

Parent Involvement in the Science Fair: Helping Students or Hindering Equity?

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Abstract

Science fairs have been around for decades, yet their critics question the extent to which parent involvement shapes students' investigations and creates inequitable experiences. Parent involvement in the science fair has been viewed as objectionable by parents themselves. However, research has shown that parent support can play a vital role in student learning. This article describes the results of research that explored the role of parents in middle school science fairs. Data from parent surveys and interviews, teacher interviews, and student focus groups were gathered from 21 schools across the U.S. (prepandemic) to examine patterns in parents' involvement in science fairs, including the roles parents play and whether involvement varied by parental characteristics. Findings show that parents' income and education affected their level and type of involvement, as did certain features of the science fair itself. Our findings have important implications for the structures of and equity in school-based science fairs.

Key Words: science fairs, parent participation, involvement, parental role, middle school, equity, science education, home, STEM teachers

Introduction

A lot of parents really dread [the science fair], just because a lot of times it ends up being a lot more work on the parent...I think a lot of parents kind of cringe at the idea of it. (Parent, School 224)

Science fairs provide students with one of few opportunities to engage in authentic science experiences wherein students can ask questions, collect and analyze data, and present their findings to others (Banilower et al., 2018; Jeanpierre, 2006). Proponents of science fairs claim that engaging in science fairs increases students' interest in science and provides a pathway to science careers. However, others view science fairs as a burden for both students and parents (or families/guardians). For example, Susan Messina's satirical science fair poster, *How Much Turmoil Does the Science Project Cause Families?* went viral, indicating that parents view the science fair as an unnecessary and painful experience. Other critics claim that schools lack the resources to make the science fair a truly valuable learning experience, requiring parents to pick up the slack. Since parents vary in their educational attainment and scientific background, reliance on parental support for such a large project may result in an experience that privileges those from particular backgrounds (Grinnell et al., 2018; Hampton & Licon, 2006). In her 2014 blog post, Susan Messina also acknowledges that science fairs advantage students from privileged backgrounds and that, to be equitable, the projects should be done in school.

The National Science Teachers' Association's statement about parent involvement offers suggestions for encouraging children's interest in science and science careers as well as strategies for parents to become more involved in their child's science schooling. While research shows a positive relationship between parent involvement and children's academic achievement (Galindo & Sheldon, 2012; Henderson & Mapp, 2002; Hill & Tyson, 2009; Pate & Andrews, 2006), as well as motivation (Park & Holloway, 2018; Simons-Morton & Chen, 2009), specific types of support have been shown to have a larger impact. In particular, Hill and Tyson (2009) found that "academic socialization"—which includes parents conveying academic expectations to their children, offering learning strategies, and strategizing for the future—had the strongest positive association with student achievement, while a popular form of parental support—help with homework—had the strongest negative association.

While this prior research provides some insight into parent involvement in children's schooling in general, parent involvement has not been formally studied specifically in the context of science fairs—an experience that can include challenging investigations and competition, which is ultimately distinct from typical classroom experiences. The study described in this article was conducted as part of a larger research project on the implementation of middle school science fairs and the relationship between participation in them and students' interest in science, science careers, and mastery of the science and engineering practices. Among other things, the larger study also raised questions around the equity of science fairs, finding that science fair implementation varies widely

across schools (DeLisi & Pasquale, 2019; Kook et al., 2020) and that teacher support for students' project work is more limited in high poverty schools and schools with a high proportion of African American students (DeLisi et al., 2020). Looking more closely at parent involvement in science fairs arguably becomes even more important in schools where teachers are providing less support, potentially providing additional insight into the roles of parents for equitable implementation of school science fairs.

Prior Research on Parent Involvement

There are many ways for parents to become involved in their children's schooling. Epstein et al. (2002) identified six types of involvement, including "learning at home," which they define as providing "information and ideas to families about how to help students at home with homework and other curriculum-related activities, decisions, and planning" (p. 14). A parent's ability to participate in this way, or in other ways such as volunteering or decision-making, is often correlated with many factors including income, level of education, and race/ethnicity or cultural background, as described below.

Income

The literature on parent involvement in education shows that income plays a significant role in the support parents provide their children. Higher income parents are more likely to be involved in their child's school and learning (Lee & Bowen, 2006; Park & Holloway, 2018; Waanders et al., 2007.) They also often have greater education themselves, making them more comfortable interacting with teachers and administrators in order to ensure their child receives the best education possible (Park & Holloway, 2018). Income and social capital, including the social networks of middle-class families, allow greater access to a variety of resources such as costly materials, laboratories to perform experiments, and mentors, each of which are relevant for conducting authentic scientific investigations (Bencze & Bowen, 2009; Czerniak, 1996; Gifford & Wiygul, 1992; Horvat et al., 2003).

