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From Graphs as Task to Graphs as Tool

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OVERVIEW: When students observed patterns in their graphed data that seemed not to align with the actions they had taken to produce those data, they appeared to shift to a deeper, more sophisticated engagement with their graphs.

AUDIENCE: District science coordinators, Instructional designers, Researchers/Researcher supervisors, Secondary science teachers, Teacher educators, Physics educators, STEM educators

KEY POINTS

- High school students interacted with their own data graphs on a continuum from producing graphs just to hand in, to trying to understand them, to using them as scientific tools.
- Case studies explore what appeared to motivate shifts along this continuum for three small groups.
- More than the presence of anomalous or surprising data appeared to be at work. Students apparently had a sense their data representations should align with the actions that produced those data.

INTRODUCTION: The Next Generation Science Standards (NRC, 2013) are part of an apparent international consensus on the need for students to gain proficiency in interpreting data graphs by age 14 or 15. In spite of the standards, difficulties with graph interpretation continue to be documented at the middle school level and up. Beyond investigating whether students are able to make use of graphs for sensemaking, we need to know more about what can prompt them actually to do so. Episodes from three small groups in high school science classes are used to explore student interactions with graphs of data they had produced. Questions guiding analysis were: 1. How were students interacting with their graphs? 2. If the students shifted in how they were interacting with their graphs, what appeared to prompt these shifts? Classroom video was analyzed using qualitative methods.

FINDINGS Among the students in these groups, interactions with their own data graphs included producing and turning in graphs without attempting to understand them, working hard to understand them, using them as feedback on their experimental procedures, and using them to generate knowledge about the natural world that was new to them. Each group exhibited shifts along this continuum. Each shift was precipitated by unexpected graphical results, but unexpected results did not always produce such shifts. In each case where they did, the students appeared strongly motivated to align graphical patterns in their results with actions they had taken to produce those data. These actions all involved physical aspects, even in the simulations, where they dragged sliders to test different independent variables.

TAKEAWAYS

It has been argued that the use of real time data graphs, such as those produced by classroom sensors, can support student development of graphical comprehension. This study suggests that pedagogy might in addition seek to leverage the potential of these explorations to foster a sense there should be some sort of alignment between student data production activities and their data representations. This can lead students to revise their conceptions of phenomena and/or their experimental procedures to bring them and the graphs of their results into alignment—not only comprehending their graphs, but making use of them more the way scientists do.