, and predictive models. In general, the new curriculum emphasized applied math and the use of real-world data. For example, students learned about estimating populations using samples through case studies that asked them to estimate the number of tanks in Germany between WWI and WWII and the prevalence of obesity in American office workers. The Beijing *Gaokao* in 2021 and again in 2022 included questions related to statistical analysis, hypothesis testing, probability, and data analysis.

The paramount importance of the *Gaokao* in the Chinese education system cannot be overstated: unlike the holistic admissions systems common among US universities, the *Gaokao* represents the single criterion for admission for Chinese students. Almost twelve million students took the 2022 *Gaokao*; fewer than 7,000 enrolled in China's top two universities, and fewer than 60% of Chinese students enrolled in tertiary education in 2023.² Undergraduate data science programs are the bridge between the skills taught

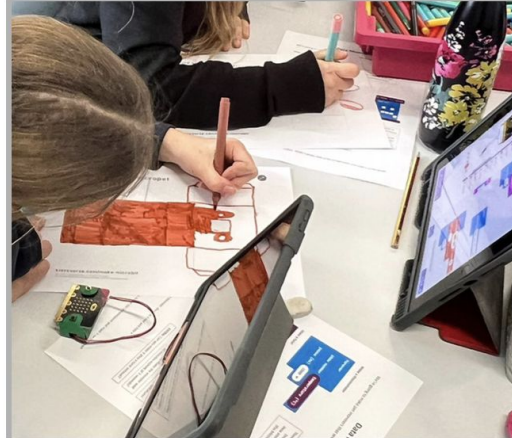
in secondary school and postgraduate study or employment in data science fields. A central feature of the Ministry's strategy has been the remarkably rapid expansion of university-level courses of study in data science topics. In 2016, only three higher education institutions in China offered the Ministry-approved undergraduate major "Data Science and Big Data Technology"; by 2018, that number rose to 250.³ In 2019, the Ministry licensed 35 universities to offer AI as a newly approved undergraduate major; by 2023, 150 colleges and universities offered AI-related programs.⁴ China's national policies emphasize multi-stream investment in AI research and development, including funding for university research centers through the "Bases and Talents" programs and public-private partnerships such as regional "guidance funds."⁵

1 Feng, April, "Memo: Data Science in Chinese Schools, Google Docs, acc High Schools.

2 CGTN, "Explainer: Why the Gaokao is China's most important exam," acc China's most important exam.

3 Jilong Zhang, Anna Fu, Hao Wang, and Shenqin Yin - The Development

The United Kingdom



spending over 15 years.¹ The Deal includes £25 million for the development of career pathways in key sectors and up to £661 million for a Data-Driven Innovation program to “establish the region as the Data Capital of Europe.”² The program is hosted primarily by the University of Edinburgh and intends to assist 100,000 people in obtaining a data-science certification or qualification by 2033.³

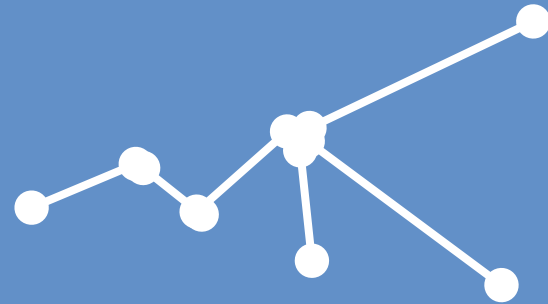
The program’s Data Skills Gateway includes discrete initiatives for data science education and upskilling in schools, colleges, universities, and the workplace. Data Education in Schools, the Gateway’s K-12 initiative, provides materials for the study of the National Progression Award in Data Science, a national course by the Scottish Qualifications Authority.⁴ The course first became available in 2019 and is available for both schools and colleges.⁵ The Award requires competencies in fundamental data science concepts and “data citizenship,” including data literacy and social responsibility, with the option to study statistics, computer programming and machine learning in more depth.⁶ Data Education in Schools also provides professional development workshops and classroom and lesson plan resources for data science teachers.⁷

“Data literacy shouldn’t be an Excel training course — it should be creative and engaging, showing learners how they can use data for social good to make a real difference. The problems learners solve don’t need to be dry or dull — instead they can pretend to be secret agents finding the evil villain’s secret lair using datasets to narrow down the possibilities!”

Kate Farrell

**Director of Curriculum and Professional Learning
Data Education in Schools**

US Economy Landscape



Growth and Proliferation of Selected Skills

Skill	% Occupations Featuring Skill	Actual Skill Growth (2019-2022)	Wage Premium
Algorithms	8.9%	-6.3%	12.3%
Analytics	11.5%	4.6%	10.9%
Artificial Intelligence	14.2%	62.2%	16.9%
Big Data	5.5%	-29.7%	15%
Business Intelligence	9.1%	-2.1%	14.8%
Business Metrics	12.1%	11.6%	11.8%
Data Acquisition	6.6%	-0.5%	1.9%
Data Analysis	59.9%	17.7%	6.1%
Data Collection	55.4%	18.9%	N/A
Data Governance	1.9%	30.8%	14.1%
Data Integrity	9.6%	-0.1%	2.3%
Data Quality	6.0%	4.3%	5.4%
Data Recording	20.8%	31%	N/A
Data Science	10.2%	34%	11.4%
Data Structures	2.8%	-2.5%	7.8%
Data Visualization	9.3%	33.5%	9%
Data Warehousing	4.0%	-17%	8.9%
Machine Learning	13.0%	31.7%	16.9%
Statistical Analysis	12.5%	2.6%	N/A

