

Piloting an Outreach Program to Address Barriers to Neurodivergence in STEM

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Background:

Neurodivergent individuals face barriers to participation and success in educational and vocational settings¹⁻³. Twice-exceptional (2e) students are neurodivergent individuals who possess extraordinary cognitive, creative, or academic ability, while simultaneously facing challenges in the form of a developmental or psychiatric disability⁴. Although they have the potential for extraordinary achievement, many 2e students are not adequately supported in educational and vocational settings⁵⁻⁷. Despite multiple first-person testimonials from prominent neurodivergent academics, the experience of neurodivergent individuals in science, technology, engineering, and math (STEM) is vastly understudied⁸⁻¹². Many barriers influencing science identity, an individual's concept of their own place in science, contribute to the exclusion of systemically non-dominant groups from achievement in science^{13,14}. However, brief science outreach programs have been shown to improve science identity and thus are promising interventions for 2e students^{15,16}.

Objective:

This study aims to define the barriers that neurodivergent individuals face to participation and success in STEM education and careers. Furthermore, we attempt to determine the ability of a science outreach pilot program to address these barriers by assessing the science identity of 2e students and the attitudes toward neurodiversity in STEM of staff volunteers.

Methods:

We developed a survey to investigate barriers to participation and success in STEM education and careers and collected responses from neurodivergent individuals affiliated with the University of Iowa. For each barrier, frequency of encounter was calculated, and thematic analyses of qualitative responses were performed to reveal details about the barrier experience. We also implemented the twice-exceptional neuroscience day camp, an immersive science outreach program for 2e secondary students including a hands-on laboratory experience. We assessed the ability of this pilot program to address STEM barriers through surveys that measure its impact on both the science identity of students and staff attitudes towards neurodiversity^{17,18}.

Results:

Neurodivergent respondents (n=147) to our survey indicated that they have experienced a wide range of barriers to STEM participation and success with mental health (80%), executive functioning (78%), lack of self-confidence or sense of belonging (66%), social skills (61%), communication demands (59%), and negative perceptions by others (58%) being the most frequently experienced barriers. 2e camp participant (n=8) responses to a 24-item survey of science identity both before and after the camp indicated a trend towards a positive impact of camp experience on overall science identity (paired t-test, $p=0.17$) and significant impacts on specific survey items including “I feel comfortable talking to people who work in science careers” (paired t-test, $p=0.049$). When asked directly about the impact of the camp, 2e students reported positive impacts on science identity and interest in scientific careers. Similarly, when staff participants were asked about the impact of the camp directly, they reported positive impacts on their perception of neurodiverse individuals in STEM. They also reported that camp participation increased their ability to help neurodivergent students in college settings when prior to the camp they indicated that their level of willingness to help was greater than their ability (paired t-test, $p=0.015$).

Conclusions:

Neurodivergent individuals face a complex array of barriers to participation and success in STEM. Participation in the twice-exceptional neuroscience day camp addresses some of these barriers by positively influencing the science identity of 2e students. Finally, staff report less ability than willingness to support neurodivergent students, but participation in the camp promotes both an increase in this sense of ability and more positive attitudes toward neurodiversity in STEM overall. Future work will collect longitudinal data on 2e student participants’ science outcomes, examine neurodivergent strengths in STEM, and expand to other academic and vocational settings. This work will inform the study and implementation of specific interventions for neurodivergent individuals in STEM, including resources for mental health and executive function supports.

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