The reasons that lower income parents are less involved are multifaceted. Lareau's (2000) research highlights how differently parents from varying income groups interact with schools; in comparison to higher income families, lower income families viewed themselves as "educationally incompetent" and were less likely to participate in their child's learning or question a teacher's judgement. Other researchers have also described the perspectives of parents in lower income communities as feeling unwelcomed by the school or not expected to participate (Dauber & Epstein, 1993; Hoover-Dempsey et al., 1995), or

they may be influenced by their own negative school experiences (Williams & Sanchez, 2012.)

Parent Education

While Lareau (2000) found that lower income parents were less likely to be involved in their child's schooling, parents' income was not the only factor that determined involvement; their knowledge and confidence in their abilities to help were equally important. In fact, research on the effects of parent education on school involvement shows a close relationship to that of parent income (Brody et al., 1995). Research linking parent education and parent involvement in school activities is less consistent, however. In a study of Mexican American parents (Peña, 2010), the school principal indicated that parents who volunteered were often those with the lowest levels of education; in contrast, Lee and Bowen (2006) and Shumow et al. (2011) found that parents with higher levels of educational attainment were more involved at school.

There is more consensus on the relation between parent education and the type of involvement; both Peña (2000) and Lee and Bowen (2006) found that parents with lower educational attainment were less involved with substantive educational issues, such as those that are more deeply involved with learning, including homework assistance, making connections to prior knowledge, and discussing relationships between subjects. Peña found that parents with less education were less likely to help with homework, participate in PTO activities, or attend parent workshops, reporting that these parents felt inhibited from involvement due to a lack of knowledge. Similarly, Lee and Bowen found that parents with higher levels of education had more substantive educational conversations at home and higher academic expectations. Interestingly, however, Lee and Bowen did not find a significant difference in the amount of homework help provided.

Cultural Background

Research also points to the influence of race, ethnicity, and cultural background on parent involvement in education. One major obstacle to involvement for non-English-speaking parents is language. Literature on Hispanic parents' involvement in schools shows that they often face language barriers that alienate them from participation, leading to difficulties in communicating with both teachers and administrators (Peña, 2000; Ramirez, 2003; Smith et al., 2008). Other cultural barriers to involvement also exist for these families, especially in terms of their beliefs around the teacher as an authority figure. Parents in Smith et al.'s (2008) study viewed teachers as being in charge of learning. Their role as parents was to ensure their children attended school, completed

homework, and respected authority, which extended to the authority of the teacher. Because questioning a teacher's expertise would be seen as disrespectful, these parents were not comfortable advocating for their children's learning or confronting teachers if there was a problem at school.

Similar barriers to involvement have been reported for other immigrant populations as well. Zhong and Zhou (2011) reported that Chinese parents in a Canadian school district were inhibited by the language barrier and by inexperience with Canadian culture, leading them to uncertainty about how to best get involved. Exacerbating the complexity of language barriers can also be the academic language used by schools in their communications with parents (LaRocque et al., 2011). Educational jargon around curriculum, standards, or learning objectives can further alienate parents from involvement in their child's education. Multiple studies have shown that in order to foster parent involvement, communication and explicit invitations to participate are essential (Dauber & Epstein, 1993; Hoover-Dempsey et al., 2001; Peña, 2000), perhaps especially for immigrant families (Ramirez, 2003; Zhong, 2011). In a review of the literature, Henderson and Mapp (2002) found that "programs that successfully connect with families and community invite involvement, are welcoming, and address specific parent and community needs" (p. 43).

Current Study

The above factors influencing parent involvement are often intertwined in the literature and are rarely focused on a singular school event such as a science fair. The review of literature clearly suggests that demographic factors influence parent support for school and for some school events, but there is little that indicates specifically whether this is also true for science fairs. However, given the general findings that there is greater involvement on a substantive level for parents with higher income and higher levels of education, and fewer barriers to involvement for parents who identify as White, we questioned whether there would be differences in the amount of substantive support provided for the science fair between parents that are White and parents from other demographic groups. Given the prevalence of science fairs—as well as many schools' expectations of parent assistance with materials, project work, and time management—our examination of how these factors influence parents' roles in the science fair experience has important implications for equity. In order to ensure that all students have access to high quality science endeavors that reflect the practices of scientists, it is essential to understand the demographics and the role of parents involved in science fairs, as well as what the expectations are for parents and how those differ by school. If we are going to level the playing field

and make sure that access to science fairs is equitable and that all students have the same opportunity to participate in high quality science fair experiences, we need to make certain that parent involvement does not decide who has access and who does not.

