Graduate teaching assistants (GTAs) play a significant role in early undergraduate education, particularly in introductory mathematics and statistics classes, making the pedagogical preparation of this population imperative. This paper focuses on the peer mentoring aspect of a comprehensive pedagogical training program for GTAs developed in a mathematical sciences department at a mid-sized urban-serving university. Our data include classroom observations made by the faculty organizers and bi-weekly reflections submitted by peer mentors and mentees. In addition to providing an overview of our peer mentor training program, we discuss some lessons learned and program modifications that enhanced support for peer mentors that may be of interest to other departments hoping to incorporate peer mentoring into their GTA training. We also share some benefits reported by mentors and mentees in their reflections and briefly outline how the data informed a potential framework for mentor identity. (Received September 16, 2019)