Integrating Data Science Explorations in Science Classrooms

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Abstract

We propose a technology-enriched learning intervention named DataX to engage students in analyzing authentic datasets about societal issues. In a pilot conducted in secondary science, students were first introduced to basic data concepts and then invited to analyze multivariate data about energy and chemical elements. Some students demonstrated sophisticated data skills and playfulness despite initial negative dispositions to data. This study showed early promise of DataX for engaging students in authentic data explorations.

Introduction

Data has been recognized as an important fabric of modern society. Data science as an emerging discipline has garnered significant attention across levels of education, in both higher education and K-12.

In K-12, a key approach to supporting data science is to interleave it within existing subject areas. One promising approach is to position students as "data analysts" who can build knowledge about important societal issues by collaboratively analyzing authentic datasets in specific disciplinary contexts.

This poster reports on an on-going design-based research project named *DataX* that aims to develop a technology-enriched learning program for secondary school students to explore data science in proper disciplinary and social contexts.

The DataX Project

Conceptual framework and curricular goals: Conceptualizing student experiences with data as an integral part of their disciplinary and civic engagement, the DataX project situates data in a larger inquiry process of value to students and strives to create positive data dispositions and develop student identities as data practitioners. DataX aims to expose students to authentic public datasets, computation tools, and data science practices.

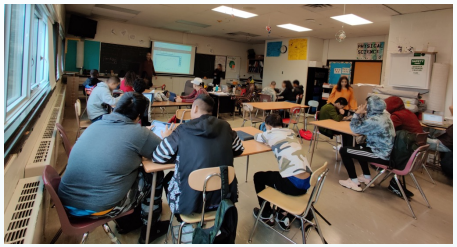
DataX environment and key features: DataX extends *CODAP* (an open-source tool designed for Grades 6-14 students) from an individual-oriented tool to a community-centric, knowledge-building environment that allows learners to collaborate on data investigations (see here). DataX allows learners to publish data analysis notebooks for others to comment on or remix.

Co-design partnerships: The project team worked closely with two science teachers to co-design pedagogical supports responsive to their school contexts. Through multiple design meetings, we created an overarching plan for their classes to work on the *NGSS* crosscutting concept of "energy" from physics and chemistry angels.

Research questions: (***1***) What data experiences and dispositions did students bring into this intervention? (***2***) To what extent did DataX facilitate students' data explorations and data dispositions?

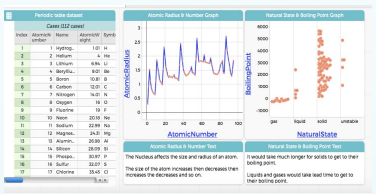
Methods

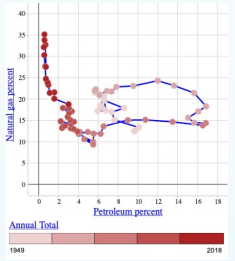
Context and participants: Two public schools in midwestern United States, racially and socioeconomically diverse with mostly immigrant students. Participants were two teachers and 81 students.



Procedures:

- Pre-survey on data dispositions
- A mini lesson about data and the DataX environment
- A warm-up data activity based on a public dataset about student growth
- Two classes diverged from here:
  - Class A (physical science) analyzed energy consumption data in the US
  - Class B (chemistry) analyzed properties of elements in the periodic table
- Teacher interviews





RQs	Data Sources	Analyses
RQ1	Pre-survey about data dispositions	Descriptive analysis
RQ2	Student-generated artifacts Videos of classroom discussions	Qualitative content analysis

Results

Student data dispositions: About 80% of students found data to be interesting; students had varied interest in reading graphs, thinking about data; about 45% of students indicated they were comfortable working with large amounts of data.

Students' data explorations on DataX: Students experiences varied. Some students with little data experiences or less positive dispositions ended up conducting sophisticated data explorations. Some students demonstrated a willingness to play or tinker with data.

Teacher interviews indicated that the pilot gave students an opportunity to work on and manipulate data in new ways and helped students think more about data in science contexts. The DataX activities offered authentic learning experiences for students to connect learning to real life situations.

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