

ON THE CUTTING EDGE

Promoting Elementary Teachers as STEM Educators by David Kretschmer, Ph.D., and Steve Holle, M.A.

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Research indicates that elementary school teachers have significant gaps in their science content knowledge (Nowicki et al., 2013), which can cause them not only to develop negative attitudes toward teaching science (Palmer, 2004) but also “science anxiety” that can lead teachers to avoid teaching science (Lewis, 2015). The same can be said of math, given that most elementary teachers are not required to take high-level math or science courses in their preparation to be teachers (Epstein & Miller, 2011). This is simply unacceptable in today’s society, given that STEM (science, technology, engineering, and math) occupations are growing at 17% compared to non-STEM jobs at 9.8% and that STEM degree holders have higher incomes than non-STEM fields (Engineering for Kids, n.d.). Clearly, elementary educators need to feel efficacious and comfortable teaching STEM content to students so that, in turn, those students will feel prepared and eager to embrace STEM coursework and future careers. Currently, research shows that elementary school teachers are often ill-equipped to prepare students for higher-level success in STEM fields (Epstein & Miller, 2011).

Since research on adolescents indicates that 94% of eighth graders make course decisions related to preparing themselves for postsecondary education or a career (Akos et al., 2007), it is critical that students develop an interest in and appreciation for STEM prior to entering high school so they will enroll in courses that can prepare them for STEM majors or careers. In addition, research has shown that science achievement correlates with attitudes toward science, and that positive perceptions of science are lower among older students than younger (Osborne & Dillon, 2008). Thus, elementary teachers must feel confident in guiding their students to STEM-related classes and careers. To do so, they need to feel confident as well.

In Fall 2017, California will begin implementation of the Next Generation Science Standards (NGSS)—performance standards which require students to think like scientists and apply their scientific understandings and engineering practices in addressing real-life problems through a “lived curriculum” (Hurd, 2002). The NGSS give significant emphasis to STEM education. *Engineering is Elementary* (EiE) is a K-5 engineering curriculum developed to guide teachers in engaging students in engineering applications of key science concepts and principles. The curriculum is NGSS-based and research-driven, has undergone rigorous field-testing, and has been shown to be an effective design of STEM-related curriculum (Oh et al., 2016). EiE is a packaged curriculum containing all materials and directions for teaching students about STEM, which can help boost the confidence of both teachers and students. By using an already created curriculum, teachers who lack strong content knowledge or coursework in STEM-related areas may still provide students with the exposure, skills, and background they need to pursue additional courses in the future in the STEM fields. The result? Elementary teachers who are more confidently and more efficaciously preparing future engineers, scientists, and mathematicians for careers that are not yet even in existence!

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Elementary Education STEM Research in Action at CSUN

Our research at CSUN has focused on working with teachers at two local elementary schools over the past year. One is a charter school and the other is a magnet school in LAUSD. Using survey research, we are seeking to identify the impact of EiE curriculum on teachers' sense of efficacy and confidence in teaching STEM-related concepts. Additionally, we plan to observe participating teachers in the process of implementing EiE units and record notes for later analysis and discussion with teachers. The next step of the research is to videotape EiE lessons in progress and then engage teachers in stimulated recall during a joint viewing of the videotape. This method is intended to "get into the heads" of those teachers as they taught the lesson. Ultimately, our research will help us to understand the minute-by-minute decisions teachers make in implementing EiE and their confidence in teaching select units related to STEM. By doing so, we hope to bring this knowledge to teacher education programs as we work to prepare future elementary educators in using NGSS curriculum to support young students in the STEM fields.

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