How can middle school science fairs help students meet science standards?

Results from a national research study

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A Framework for K–12 Science Education and the Next Generation Science Standards (NGSS) (NRC 2012; NGSS Lead States 2013) have elevated the importance of engaging students in science and engineering practices. Given the long history of school-based science fairs (e.g., McComas 2011), it is worth understanding whether science fairs help students comprehend science and engineering practices and how teachers support students as they develop their science fair projects.

With funding from the National Science Foundation, researchers at the Education Development Center embarked on a four-year study, from 2014 through 2018, that explored the implementation, student outcomes, and costs associated with school-based science fairs (see Resource for project website). This article describes the results of a subset of this study that examined the following questions:

1. How do middle school teachers support students with their science fair projects?
2. Which of these supports develop students’ science and engineering practices?

Our study specifically focused on sixth-grade students, because the entry into the middle grades offers many students the first opportunity to engage in a science fair. We were particularly interested in the kinds of support teachers offered because we wanted to understand how students could be engaged with science and engineering practices beyond the science fair. To address these questions, we conducted a survey of middle school science fair coordinators from 48 states and then collected data from 21 middle schools; 16 of the schools are located in states that have adopted the NGSS. Data from these case study schools included surveys and interviews with science fair coordinators, science teachers, school administrators, parents, and judges, as well as student focus groups and assessments.

As we collected and analyzed our data, we found far more variation in the fairs than we expected, including in how schools determined who would participate, the ways in which teachers supported students’ work on science fair projects, the parents’ support, the principals’ involvement, and the presence of competition and judging. However, even with so much variation, there were certain characteristics that seemed to be critical for students to conduct a science fair project. Overall, two important aspects of the science fair experience emerged: the goals for having a fair and the types of support teachers offered.

First, even within the same school, teachers—and sometimes administrators—had very different goals for their fair, and in each case, the goals had implications for the characteristics of the fair.
and kinds of supports students received. When we categorized the fairs according to the teachers’ descriptions of the primary goals for students, we identified three main goals:

1. building science interest,
2. increasing students’ understandings of science, and
3. building students’ project-completion skills.

Urban schools and schools with a high proportion of low-income students were more likely to focus on building students’ interest in science, whereas rural and suburban schools were equally as likely to focus on students’ science interest and science understandings. We also found patterns in the types of support that teachers provided. Most provided at least some instructional time for students to work on their projects. Our analysis reveals that the use of instructional time for supporting students’ investigations may be particularly important in schools with high proportions of low-income students; for students in these schools, providing class time was a significant factor in increasing their understanding of science and engineering practices. Teachers in schools that used instructional time told us that while they needed to balance science fair instruction with their required curriculum, allowing students to take time during class gave all students access to the same types of support, which meant that project work did not need to rely on parents’ knowledge and other outside resources.

The science fairs also differed in terms of the extent to which teachers helped students explore science and engineering practices in depth. Teachers’ descriptions of their work with students focused on either monitoring students’ work or helping them think deeply about their topic. Teachers, many in urban and rural schools, described taking time with students to refine questions and procedures, provide written feedback on student data and analysis, introduce mini-lessons to help students analyze and interpret their data, and provide structured time for students to practice presenting their projects. Some teachers described their work as helping students see how the data they collected informed their interpretations and findings.

In schools where teachers helped students prepare for their presentations, students explained that the feedback they received from their classmates and teachers helped them feel more confident when presenting to judges, and that presenting to any adults, including parents, also boosted their confidence in their understandings of their investigations.

Overall, our research reveals that teachers’ goals for having a science fair and the emphasis they place on students’ learning through investigations may be important factors in student learning. As teachers seek to meet the demands of new state and national standards, science fairs may provide one way to support this effort. In these and other classroom investigations, it may be important for teachers to clarify their goals, provide class time, and focus instruction on the connections between asking questions, collecting and interpreting data, and engaging in argument from evidence to develop students’ understandings of these science and engineering practices.

REFERENCES


RESOURCE
Science Fairs Under the Scope—http://sciencefairstudy.edc.org

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