Skill Analysis: Refined Search Terms

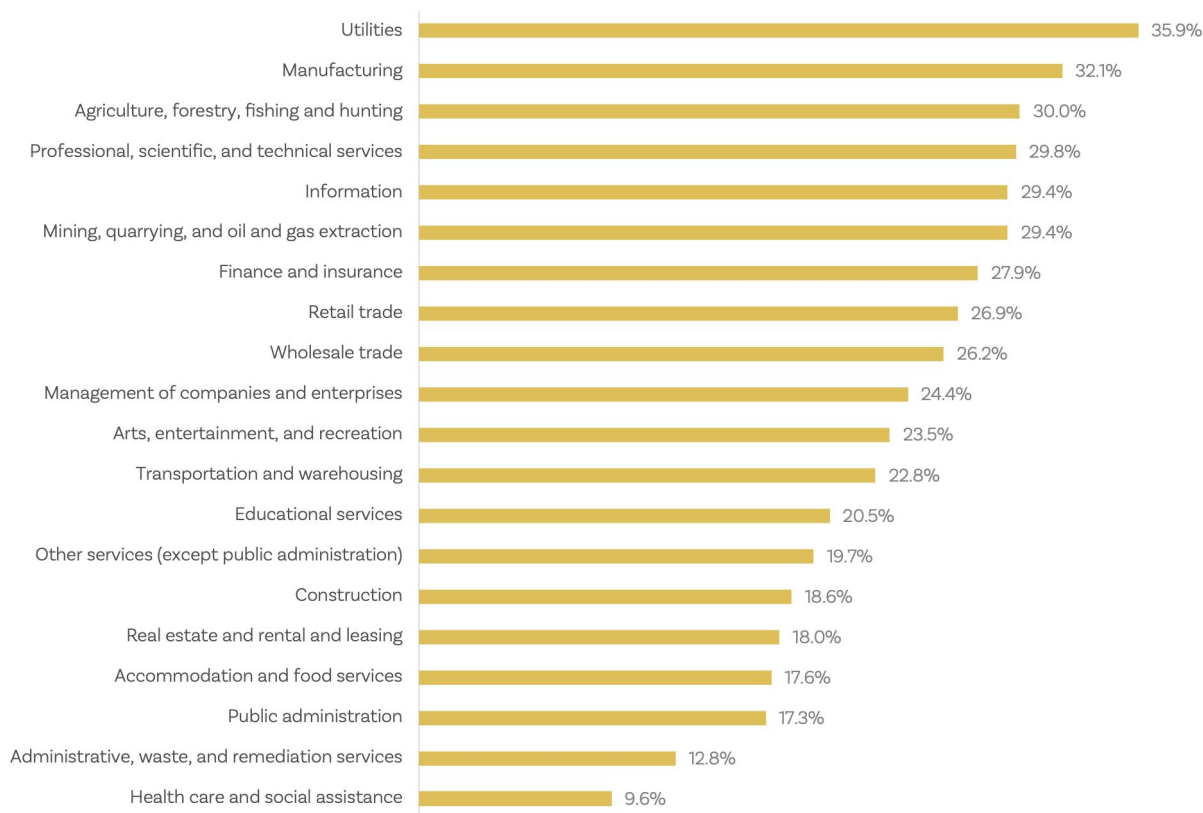
FIGURE 1 – Data science skill analysis framework. Source: Burning Glass Institute

Getting the Data			Communicating Results
Data Collection + Data Quality + Data Ethics + Data Recording + Data Acquisition + Data Collection	Data integration + Data validation + Data structures + Data processing + Data architecture + Data cleaning + Data manipulation	Data management + Data privacy + Data security + Data governance + Data migration + Data integrity + Data warehousing	+ Data presenting + Data writing + Interpersonal communication
Exploring and Analyzing the Data			
Business data strategy + Business intelligence + Business metrics + Data strategy + Data literacy	Statistics and mathematics + Mathematics + Statistical analysis + Statistical modeling + Statistical reporting + Statistical methods	Analyzing trends and prediction + Analytics + Data science + Data analysis + Quantitative research + Forecasting + Big data + Artificial intelligence + Algorithms + Machine learning + Data visualization	Data software + Programming language + Statistical software + Business intelligence tools

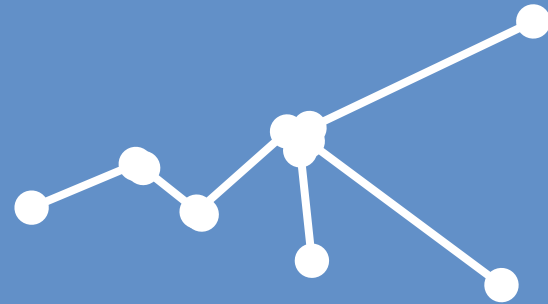
Skill Analysis: Refined Search Terms, by Sector

FIGURE 5 – Share of job postings listing at least one data science skill as a share of all job ads in the industry, 2023

