Mindset Math × Data Science: A Formula for a Multidisciplinary Framework in Math Instruction

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Mindset Math

Abstract: The recent expansion of the data science field has inspired educators and policy designers to question the effectiveness of traditional models for mathematics. In this paper, Mindset Math introduces an initiative based on a hybrid model of data science and traditional educational algebraic curricula built upon the success of previous projects. Highlighting the diverse use of Artificial Intelligence (AI) in career and technical fields, Mindset Math aims to use data science's multidisciplinary properties to supplement the growth of data literacy and quantitative analysis abilities.

Key Words: Data Science, Artificial Intelligence (AI), Data Literacy, K-12 Education, Equity, Curriculum Reform, Inquiry-Based Learning, Student Engagement

Introduction

Mathematics education has been the topic of much discourse largely because the structure of common curricula neglect evolution alongside the development of technology. Pamela Burdman, an educational policy analyst and college success strategist, highlights the education system's use of outdated tactics and lack of diversification. She states that much of its curriculum is unengaging and derived from policymakers who are often distanced from day-to-day classroom realities (Burdman, 2025). The development of skills in basic data interpretation and statistical analysis are not as emphasized as the age of the internet requires. Due to the substantial volume of information that is provided and freely accessible, the applications and relevance of data literacy is increasing. However, the traditional algebraic-centered course model has remained largely without proper integration of data science topics because of outdated teaching methods and a lack of resource consolidation.

The lack of foundational knowledge in data interpretation can increase vulnerability to misinformation in seemingly credible data. A prime example is p-hacking, the practice of making a non-significant p-value appear more or less significant by adjusting the data (Frost, 2023). P-values are statistical measures that help researchers determine the strength of the evidence and how likely the differences or patterns in data happen by random chance. While p-values can be considered a deeper statistical concept, subsequent results and information can be misleading to the general public, specifically those without strong data literacy. Without learning how to comprehend and infer proper conclusions from statistical or analytical measures, many children, teens, and adults use statistics to support claims without fully understanding the critical information behind the numbers, unaware of key factors such as sample size, confounding variables, or significance levels.

Mindset Math

Mindset Math is an organization founded by high school students frustrated with the rigidity of STEM subjects in K-12 schools and lack of accessibility to creative and intuitive math lessons. As lessons are reduced to formulas and procedures, there is an undue emphasis on speed and correctness rather than fostering curiosity and deep understanding. This approach discourages students from exploring the complexity of mathematics and science, leading to widespread anxiety and disengagement regarding foundational mathematical concepts. Mindset Math serves K-12 students with a focus on reaching underserved communities, and the organization is committed to addressing educational inequality by ensuring that children of all socioeconomic status have access to quality STEM education using a four-step approach:

1. **Curriculum Design**: Create research-backed, engaging curricula that emphasize problem-solving, critical thinking, and interdisciplinary connections. Incorporate real-world applications and hands-on activities to make learning meaningful and enjoyable.
2. **Implementation**: Bring programs to students through after-school clubs, tutoring initiatives and partnerships with other educational nonprofits. Volunteers work directly with students to provide personalized instruction and mentorship.
3. **Evaluation and Refinement**: Continuously assess the effectiveness of programs by gathering feedback from students and educators. This iterative process allows refinement of curricula and teaching methods to better meet students' needs.
4. **Scaling and Resource Sharing**: Expand reach by making curricula freely available to educators and nonprofit organizations. By sharing resources, more teachers are able to adopt innovative teaching strategies in their own classrooms.

Mindful Mathletes

Inspired by Stanford Graduate School of Education professor Jo Boaler's *Mathematical Mindsets,* the Mindful Mathletes program fosters the growth of arithmetic abilities, problem-solving skills, and positive attitudes in the math education of children grade 4-8. The program aims to nurture students' growth and mathematical mindsets—positively shaping their beliefs about their math abilities and their relationship with math using psychology topics and additional optional kinesthetic reinforcement.