In this study, we explore parent involvement in middle school science fairs and the extent to which science fairs rely on parent participation for a successful experience. We address four research questions related to parent involvement in the science fair:

1. What are parents' perspectives of their middle school students' science fair experiences?
2. What types of support do parents provide to their children during the science fair experience?
3. Is there a difference in the types of support provided by parents of particular backgrounds (race/ethnicity, income/socioeconomic status, parent education)?
4. What are some features of science fairs that influence parent involvement?

We answered these questions through an exploratory study using survey and interview data from parents and teachers.

Methods

Sample

In order to answer our research questions, we collected data from 21 schools from across the United States. We began identifying potential schools by following up with contacts obtained through the first phase of our study (Kook et al., 2020). We then collected names of additional schools and science fair coordinators through organizations such as the National Science Teachers' Association (NSTA) and Broadcom Masters. We developed criteria for including schools in the study based on our project's definition of a science fair— any occasion when a teacher (a) has students answer a question or solve an engineering challenge of their own choosing, (b) has students present their work to others, and (c) has projects judged or assessed. Science fairs can happen within one classroom, across a grade, or a whole school; judging can be done by teachers or volunteers; and there do not need to be winners or prizes. Schools that met this definition were eligible to be included, and from there we ensured that the sample represented schools from four regions of the U.S. (Northeast, South, West, Midwest) and included schools from different locales. Schools also varied by family income levels and school types (e.g., traditional public, charter, STEM focused). All schools included Grades 6–8 and provided a

science fair experience for sixth grade students. One classroom of sixth grade students in each school was selected as the focus of the study. More details about the sample and criteria for choosing schools can be found in DeLisi et al. (2020).

A total of 701 parents of sixth grade students who were participating in the larger study were sent a consent form that also asked them to indicate whether they were interested in participating in an interview and to provide their email address and/or phone number. Of those, 272 parents expressed interest. Once the science fair had been completed, we worked with the teachers to make sure that all 701 parents were sent a link to a Parent Survey. Data collection instruments and the invitation to participate in the research were provided in both English and Spanish, and some parent interviews were conducted in Spanish.

We collected survey data from 127 parents of sixth graders from 17 schools participating in science fairs, as well as interview data from 39 of these parents from 13 schools. Parents received a \$25 gift card for completing the survey and participating in an interview. Interviews with science teachers and science fair coordinators at all schools also informed our understandings of the role of parents in the school science fair. Parents were interviewed after their student participated in the science fair, the timing of which varied by school. Each interview lasted approximately 30 minutes, with an average transcript length of seven pages. For each question, we both conducted descriptive analyses of survey responses and coded interview data to identify and examine emergent themes. To address Questions 3 and 4, we also conducted chi-square analyses to test if parent support and involvement was related to parental income, education, race/ethnicity, and structure of the science fair (mandatory or voluntary). Descriptive information about the schools and parent respondents are provided in Tables 1 and 2.

Table 1. School Sample

Voluntary/Mandatory	Locale	School Type
Voluntary – 3 Mandatory – 14	Urban – 6 Suburban – 4 Town – 3 Rural – 4	Regular – 14 Charter – 3

Notes. Voluntary – Participation in the science fair is voluntary. Students may decide whether they want to participate or not. Mandatory – Participation in the science fair is required. All students must participate in the science fair.

Table 2. Science Fair Parent Survey Respondents

	%
Annual Household Income (<i>n</i> = 98)	
<\$50,000	39.8
\$50,000-100,000	30.6
>\$100,000	29.6
Maternal Education (<i>n</i> = 123)	
High School/GED or less	33.3
2-year college degree	14.6
4-year college degree	23.6
Graduate or professional degree	28.5
Race (<i>n</i> = 117)	
White	68.4
African American/Black	12.0
Asian	6.8
Native American	3.4
Ethnicity (<i>n</i> = 111)	
Hispanic/Latino	14.4

Measures

Both the Parent Interview and Parent Survey were designed to provide descriptive information about students' work on their science fair projects, parents' roles in supporting the investigations and the science fair event, and parents' perspectives on students' learning and interest through the science fair investigations. Each measure was designed specifically for this study. The interview protocol contained 22 items including questions about school support and communication, such as, "How did you learn about how the science fair works and what to expect?" and "What support did you get from the school to help you?" The survey contained 31 items, including multiple choice, 5-item Likert-scale, and open response questions. Data was also collected on parents' demographic backgrounds and any professional or personal interest in science.