Source: Burning Glass Institute analysis of Lightcast posting data

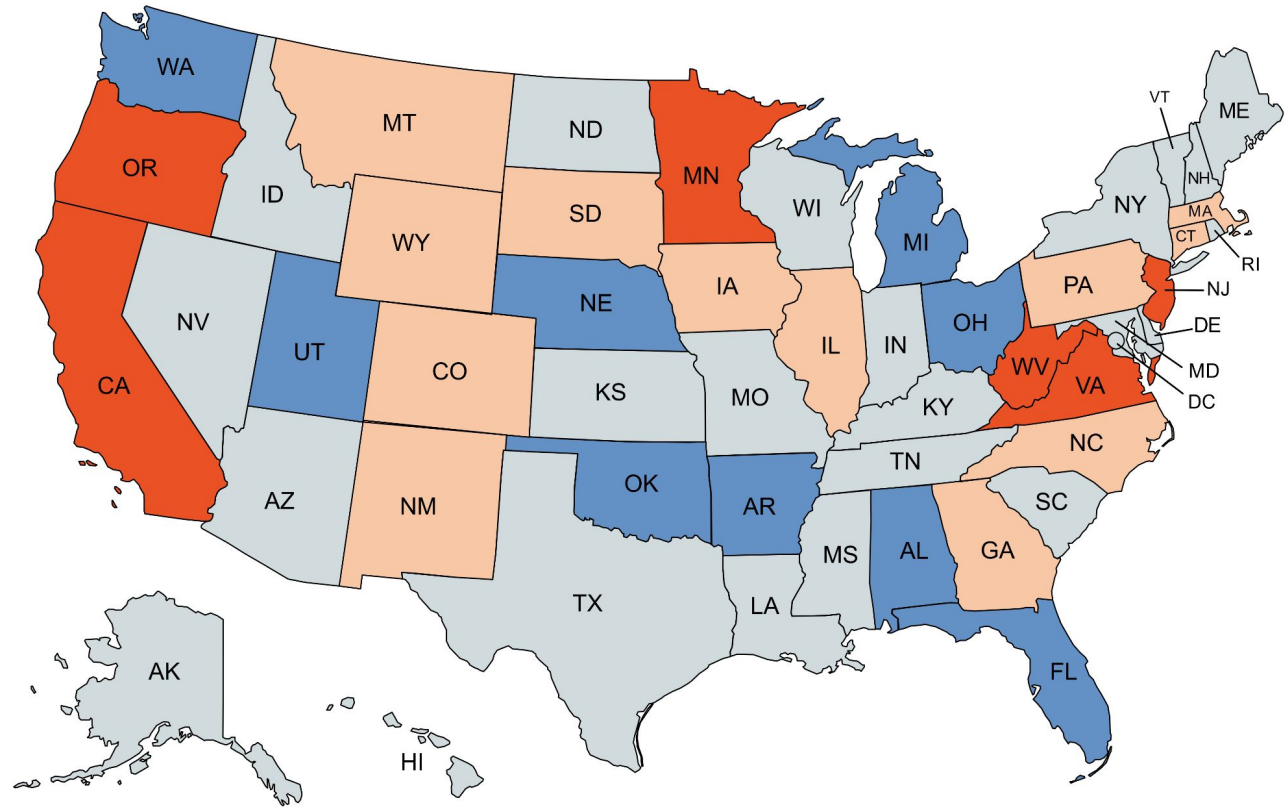


US Policy Landscape

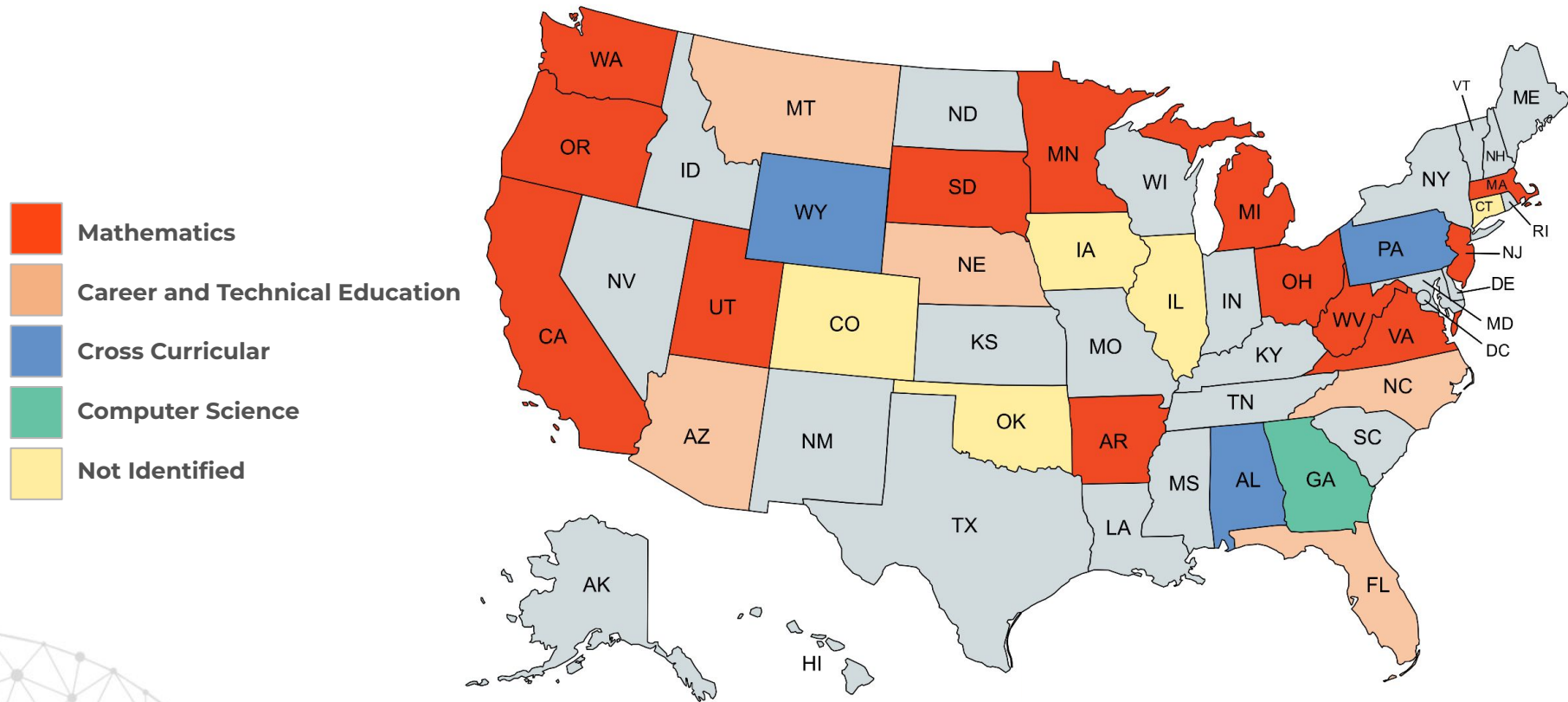


Data Science State Implementation Tiers

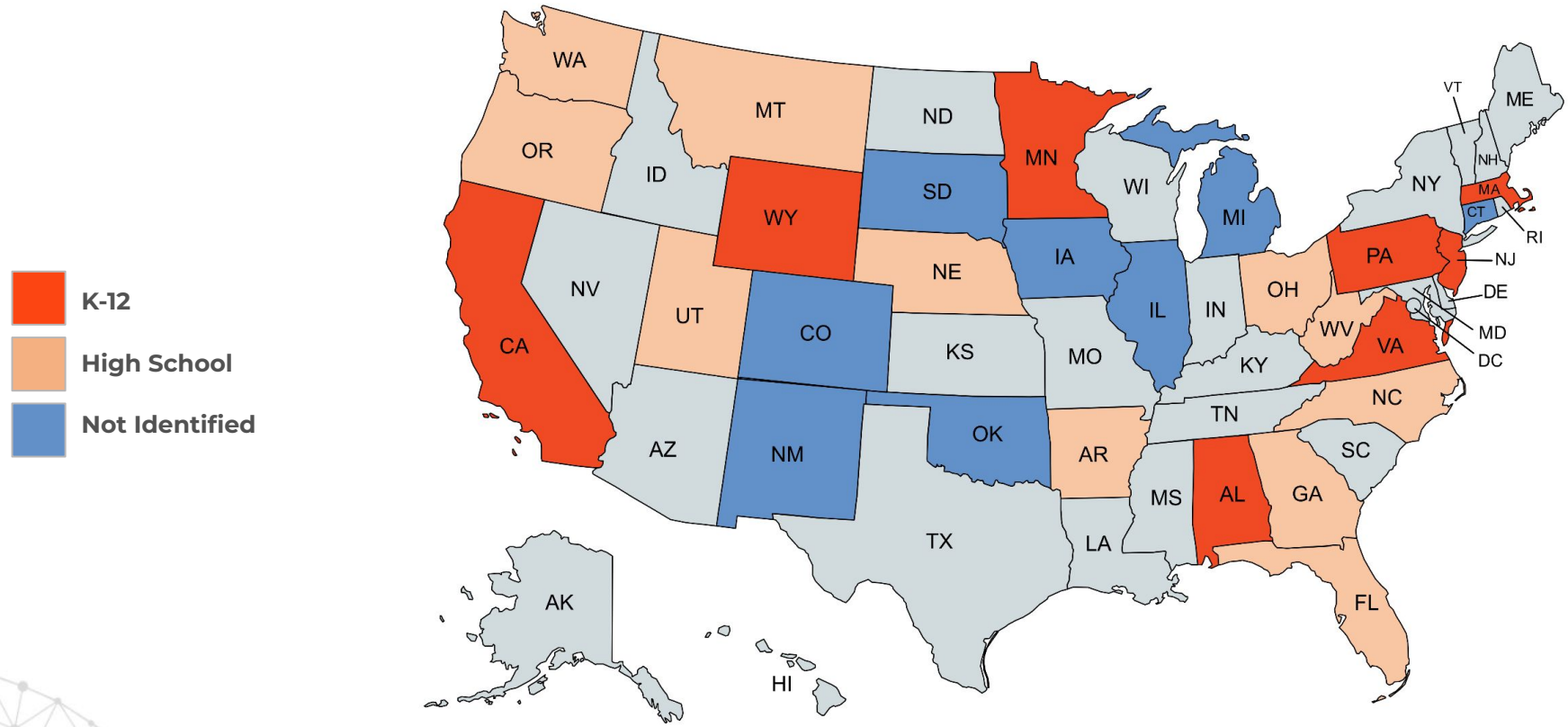
-  Tier 3 - Standards or Framework Adoption
-  Tier 2 - Course Pilot, Course Sequence or Teacher PD
-  Tier 1 - Added to State Course Catalog



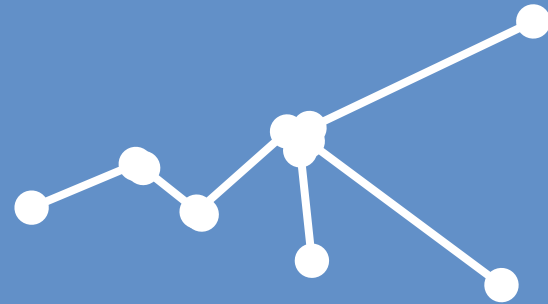
Content Area Implementation



Grade Band Implementation



Implementation Data



Course Catalogs and Enrollment

Forum Guide to Understanding the School Courses for the Exchange of Data (SCED) Classification System



School Courses for the Exchange of Data ([SCED](#)) is a voluntary, common classification system for prior-to-secondary and secondary school courses. It can be used to compare course information, maintain longitudinal data about student coursework, and efficiently exchange course-taking records. SCED is based on a five-digit Course Code that provides a basic structure for classifying course content. Additional SCED elements and attributes provide descriptive information about each course.

