The Center for Research in Mathematics and Science Education Colloquium Series

CRMSE

Students' Conceptions of and Tools for Handling Multi-level Data

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Abstract: I first describe recent research on student capabilities working with complex, hierarchical data — the types of data that are ubiquitous in science and increasingly encountered in the age of Big Data. We gave participants diagrams of traffic on two roads with information about eight attributes, including the type of each vehicle, its speed, direction and the width of the road. Their task was to record and organize the data to assist city planners in its analysis. Successfully encoding the information required the creation of a case, a physical record of one repetition of a repeatable observational process. We analyzed data sheets participants created and the methods they used to bind information together into cases. Overall, 79% of their data sheets successfully encoded the data. Even 62% of the middle school students in the study were able to create a bound structure that could hold the critical information from the diagrams. A majority of these structures involved a hierarchy of cases rather than the "flat" case-by-attribute structure that virtually all statistical software require.

I then demonstrate a web-based data-analysis and visualization tool (CODAP), which we've been developing over the last eight years. In designing it, we've drawn on our experiences as developers of *Fathom* and *TinkerPlots*, but also tried to anticipate the sorts of capabilities required in the emerging field of Data Science. We'll explore in particular CODAP's ability to flexibly structure data and thus handle the sorts of hierarchical data described above. CODAP's audience is students of mathematics and science grades 6 – 14 as well as education-based projects that require data-analysis/visualization capabilities.