Analysis Methods

This study used exploratory analysis to gain an understanding of the factors associated with parent participation in science fairs. We analyzed survey data descriptively (Creswell & Creswell, 2017) to understand the percent of respondents who provided different types of support. Interview data were used to further understand and describe what each type of support may have entailed.

Interviews were audiotaped, transcribed, and reviewed by the interviewer for accuracy. They were then entered into MAXQDA and coded based on a coding system previously defined for the larger study. As themes emerged from the data, codes were developed to summarize themes around parent involvement such as Family Responsibility (which was defined as any support for the students or the science fair event that is provided by a parent/guardian or other family members including siblings, e.g., purchasing materials, creating a graph, or decorating a board); Adult Feelings/Opinions About the Science Fair; and Equity. The themes that emerged were relevant across research questions. More details about the measures and qualitative analysis procedures can be found in DeLisi et al. (2020). For the purposes of this article, parent and teacher interviews were reviewed again to look for additional information to help understand the parent role.

Results

Students' Science Fair Experience

Our first research question is focused on parents' view of their students' science fair experience. We analyzed survey data to understand parents' perspectives and linked these findings to related themes that surfaced from the interview data to provide greater detail. Parents were asked to provide three words to describe their child's science fair experience. A total of 125 parents responded to this question, and although some parents provided words such as "disappointing," or "exhausting," the responses to this question were overwhelmingly positive, with words such as "fun," "interesting," and "exciting" being prominent, as is shown in the word cloud in Figure 1 (larger words are those mentioned more frequently). Only 7% of parents responded with exclusively negative words, while 46% of parents responded with only positive words, and an additional 46% responded with a mixture of negative, positive, and/or neutral words.

During the interviews, many parents talked about the positives of the science fair and how much their children enjoyed participating. Some typical comments included:

All the kids could decide for themselves whether to participate or not in the actual fair, and he wanted to do it. And he was excited, and he dressed up, and I did not even have to encourage him in any way to do that. And now he has the choice to go to the county science fair, and he really wants to do that. (Parent, School 228)

I only have my kids' excitement or non-excitement to base it off of, and they came home really excited. (Parent, School 421)

Parent Involvement in the Science Fair

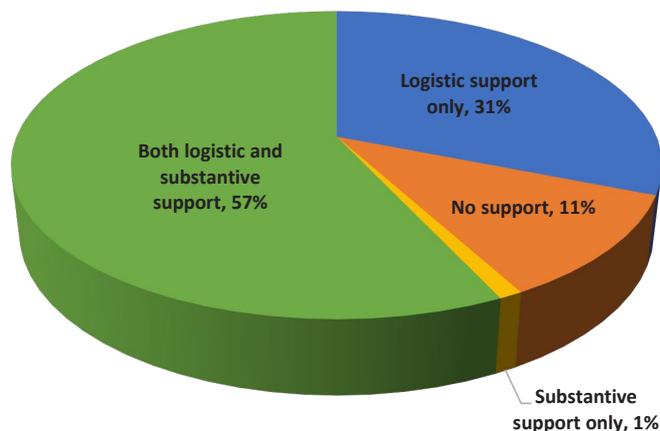
Our second research question is focused on understanding the role of parents in supporting their students’ science fair investigations. Survey data provided a sharper picture of the support parents provided to their children during the science fair experience. Parents were asked to check off all the ways that they or other family members helped their child with the science fair project. The types of support were divided into two categories: (1) logistic support, which included helping students manage their projects in terms of time and staying on task, purchasing materials, or providing emotional support; and (2) substantive support, which included more academic support such as helping their child choose a question to investigate or providing hands-on help with the experiment. Table 3 shows the survey answer options given to parents.

Table 3. Type of Support Provided

Category of Help	Survey Answer Options	
No Help	Did not help my child at all with their science fair project	11%
Logistic Help	<i>ANY type of logistic help</i>	88%
	• Helped my child choose a topic	14%
	• Purchased materials/equipment/supplies	69%
	• Made sure they stayed on schedule with the science fair project	57%
	• Answered questions and/or provided encouragement	65%
Substantive Help	<i>ANY type of substantive help</i>	58%
	• Helped my child think about and organize project work	39%
	• Provided some hands-on help with their science fair project	44%
	• Provided access to science resources (e.g., labs, equipment, investigators)	17%
Other	Did the majority of the project myself	0%
	Other type of help (please describe)	9%

The majority of parents provided their child with some type of assistance, however a greater number offered logistic support. As Figure 2 shows, 31% of parents offered *only* logistic support, 1% of parents offered *only* substantive support, and 11% of parents reported that they provided no support at all. Overall, 88% of parents provided logistic support, and 58% provided substantive support, with a slight majority, 57%, providing both.