SCED 10.0 - 11.0

22 Miscellaneous

SCED 12.0

25 Integrative Learning

25 051

Data Literacy

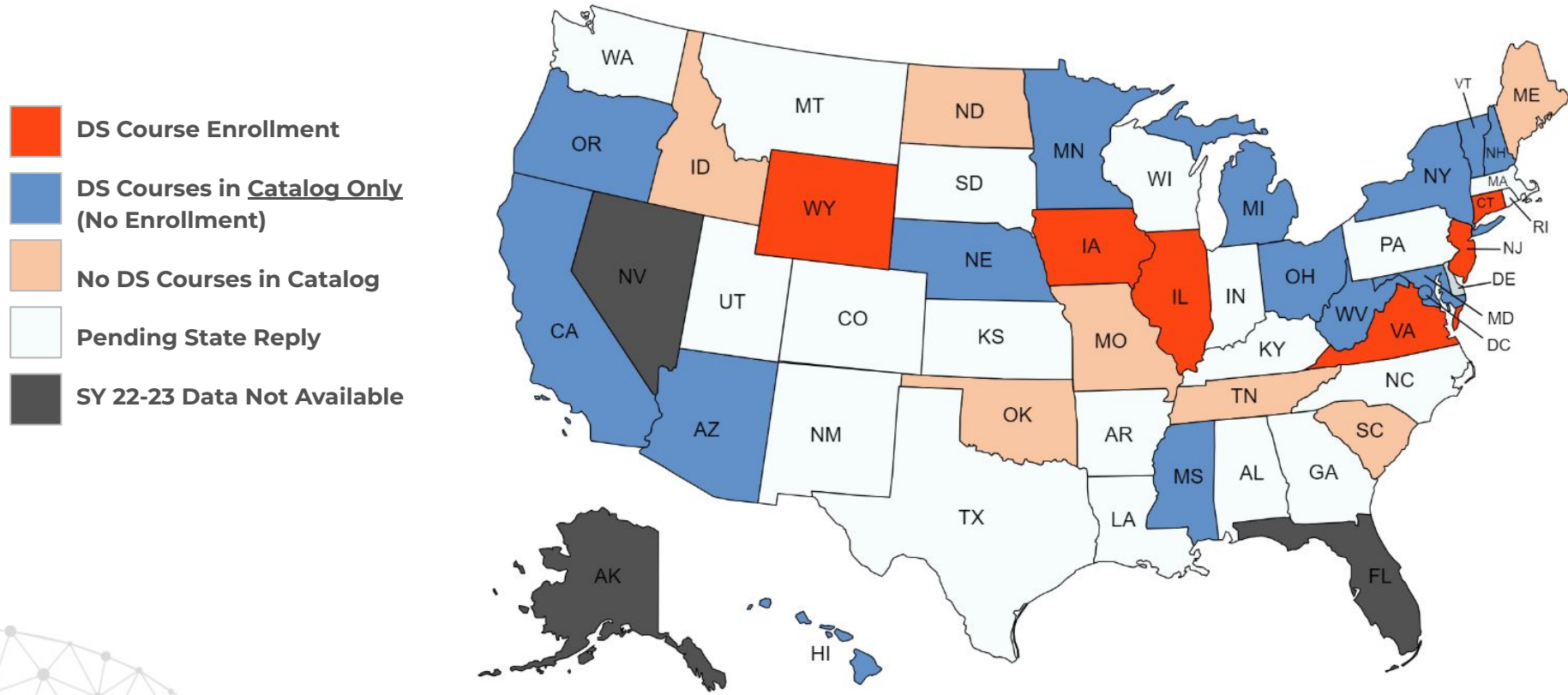
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Data Science

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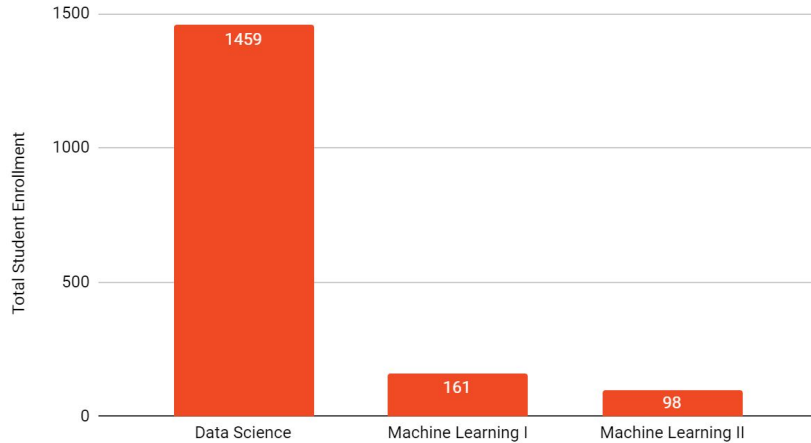
Data Science Applications

