

Undergraduates' Graph Interpretation and Scientific Paper Reading Shift from Novice- to Expert-like as a Result of Participation in a Summer Research Experience: A Case Study

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Abstract

Research Experiences for Undergraduate (REU) programs often introduce students to scientific research and STEM career possibilities. However, the program impact on students and their research skill development is not well understood. In a case study with 10 REU students, the authors used eye-tracking and self-report data to determine student strategies for reading scientific papers and interpreting graphs at the beginning and end of the program. The strategies of REU students and science experts were then compared. The REU students changed their strategies and performed more like experts at posttest. These findings indicate that, during the REU, students acquired expert-like strategies necessary to engage with scientific articles and extract key information from graphs. The study demonstrates that eye-tracking can document skill growth in REU students.

Keywords: *community college students, eye-tracking, Research Experiences for Undergraduates, scientific graph interpretation, scientific paper reading*

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The 2018 National Academies report on undergraduate STEM indicators highlights the need to involve students in authentic STEM practices (National Academies 2018). Research Experiences for Undergraduates (REU) programs offer such opportunities. Many benefits of REU programs have been described in the literature—from increased enrollment in STEM majors and continuation

toward a graduate degree (Brewer and Smith 2011; Graham et al. 2013; Cooper, Jabanoski, and Kaplan 2019) to gaining professional skills (Hunter et al. 2007; Thiry, Laursen, and Hunter 2011), developing a science identity (Seymour et al. 2004; Russell et al. 2007; Hunter et al. 2007; Thiry et al. 2011; Weston and Laursen 2015; Cooper et al. 2019), and research skill building (Seymour et al. 2004; Hunter et al. 2007; Thiry et al. 2011; Linn et al. 2015), among others. The National Science Foundation (2019) describes research experience programs as “one of the most effective avenues for attracting students to and retaining students in science and engineering, and for preparing them for careers in these fields.” REU participants tend to express high satisfaction with and strong learning gains from their experience. However, using self-report data from students as an impact measure for REU programs has been criticized, and researchers have called for reliable, robust assessment of students’ learning gains from REU programs to evaluate the efficacy of REU programs, justify their cost, and help improve their design (Linn et al. 2015).

Here, findings are reported from a case study with a cohort of REU students ($n = 10$) that examined student eye-movements as a representation of the strategies employed by students in reading scientific papers and interpreting graphs before and after their REU experience at the beginning and at the end of the program and compared them to experts. A cohort of experienced researchers (“experts”; $n = 16$) was recruited to participate in the same exercises as a comparison group. Study participants were recruited from the Research Experiences for Community College