Figure 2. Types of Support Provided by Parents



Parent interviews reflected the types of support parents provided to their children and shed further light on the specific actions they took. Parents described the ways in which they provided their students with logistic support. For example, one parent helped their children manage a timeline so they could complete their project on time:

I think the big thing for me was just getting them organized on a timeline...explaining to them, hey, if the science fair's on a Thursday, you need to get your testing done the previous Friday, and you need to get all your write-ups done by Sunday, so then you can stare at the thing for three days and make any changes that you might want to make.... So really, I was just helping them from a time-management standpoint. (Parent, School 123)

And another offered logistical support in terms of supplies:

The only thing he really needed from me was a hammer. So, you know, I mean I offered, but he was like "No, I've got it," you know, "I'm all set." (Parent, School 127)

Some parents also described more substantive support, including the kinds of hands-on help they provided and the ways in which they prompted their children to manage their projects. For example, one parent helped to organize their child's data materials:

He dug through my materials and got all the different fabrics that he wanted. I did help him to, you know, think about how to organize them. So, should they all be the same size, or should they be different sizes, and how was he going to keep track of which ones were washed with the fabric softener and which ones weren't? (Parent, School 228)

Meanwhile, another parent provided more assistance with research and data collection:

My husband and I, we all kind of worked as a team...the nature of his project, he made a hydroelectric generator, and creating that, we needed dad's help. You know, you had to get some magnetic wire, and you had to spool the wire a certain way, so it was kind of one of those things where we did the explanation, "Okay, this is what you need to do. This is what the directions are." So, then we showed him how to do it, and then he was able to do it...At one point my husband actually said, "I don't know anything about hydroelectric power." I'm like, "Well, you better do some research."...So it actually worked out really well with the two of us kind of doing the project with him together. (Parent, School 322)

Who Provided Support?

Our third research question focuses on understanding whether there are patterns in the types of support offered based on the characteristics of parents. To examine the data for any of these patterns, we created crosstabs and conducted chi-square analyses that tested for differences by characteristics, including parental income, education, race/ethnicity, and structure of the science fair (mandatory or voluntary).

Income

Of the 127 parents who responded to the survey, 98 answered a question about income, selecting one of five ranges of income. In order to avoid small cell sizes and potential bias in chi-square testing (Haberman, 1988), we collapsed the two lowest categories ("Less than \$25,000" and "\$25,000 to \$50,000"), and the two highest categories ("\$100,000 to \$150,000" and "\$150,000 or more"). This resulted in three categories, with 39% falling in the low-income range (\$50,000 or less), 30% in the mid-income range (\$50,000 to \$100,000), and 29% in the high-income range (\$100,000 or more). Our analysis shows that income was not significantly associated with the likelihood of providing logistic support, $\chi^2(2, N = 98) = 0.82, p = .664$. However, income *was* significantly associated with the likelihood of providing substantive support, $\chi^2(2, N = 98) = 10.9, p = .004$. Comparing each income group, high-income parents were significantly more likely to provide substantive support compared to mid-income parents, $\chi^2(1, N = 59) = 5.85, p = .016$, and compared to low-income parents, $\chi^2(1, N = 68) = 10.7, p = .001$; mid-income parents were no more likely to provide substantive support compared to low-income parents, $\chi^2(1, N = 69) = 0.65, p = .422$.

Part of this difference may be explained, not by lower income parents' lack of interest in providing substantive support, but by their lack of confidence in their knowledge and availability. Comments from the interviews indicated that lower income parents often identified themselves as less able to support their child with the science fair project. One lower income parent suggested that they were unable to help because they didn't have the knowledge to do so:

We all work, and it was hard to get them together all the time...I think the only one that was helping them was one of the parents, because he had a little bit more experience than us. (Parent, School 426)

And another did not have time to help their child:

The time overlapping between when I get home and he comes home from school is very short, because I have to go to work, so it was he who did everything, more than anything. (Parent, School 127)