Around the World In 80 Math Problems

Guided by mentors from the National Math Foundation (NMF), *ATWI80MP* is a high school leadership and multisensory math instruction training program that focuses on integrating kinesthetic learning in math instruction. Providing a platform for high schoolers to exercise and strengthen their pedagogical skills, creativity, and leadership, the creation and implementation of movement-based teaching resources ("Activity Guides") support students' competencies and attitudes towards mathematics in a distinctly positive way. *ATWI80MP* encapsulates the iterative process of coalition building in the contexts of history, biology, computer science, and other fields to give back to a larger community.

Data Science Initiative

In 2021, The National Center for Education Research (NCER) facilitated a panel to discuss data science education and produced five objectives for the advancement of curricula (Drozda, 2021). Interpreted and framed by Mindset Math's objectives, NCER's goals are:

1. **Articulate the Developmental Pathway**: Define pedagogy for data science in K-12 including extent of interdisciplinary relations and appropriate lesson content.
2. **Assess and Improve Data Science Software**: Determine suitability of data science tools according to factors such as education and allocation of resources to decrease terminology or technology based issues.
3. **Build Tools for Measurement and Assessment**: Advance current evaluation methods to recognize satisfactory growth and account for student identities and the curriculum's long-term outcomes.
4. **Integrate Equity into Schooling and Educational Systems**: Address bias in research and practice by ensuring access to opportunities for quality and diverse resources, curriculum, and methods.
5. **Improve Implementation**: Overcome systemic barriers of policies, resource deficiency, and inadequate teaching credentials. Develop strategies focused on scalability and implementation effectiveness.

Priorities four and five listed by the NCER closely align with the central mission of Mindset Math and provide a roadmap for curricular innovation, which is reflected in its current and planned programming. By integrating data science concepts into established curricula designed by Mindset Math, students from varying socioeconomic sectors can be engaged in individualized lessons while learning applications of data science in various fields. AI and data analysis reinforce the broader relevance of

technology across various industries. In health and social care, techniques like data extraction, cloud-based computing, and data mining assist in efficient decisions in social interactions (Subrahmanya et al., 2021). Machine learning and natural language processing optimizes production processes, analyzing data from equipment and sensors to improve engineer processes. In financial modelling, data from analyzing transactions, stock movements, and customer behavior advance techniques.

Motivated by this wide potential, Mindset Math is creating a new program that combines previous initiatives and successful tactics with data science in education. The goal of this initiative is to leverage preexisting AI-based tools to increase data literacy by designing innovative and research-based curricula that highlight the interconnectedness of data analytical concepts, demonstrating their real world applications. Mindset Math hopes to diversify its programs through three key components: capstone projects, coalition building, and a new curriculum.

Capstone Projects

The goal of the data science initiative is to both produce new content from the perspective of high school students as well as innovate on existing materials. Pre-existing projects inherently contain opportunities to emphasize the data related topics to expand their effectiveness. In combination with comprehensive and anecdotal reports, statistical observations from data analytics further strengthen general curriculum evaluation as seen in sample reports by authors Samantha Senajon and Annie Shan. An implementation of *capstone projects* using AI and related tools will act as extensions to established projects, providing an understanding and exploration of covered topics for educators. Educators will utilize data visualization by embedding visuals and data in dashboards and interactive notebooks such as Jupyter, Tableau, or similar version control softwares. In the context of both *Mindful Mathletes* and *ATWI80MP*, a capstone project using data analysis can be a way for program designers to demonstrate data collected in pre and post surveys from their experiences and display it in an understandable way. This insight report compiles data collection from educator's curriculum on student engagement to better predict the validity and effectiveness of each lesson plan, ensuring quality resources as stated in NCER goal 5.