Course Catalogs by State

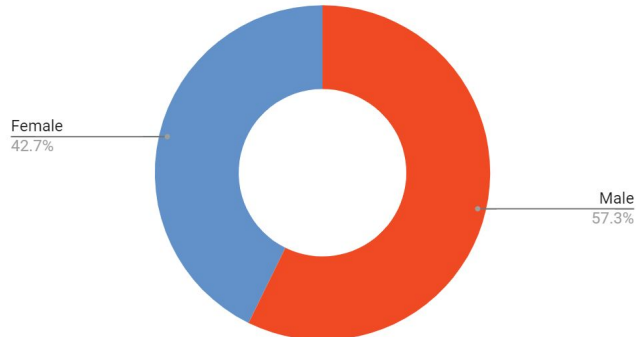


SY 22-23 Virginia Course Demography

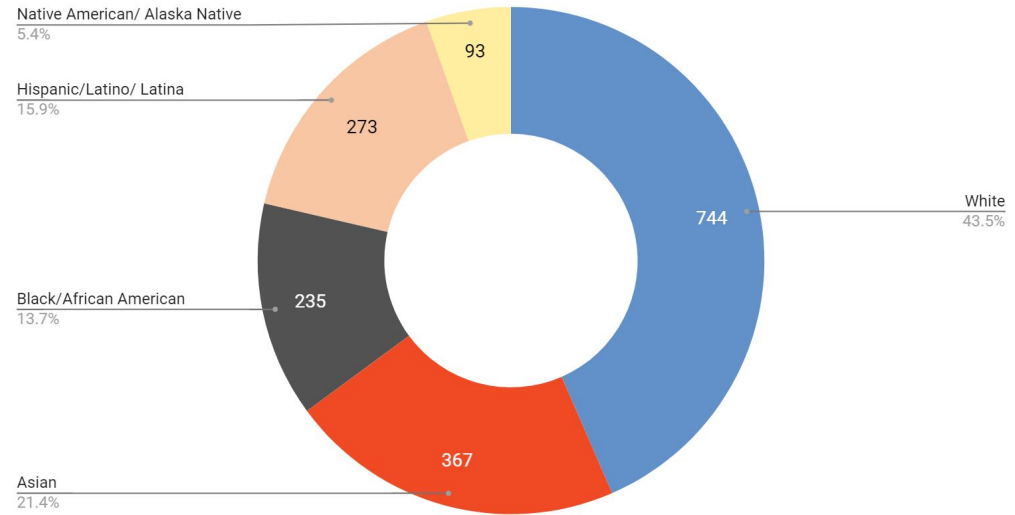
Enrollment by Course



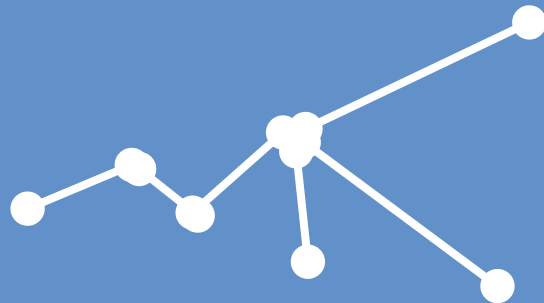
Total Enrollment by Gender



Total Enrollment by Race/Ethnicity



State Exemplars



Oregon

2 + 1 Mathematics Model

2022

The Oregon Math Project 2+1 Model was released as an official update to state standards and learning guidelines for districts statewide.

The model specifies that all students learn a full year of Algebra, a semester of Geometry, and a semester of Data Analysis before 10th grade. In the 12th grade, students are able to select from multiple mathematics course sequences, which includes a two-course pathway for data science and statistics and/or AP statistics.

Virginia

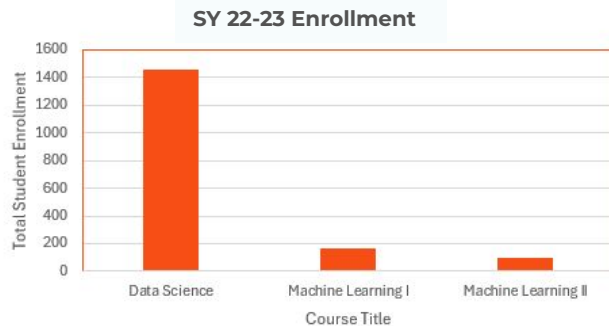
Data Science Standards, Math

2022

Virginia became the first state in the country to develop dedicated standards for a data science high school course. The standards were created through a multi-year effort through collaboration from the Virginia Department of Education, local school districts, state industry partners, higher education partners, and other stakeholders. These standard have been formally added to the mathematics standards.

SY 22-23

Virginia Department of Education approved and began implementing a full year course pilot for a high school data science course.



West Virginia

Data Science Standards, Math + CS

2023

West Virginia Department of Education developed standards for a standalone data science course.

These were created in collaboration between mathematics and computer science educators. The course is an exemplar example of fusion of mathematics and computer science content.

Arkansas

Career and Technical Education + Math

2019

Arkansas Department of Education developed a new three-course high school program for Data Science that can fulfill both CTE and mathematics credits.

These were created in collaboration with the University of Arkansas and local industry to meet the needs of the workforce and employers who are seeking stronger technical skills from high school graduates.