Education

Of the parents who responded to the survey, 123 reported maternal education, or the highest level of education of the child's mother. Of those mothers represented, 27% had a graduate or professional degree, 23% had a Bachelor's or other 4-year degree, 14% had an Associate's or other 2-year degree, 28% had a high school diploma or GED, and 5% had not completed high school. Relative to U.S. Census data (2019), this sample has a very high average educational attainment. In order to avoid small cell sizes and potential bias in chi-square testing (Haberman, 1988), we split the sample as evenly as possible into two groups: 52% with a Bachelor's degree or higher (high educational level), and 48% with an Associate's degree or lower (relatively lower educational level). Chi-square testing showed that parents with a Bachelor's or higher were significantly more likely to provide substantive support to their children compared to parents with an Associate's degree or lower, $\chi^2(1, N = 123) = 7.62, p = .006$. They were also significantly more likely to provide logistic support compared to parents with an Associate's degree or lower, $\chi^2(1, N = 123) = 4.88, p = .027$.

Race/Ethnicity

Our tests for differences by race and ethnicity revealed that of the 111 parents who reported their race and ethnicity, there were no significant differences in the type of support provided. White parents were marginally more likely to provide logistic support compared to non-white parents, $\chi^2(1, N = 117) = 3.34, p = .068$ and were no more likely to provide substantive support compared to non-white parents, $\chi^2(1, N = 117) = 1.62, p = .203$. In addition, Hispanic parents were significantly less likely to provide substantive support

compared to non-Hispanic parents, $\chi^2(1, N = 111) = 4.45, p = .035$, but were no less likely to provide logistic support compared to non-Hispanic parents, $\chi^2(1, N = 111) = 2.16, p = .141$. However, Hispanic parents represented only 14% of the sample, so these findings need to be viewed in that context.

Features of the Science Fair

Our fourth research question focuses on understanding how the structure of the science fair influenced the extent of parent involvement. Structural differences include whether the fairs were mandatory or voluntary, whether parents were expected to be involved, and whether parents were invited to play a role in supporting their child. In some of our sample schools, the science fair projects were done primarily or entirely in class, so parents did not have an opportunity to provide extensive support. In other schools, the projects were done primarily at home, with little class time or teacher assistance, and in some of these schools there was an explicit expectation of parent support; and in others still, students worked on their projects equally in class and at home.

Mandatory vs. Voluntary Participation

For those schools with mandatory participation, teachers often provided class time for students to work on their projects; however, for those with voluntary participation, school time was rarely used for project support. Not surprisingly, we found that parents at voluntary schools were significantly more likely to provide substantive support $\chi^2(1, N = 111) = 10.6, p = .001$. In mandatory schools, approximately half of the parents provided substantive support, but in voluntary schools all parents provided this support. It should be noted, however, that we only had 12 survey responses from parents at voluntary schools, which might explain the limited amount of variation with this small sample. There was no difference for logistic support; parents at mandatory and voluntary schools were equally likely to provide logistic support to their children.

Expectations for Parent Involvement

Expectations for parents in schools that primarily serve low-income students are quite different for those from schools that serve a higher proportion of high-income students. Data from parent and teacher interviews show that, in the schools with the greatest percentage of students eligible for free and reduced lunch, parents were not expected to participate in or support their students' science fair project in a substantive way. According to teachers from these schools:

Well, we really don't require much of the parents beyond asking them to show up for the science fair... We try really hard to keep the burden of

financial as well as even participation off of the parents. (Teacher, School 426)

Some of them don't even have access to computers at home which is a reason why I would do it at school. (Teacher, School 221)

Communication With Parents

An examination of the interview data also suggests that some parents wished communication and information about the science fair had been shared more readily so they could have been more involved. Feeling removed from the experience was a common theme that emerged from the parent interviews. Some parents felt the school didn't do enough to communicate with and involve parents in the process:

Felt some bit of a disconnect...maybe if there was like an email sent to the parent saying...we're going to be doing this, and if you want to be more involved in the process or more involved in the choice or more involved with this project, let us know, and that would have been an opportunity for us being parents. We could have been more involved in the actual project instead of on the back end. (Parent, School 125)

It was hard to get a lot of the answers from teachers because again, they wanted the students to be responsible. They didn't want parents to take over, and I get that, but then there were times where the students—my son, he just was completely clueless, and I would just have to keep reiterating to him to keep going back and just ask and ask and ask until you get the right answer. So maybe, I think a little bit more in the way of just orientation for parents. (Parent, School 421)

Another parent implied that it was their child who barred them from being involved:

You know, that's the only thing that I didn't like, was that I felt like, you know, I don't know if it's because of my son or because he felt like he wanted to do it on his own, but I wish I could have been more involved in the project. (Parent, School 127)

Equity in the Science Fair

Another common thread throughout the interviews was the issue of equity. Teachers in our study were aware of the constraints put on families and had developed some ways of addressing the challenges posed by the science fair. Many teachers saw this as an equity issue, making sure all students had access to the same resources.

