Mathematics is a central part of all STEM disciplines, and undergraduate success in mathematics courses is an increasingly critical piece of the growing national need to train the next generation of U.S. STEM professionals. The Promoting Success in Early College Mathematics through Graduate Teacher Training project (supported by NSF Award #1539602) at the University of Colorado Denver (CU Denver) addresses this critical national issue through improved teaching preparation for Graduate Teaching Assistants (GTAs) in the Mathematical Sciences. In particular, the project focuses on how a more comprehensive approach to training GTAs can impact their classroom practice and benefit their students, ultimately increasing success, particularly in early undergraduate mathematics courses. Further, a large proportion of PhD graduates, with appointments ranging from community colleges to large research universities, have a significant part of their professional responsibilities focused on teaching undergraduates. By providing an effective model of broad graduate student training that encompasses a wide variety of components, the project will study the impact on the overall undergraduate teaching and student learning effectiveness of the GTAs. (Received September 18, 2016)