Washington

Modernized Algebra II

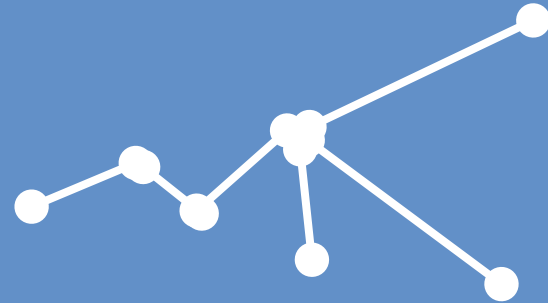
2022

Washington Office of Superintendent of Public Instruction began work to design a modernized Algebra II course that would integrate data science, mathematical modeling, and financial literacy into the standards content for all students.

The course design was in collaboration between OSPI, state higher education partners, and local industry.

DS4E

2024 Roadmap



Mapping Efforts on Data Science & AI Education

K12 DSE Framework Roadmap		2023												2024												2025																							
Driver	Effort / Outcome	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec												
National Academies	Data + Computing Consensus Study										Planning			Committee Meetings					Comisioned Papers Process				Report Draft						Report Review			Release + Briefings																	
	Data + Computing Consensus Study																		Public Input / Presenting Speakers				Other Speakers																										
NCTM	Position Statement: Required Math in DS	Review Groups			Writing						Review		Release																																				
NCTM / NSTA / NCSS / CSTA / etc.	Position Statement: DS = Integrated in K-12 Subjects	ZD connect <- Kevin / NASEM								Review Groups				Writing				Review				Release																											
ASA	Position Statement: Role of Stats in DS + AI	TBD																																															
ADSA	Ramps & Pathways Report	TBD																					Finalizing																										
ASA / CBMS	SETS II Creation									Planning Meetings				? ? ?																																			
CBMS	METS II Update	TBD																																															
CSTA	CS K-12 Framework Update												Drafting				Release								Writing Committee Forms				Working Groups				Drafting																
TeachAI	Guidance for CS in Age of AI												Drafting				Release																																
AIAK12	AI Updates												A A		A A																																		
TeachAI	AI Literacy Framework (on hold)									Drafting								Release																															
CTE Framework	Career Clusters Revision									Drafting								Release																															
DS4E / Concord Consortium	Research-Practice Working Groups	Expert Meetings + Lit Review				Paper Writing				Review Rounds				Release																																			
Concord Consortium	NSF Learning Progression Research Framework	Steering Committee for DS NSF Workshop								NSF Workshop				Summary Report				Release																															
DS4E	SBOE Guide for States and Districts									Internal Team Prioritization				Release																																			
DS4E	DSE Learning Progressions (beta)																	Website Build				Website Uploads				Beta Release				Public Release																			
	Curriculum / Content Providers													Design Session Focus Groups				Summaries				Cross-Group Review								Community Review																			
	Professional Societies (educator)													Design Session Focus Groups				Summaries				Cross-Group Review								Community Review																			
	Professional Societies (policy)													Design Session Focus Groups				Summaries				Cross-Group Review								Community Review																			
	Industry Advisory													Design Session Focus Groups				Summaries				Cross-Group Review								Community Review																			
	Math Faculty / Higher-Ed													Design Session Focus Groups																																			
Student Achievement Partners	XQ Math Badging Framework (DS)													Design Session Focus Groups				Summaries				Review				Badging Design + State Feedback				Beta Release				Public Release															
DS4E / Concord Consortium	DSE-K12: Research to Practice Conference													Launch Collective												DSE Annual 1																							
DS4E + NCTM	Subject Specific: Math - NCTM																																					Design Session Focus Groups				Review							
	Subject Specific: Science - NSTA																																					Design Session Focus Groups				Review							
	Subject Specific: Social Studies - NCSS																																					Design Session Focus Groups				Review							
Concord Consortium & Research Con	Research Conference Dissemination (ISLS, AERA, NARST, ASTC, AMTE etc)											ISLS Proposals		ASTC P		AMTE		AERA/NARST		AMTE P		ISLS		AERA P		NARST Proposal		ISLS P		ASTC		ASTC P		AMTE		AERA/NARST		AMTE P		ISLS		AERA P		NARST Proposal		ISLS P		ASTC	

Data Science Learning Progression - Draft Plan

	2024				2025				2026
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Core DS Framework	Focus Groups		Writing	Build	Beta Release				
			Public RFI Period						
Subject-by Subject					Subject Articulation Groups (Math, Science, Social Studies)		Writing	Build	Release

Focus Groups Phase I:

- Curriculum providers (CP Network)
- Industry
- Higher-Ed (Mathematicians et al.)
- Higher-Ed Data Science (**ADSA**)
- Students (college / undergraduate)
- Policy - State Subject Leads
- Teacher-Educators - Math, Science, Social Studies (**AMTE**)
- Teachers - Math (**NCTM**)
- Teachers - Science (**NSTA**)
- Teachers - Social Studies (**NCSS**)
- Teachers - Computer Science (**CSTA**)
- Teachers - English (**NCTE**)

Data Science Learning Progression - Draft Plan

Three goals:

1. **Identify Priority Learning Outcomes** (+ measure differences)
2. **Identify Design Recommendations** for the format & aligned resources to the progressions
3. **Socialize that this work** is happening broadly, and identify volunteers / leaders for future work across sectors



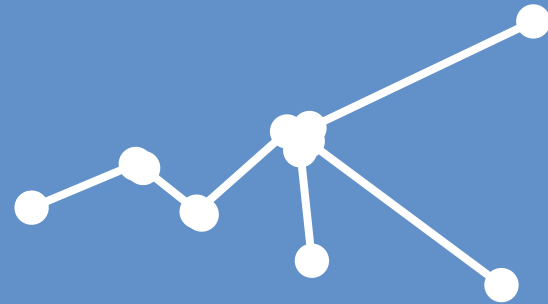
Prompt

A single question:

“If a hypothetical high school exit exam about data was given in 2030, what should be covered?”