They can do it at home if they want, but there's a lot of kids that can't. So, what we try and do is we give them the opportunity here at school, because it's just an equity thing if we don't...there's a huge amount of support and a huge amount of wraparound. (SF Coordinator, School 123)

I think on the whole most families didn't end up getting involved, at least as far as I can see, and that was one of my goals, too, because I know that a lot of our families, not all of them, but a lot of them usually get that one parent is very busy working or both parents are very busy working. You know, the student does a lot of household chores and other things when they get home. So, I didn't want to create a new burden for a family. (Teacher, School 127)

However, other schools, even if they recognize the problem, simply don't have the resources or the capability to invest class time or teacher time. One principal mentioned his concern that the most successful students might be receiving more parent support, but also posited ideas for how to ensure equity:

I'm always curious about, well, our kids that were most successful, how much outside support did they get? Are they more successful because their parents are able to be more involved or parents have access to more resources?...and so I'm always thinking about how we can level the playing field....It'd be nice if we can partner with volunteers and/or aspiring future science teachers who maybe want to come and mentor students through their science fair project. I think that would also relieve some of the burden off of the primary teacher from feeling like, again, time they have to put in, either after school or before school or during class to support kids with completing the project. (Principal, School 127)

Teachers also spoke about the inequity of having students work on their projects at home. Lack of internet access was one problem:

Then the next day I couldn't get the Chrome Book or Net Book cart back. So, I think that's been a struggle, because they haven't had enough computer time, and like I know there are kids who don't have wi-fi at home. (Teacher, School 125)

Parents with little free time or subject-matter knowledge was another impediment to equal access:

The biggest [challenge] is support from the home. We can only do so much in the classroom. It's such a significant project, and a lot of times we have difficulty with students following through at home, and many times, it's because the parents are not fully aware of how to help them or what to do. So that home connection is really difficult we found every year. (Teacher, School 126)

Many schools also expected the parents to provide the support that schools cannot and acknowledged that success would be difficult without parental support. As one teacher said, “The parents had to be on board for these kids to succeed” (Teacher, School 221). However, this is not always possible, as one parent articulated, “I work in the evenings, and he studies in the morning, so the time I spend with him is short” (Parent, School 127). Teachers and administrators were also aware of the inherent bias towards students with parents who had the means and the time to help:

I mean a lot of students who get to do something like this with their parents, or who have parents who can support them in a much more independent environment, are sort of middle- and upper-class students. Their parents have some education, who have experience and [have] done their own science fairs. My students at my school, the vast majority of them have parents who have barely finished high school. Very few of the parents of my students have been to college. Very few parents of my students have done something like science fair...so those parents can't do the background work. I can't just throw something at students and say, okay, go do this with your parents, because my parents can't help their students. (SF Coordinator, School 127)

Teachers and some parents recognized that students with access to fewer resources at home not only require more support at school, but can also feel demoralized when comparing their projects to students with more resources, as these reflections illustrate:

I think the kids that are socioeconomically challenged, those kids who have less support at home, they have less motivation to create a project or put one together. They just require a lot more of my help, and then because they're not quite as resourceful, their projects might not look like someone else's project. So, I think that's kind of a downside for the kids who figure out, they're like, “Hey, my parents don't support me in this, and look at that fancy one that I couldn't do.” (Teacher, School 322)

It's kind of discouraging when you see somebody's project, and you're like, hmm, how much parent work was involved in that, you know? And not all parents can be involved, so it kind of makes it not—I don't want to say fair. The projects are very different. You can tell. (Parent, School 123)

In addition, for schools where participation in the science fair is voluntary and most students are from the gifted programs, the science fair can feel like a self-selecting and exclusive club that is out of reach for other students.

Also, there's the elitism of a lot, you know, the majority of the kids doing it are in gifted programs, and there's nothing wrong with gifted kids, but I wish...it kind of looks like an elitist thing if it gets too gifted. (Teacher, School 423)

The amount of support students receive from schools and parents for their science fair project is an issue of equity. Judging science fair projects of students with such different levels of support and access to resources serves to perpetuate inequities for students from households with incomes at or below the poverty level or students from historically marginalized communities.