MV-Squared & The Concord Consortium

In emphasizing the importance of coalition building and expanding data literacy's reach to various communities, Mindset Math's collaborations focus on educational research and STEM development. Mindset Math is mobilizing its network of youth to facilitate development of MV-Squared's early stage AI model *MathVoyagers,* a platform focusing on deep understanding rather than accuracy, as well as circulating The Concord Consortium's established resource *M2Studio,* a web-based environment enhancing AI literacy. As an effort to combat systemic barriers in the lack of resources as listed in NCER goals 4 and 5, participation in *MathVoyagers* involves early-stage innovation, mid-stage testing, and mature project continuation under the mentorship of Dr. Jie Chao, who is a learning scientist at The Concord Consortium and leads the development of *MathVoyagers* for MV-Squared. Member expertise in technology and web design is maximized to suggest improvements in the design of the platform to increase user friendliness. Secondly, Mindset Math members are managing and directing solution verification for quality content intended for younger audiences via ensuring diversity in feedback by recruiting testers of various backgrounds. During the last stage, members are free to propose independent projects in data science specific fields under Dr. Chao's guidance. As for *M2Studio,* members are working on disseminating resources via local community contributions in a format similar to previous Mindset Math initiatives. By contributing to cutting-edge curriculum design and implementation, participation members will deepen their understanding of learning science and clarify their own academic or career interests in technology, research, and education as well as help transform the state of math education and exemplify the role of emergent technologies in math education.

New Curriculum

Mindset Math's new data science initiative integrates authentic, socially embedded data science education in K-12 learning. Curriculum organization follows the structured approach of design, implementation, evaluation, and resource sharing. In a similar approach that curriculum designs in both *Mindful Mathletes* and *ATWI80MP* follow, students may choose a topic that they are interested in and further create their own lessons and analysis reports applying data science models. Mindset Math aims to consider NCER goal 4 by implementing these diverse developmental tactics. In the design phase, the focus is on outlining interdisciplinary lessons that position students as both consumers and creators of data narratives, echoing best practices from emerging civic data science research. Lessons in analysis will draw from real-world datasets—such as UN Sustainable Development Goals, country health ranks, and census data-centered on topics students care deeply about, like environmental justice, mental health, identity and inclusion, and civic infrastructures (e.g. broadband access, transportation safety). Select topics and datasets in consideration by members include:

1. **Education**: U.S. Department (USDA), U.S. Department of Education, OECD Programme for International Student Assessment (PISA), National Assessment of Educational Progress (NAEP)
2. **Civic and Environmental**: Environmental Protection Agency (EPA) AirData, National Oceanic and Atmospheric Administration (NOAA), U.S. Energy Information Administration (EIA)
3. **Social Justice & Equity**: U.S. Census Bureau, MIT Election Lab Datasets, Bureau of Labor Statistics (BLS), Civil Rights Data Collection (CRDC)
4. **Science & Technology**: NASA Open Data, NASA Earth & Space Data, U.S. Geological Survey (USGS), Centers for Disease Control and Prevention (CDC)

Implementation will occur through out-of-school programs such as after-school clubs and summer workshops. Similar to other Mindset Math programs, members outreach within their own community along with established networks. In these sessions, students explore topics such as the history of population movement after the Civil War or patterns of sports injuries, connecting statistical analysis to civic and social phenomena. In partnership with researchers and educators, Mindset Math will co-develop materials alongside social studies teachers, focusing on embedding data inquiry sequences into social studies and math classrooms. Evaluation will be embedded throughout formative assessment rubrics created to gauge students' data reasoning, inquiry skills, and civic agency. Inspired by work highlighted in *Data and Social Worlds,* Mindset Math aims to foster students' "data identity" and agency by encouraging critical interpretation, storytelling, and real-world action through data (Miller et al., 2024). Mindset Math curriculum designers will create plans in accordance with the Levels of Conceptual Understanding of Statistics (LOCUS) to track growth over time. Students will engage in inquiry-based activities using AI and data analysis tools like CODAP, developed by the Concord Consortium, for exploratory data analysis. Similar tools and rubrics will supplement the active learning of mathematical concepts by holding students accountable in analyzing local and global datasets, formulating questions, and constructing data-supported stories that bridge mathematics, statistics, and social studies.

Conclusion

Mindset Math partners with other nonprofits and provides internships for students, allowing for people from any background to contribute regardless of knowledge and offer a variety of roles. Ultimately, Mindset math will make its data science curriculum and resources publicly available by engaging its network with organizations such as A+ Academy, Skew the Script, and UChicago's Data Science for Everyone. In doing this, Mindset Math aims to apply AI and data analytical tools to contribute to a broader movement toward equitable, humanistic, and action-oriented data science education that empowers young leaders to engage meaningful with their social worlds, As Mindset Math expands its initiative, it invites educations, researchers, and youth leaders to co-create a future where all students see themselves as capable data citizens.

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