Focus Group Results



Focus Group Results: Ranked Outcomes

"If there were a hypothetical high school exit exam about data in 2030, what should be covered?"	Out of 10
Content Outcomes	Total
Be able to conduct an Exploratory Data Analysis including identify, collect, organize, interpret, visualize and predict with data and be able to exploratory data analysis, and basics of data process design or building comfort with a dataset	8.1
Being Data Literate and having the ability to interpret and analyze various presentations of data from others across subjects / disciplines in daily life or media , including textual, numerical, and visual data, and be critical, cautious, curious.	7.1
Understand data visualization methods and their importance, including to recognize appropriate ways to visualize data according to their types and interpret them to identify trends, patterns, etc	6.1
Understand statistics through simulations and intuition for re-sampling methods, (beyond the "famous formulas") including the effects of outliers or other features	5.4
Algorithmic Thinking Skills: Be able to recognize patterns, decompose problems, algorithmically think and abstract from computation or technology	5.1
Carry out basic probabilistic calculations/interpretations and apply them to actual situations (in games of chance, medical judgements, etc.)	4.0
Understand biases in data-based conclusions and the ethical issues surrounding those	3.9
Demonstrate responsible data collection approaches -- data sheets for data sets, other ethical considerations	3.7
Know various ways to story tell with data including the visualization of data, including intentional design for an audience and using clear models for story telling	3.6
Understand that domain knowledge should guide data analysis for most real world problems , and build comfort interfacing with disciplines where data comes from: how can you find that info? what do you need to know quickly? What do you need to ask an expert about?	3.6

Higher Education:

10 faculty

4.5 mathematics

2.5 computer science

1 bio-engineering

1 bio-informatics

1 political science

Focus Group Results: Ranked Outcomes

"If there were a hypothetical high school exit exam about data in 2030, what should be covered?"	Out of 10
Content Outcomes	Total
General Data Literacy: Understanding types, sources, ethics, and the importance of data in various contexts	19
Communicate results / effective storytelling from data analysis for decision-making.	10.5
How to ask questions about data / identify questions for data analysis	7.5
Ethical use of data - analyzing and interpreting data, using a responsible approach, and being able to articulate possible implications of the use of data	6.25
Be able to critically consider data presented in the media and other life contexts - such as the doctor's office.	6.25
Demonstrate competency in working with numerical information by critically analyzing quantitative information, generating ideas that are supported by quantitative evidence	6
Drawing conclusions from data (confounding and causal inference)	4.75
Identify and characterize relationships between things and trends	4.5
Data Visualization: Principles of visual data representation, using tools like Tableau or Power BI., storytelling	3.5
Programming for Data Analysis: Basics of Python or R for data manipulation, analysis, and visualization.	5.5

Data Science Specialization

12 program directors from around the country, representing community college and 4-year undergraduate programs in data science, with a focus on incoming students

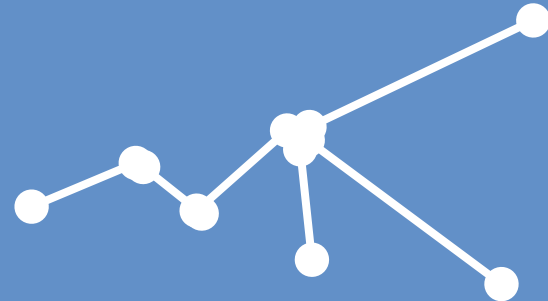
Focus Group Results: Ranked Outcomes

Math Educators

12 math educators from around the country, representing different states, schools, and districts

"If there were a hypothetical high school exit exam about data in 2030, what should be covered?"	Out of 10
Content Outcomes	Total
Tool selection: Effectively and efficiently use appropriate tools to collect, store, visualize, and analyze data (tool selection) (no willy-nilly tech use)	12
Use and interpret appropriate data to inform decisions, support and evaluate claims, and create solutions to local and/or global problems (i.e. to current events, community challenges, social justice, race / culture, or other advocacy).	11.5
Telling a story with data: Students are able to visualize and analyze, and then effectively communicate results to a selected audience based on the data	11
Determine the validity of data source AND the data analysis , including the collection methods, intent of data collection, and identifying possible sources of bias (validity = "unbiased") in analysis	11
Ask good questions and gather / collect data to answer them	10
Students can create multiple types of data representations , and how to create those different visuals (spreadsheets, graphing software, etc.) (transition from spreadsheets to other tools), and be able to explain which is the most useful / problem / use-case at hand	9
Students will know how to implement modeling techniques and know the limitations of the chosen modeling techniques (linear regression vs. other types, descriptive vs. predictive)	8
Develop and design an analysis plan (up-front) to approach the problem-solving process	7.5
Apply sound, ethical, legal, professional, and security measures while conducting statistical investigations	5
Cleaning data: how to validate quality, missing data, etc.	4

One more thing...



Practitioner Literature Reviews: Forthcoming

Topics:

- Learning Progression Design
- Assessment Design
- Educator Professional Learning
- Technology Access & Transfer
- Informal & Out-of-School