Discussion

Parent involvement in the science fair is a complex matter. Our study found that parents viewed their students' science fair experiences as primarily a positive experience. Higher income parents and those with greater educational attainment were more likely to provide substantive support to their children, while there was limited expectation of participation for lower income parents, partially as a result of school personnel's recognition that they have less time and fewer resources available.

Results from a national survey of science fair coordinators (Kook et al., 2020) indicated that teachers in low-income schools provide *less* support than teachers in high-income schools, which means low-income students are getting both less parent support *and* less teacher support, setting the science fair up to be a selective competition. Our finding that higher income parents are more likely to provide substantive support is consistent with the literature that students from higher income homes have a greater advantage when it comes to the science fair (Bencze & Bowen, 2009). In addition, Grinnell et al. (2022) found that Black students were much less likely to move beyond school-based science fairs than students of other ethnicities, in large part because other students had greater access to resources and parent and teacher support. Some schools earnestly try to compensate for parents' lack of time, limited content knowledge, and inadequate resources to help with the science fair, with varying degrees of success.

Our study offers a unique lens on parent involvement in education. There is much research about parent involvement in school activities and students' education broadly (e.g., Hill & Tyson, 2009; Jeynes, 2007; Lee & Bowen, 2006; Wilder, 2014), but research focused on science fairs is particularly scant. However, the unique nature of a science fair project and the attention that parent communities give science fairs, as evidenced by Susan Messina's (2014) viral poster, indicates that they require attention separate from the broader, more

general studies of parent involvement in schools or homework. Our study begins this conversation, although further research that looks specifically at parent involvement in discrete academic projects such as science fairs would shed additional light on issues of equity and participation. Given the limitations of our own research, the field would also benefit from studies with a larger sample size, random sampling, and research questions that specifically explore the relationship between parent involvement and equity in the science fair.

Limitations

Study limitations included a low return rate on the parent survey, a small sample size for parent interviews, particularly for lower income parents, and a convenience sample. Due to these limitations, our results may not be representative of all parents in all middle school science fairs. However, these limitations also highlight the findings that lower income parents may feel less comfortable engaging substantively in their child's schooling and that they have less availability to participate. In 28% of the schools in our sample, participation in the science fair was voluntary; however, across our research we have found that voluntary fairs are less common (Abernathy & Vineyard, 2001; Kook et al., 2020).

Implications

In order for science fairs to be truly equitable and valuable for all students, they need to be structured in such a way as to support those goals. School leaders need to consider the equity implications of engaging students in science fair investigations and competitive showcases of their work. Some possible mechanisms for equalizing the experiences *could* be:

1. Make science fair investigations and participation in science fair events mandatory for all students. This would mean that all students, and not only the well-resourced students, participate in the competition.
2. Engage volunteers or partner with outside organizations. Parent volunteers with knowledge and expertise can be recruited to help students other than their own children, or schools can partner with local organizations who can provide mentors and/or materials for science fair projects.
3. Allocate sufficient resources at the school level. Regardless of where project work is completed, teacher time, access to materials, and space in the curriculum must all be provided for an equitable experience.
4. Do science fair projects exclusively in school. Allowing students to work at home provides an advantage to students whose parents have the time, money, and knowledge to provide support. One possible remedy is to have students work on their projects in school. To accomplish this, however, engaging outside volunteers and allocating resources at the school level become even more critical.

In order to create an equitable science fair experience, it is essential that schools develop strategies to level the playing field and ensure that all students have the opportunity to participate and the support to be successful. Cultural, educational, and socioeconomic factors can impact parent involvement in the science fair, creating unfair advantages for some students and constraining others with insufficient resources and support. Recruiting volunteers or partnering with outside organizations can help relieve some of the added strain on teachers. Schools will still need to engage parents across all levels of income and education, communicating about the purpose of the science fair, providing appropriate ways for parents to get involved, and inviting them to come see student projects. Our research has shown that science fair implementation varies considerably, with some schools creating mandatory experiences, while others create voluntary experiences; some science fair investigations occur solely in classrooms, while for others they are “take home” projects (DeLisi et al., 2020). Regardless of how a school decides to structure its science fair, school leaders will need to determine how to attend to equity so that all students are afforded opportunities for engaging in science and engineering practices. One principal in our study felt strongly that the science fair should be an opportunity for underrepresented students to thrive and that one of the goals should be “to dispel the beliefs that minority students can’t succeed at high academic levels” (Principal, School 125). Indeed, if the science fair is one of few opportunities students have to engage in authentic science, it should be accessible to all.

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