Graduate Teaching Assistants Can Affect Undergraduate STEM Retention Rates: A Need For Graduate Teaching Professional Development

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Abstract
The first two years of college are the most crucial for retention, and less than 40% of entering college students actually complete a STEM degree. Graduate teaching assistants (GTAs) play a vital role in biology departments across universities by teaching the majority of introductory laboratories and discussion sections. Though GTAs are not directly attributed to attrition rates of undergraduate science majors, attrition rates can be linked with lab climate which is influenced by GTAs. However, most GTA teaching at universities and colleges is done without any formal training and this could have a serious effect on STEM retention rates. This research examines the effects of a biology pedagogy course on GTA teaching confidence and teaching concept awareness. Based on pre-assessment surveys, GTAs walk into their first day being confident in their teaching abilities; however, they had minimal knowledge of basic concepts. GTAs felt slightly more than “I have heard of this” but much less than “I know this” across all teaching concepts. There was a significant increase in both teaching confidence and teaching concept awareness, across all parameters. However most importantly, GTAs moved from an “I’ve heard of this” to an “I know this very well” teaching confidence. Importantly, this means that most GTAs are teaching with an “I’ve heard of this” teaching mentality in the majority of introductory laboratories and discussion sections where no teaching professional development or poorly taught introductory courses contribute to the significant loss of STEM majors and GTAs teach with an “I’ve heard of this” teaching mentality it is no wonder that GTAs could have a serious effect on undergraduate STEM retention. If STEM retention rates are to improve not only must we look to the current faculty, we must also train our graduate teaching assistants.

Results
Over four semesters, 43 GTAs took the teaching course. Pre-assessment results revealed that GTAs are confident in their teaching abilities, where across all questions most GTAs feel more (5.23 of 7) than moderately confident in their teaching abilities (Fig 2). Graduate TAs reported an average of 5.44 out of 7 that they were confident they could create a positive classroom climate (Fig. 2). However, GTAs felt slightly more than “I have heard of this” (2.32 out of 5, Fig. 1), but much less than “I know this” across all teaching concepts (Table 1). Specifically in areas of student motivation techniques (Table 1), GTAs felt on average 1.93 out of 5 and in classroom management techniques an average of 2.16 out of 5 (Fig. 1). In comparing pre- and post-course assessment results, a significant difference was determined in all teaching confidence and concept awareness categories. Post-course assessment results revealed that GTAs confidence rose from 5.23 to 6.80 across all confidence questions (Fig 2), and from 2.32 to 4.26 across all concept awareness questions (Fig 1).

Conclusion & Discussion
Over the course of the four semesters of this study, between the GTAs and their GTA mentors, the GTAs had the potential to affect up to 13,464 undergraduate students (Table 2). With most GTA teaching at universities and colleges is done without any formal training (DeHaan 2005; Sundberg et al. 2005; Tanner and Allen 2006), the number of undergraduates receiving an education from GTAs without formal teaching professional development is incredible. Without the Biological Pedagogy course, unless achieved under the GTAs own initiatives, these GTAs would have taught these thousand 13,464 undergraduates with little understanding about teaching. GTAs might have walked into their first day being confident in their teaching abilities (Fig 2); however, they had minimal knowledge of basic teaching concepts (Fig. 1). For example, they could not even answer the pre-assessment survey, with regards to Accommodating Students with Disabilities, GTAs responded on average 2.63, in between “I’ve heard of this” and “I know this” (Fig. 1). However, when asked their confidence in “Provide support and encouragement to students who are having difficulty learning” GTAs responded on average 5.42, more than moderately confident (Fig 2). This indicates a disparity between teaching confidence and an understanding about the theory behind teaching.

If undergraduate student leave STEM majors because of poorly taught introductory courses and there is a teaching gap in GTAs (Seymour and Hewitt 1997; Labov 2004), STEM attrition could be attributed to a lack of teaching professional development. Though GTAs have not been directly attributed to attrition rates of undergraduate science majors, attrition rates can be linked with lab climate which is influenced by GTAs (O’Neal et al. 2007). GTAs are teaching with an “I’ve heard of this” teaching mentality in many areas of the course and introduction to teaching concepts in the classroom it is imperative that they receive some form of teaching professional development. If STEM retention rates are to improve not only must we look to the lecture, focus must also give to train our graduate teaching assistants early in their graduate programs.

Teaching Concept Awareness
For each of the following items students were asked to answer the question, I have knowledge of the following teaching concepts (Answer choices are presented on a continuum between 1 and 5; 1 I have never heard of this, 2 I have heard of this, 3 I know this, 4 I know this very well, and 5 I know this so well I could teach someone else):
1. Student Motivation Techniques
2. Classroom Management Techniques
3. Reflective Teaching
4. Learning Styles
5. Questioning Strategies
6. Teaching Methods
7. Student Assessment
8. Accommodating Students with Disabilities
9. Expected Learning Outcomes
10. Teaching Philosophy Statements & Teaching Portfolios

GTA Impact Numbers

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