



A Comparison of STEM and Non-STEM Graduate Teaching Assistants' Cognition Related to Teaching

Dirhat M. Mohammed, Grant E. Gardner (Faculty Advisor)

Department of Biology, Middle Tennessee State University



Abstract

Graduate Teaching Assistants (GTAs) teach a large number of undergraduate students in many university departments yet receive few opportunities for teaching professional development (Gardner & Jones, 2011; Schussler et al., 2015). Understanding how to design effective teaching professional development (TPD) requires scholars to first elicit pre-established cognitive variables that GTAs bring to the classroom. Yet, there is little research dedicated to measuring these variables related to effective teaching in GTAs (Reeves et al., 2016). With the number of students matriculating into post-secondary school increasing, and the wide spectrum of disciplines in which GTAs teach, it is necessary to evaluate measures of cognition related to teaching to enhance undergraduate education quality and formal preparation for careers (Gardner & Jones, 2011). This study investigates the potential differences in cognition variables between STEM and Non-STEM GTAs, as well as if there were changes between pre- and post- data on five instruments including: Teacher Beliefs Instrument, Pedagogical Discontentment Inventory, Teaching Self-Efficacy Instrument, Goal Orientations Toward Teaching, and the Postsecondary Instructional Practices Survey. A Mann-Whitney U test was conducted to compare STEM and Non-STEM GTAs on these instruments, as well as a Wilcoxon Test to investigate any changes in the total sample ($n = 52$) of GTAs pre- and post-TPD at a large southeastern university.

Methods

Participants: The sample composed of $n=52$ GTAs within a range of disciplines each having taught from 1 to 6 semesters, in either M.S. or Ph.D. programs.

Survey Distribution: Questionnaires were distributed at the LT&ITC GTA Teaching Preparation Certificate Program with five instruments measuring the GTAs' cognition before and after the TPD program.

Data Analysis:

Part I: Confirmatory Factor Analysis (CFA) was conducted to provide validity evidence for the instruments used.

Part II: Quantitative Analyses

RQ I: Mann-Whitney U Test was conducted to determine the statistical differences between the two groups.

RQ II: Wilcoxon Sign-Rank Test was performed to investigate changes in cognitive sub-scales on the instruments used pre- and post-TPD.

Part III: Interviews were held with $n=7$ GTAs to gain a better understanding of GTAs' attitudes and beliefs towards teaching.

Research Questions

RQ I: Is there a statistical difference between STEM and Non-STEM GTAs' cognition related to teaching?

RQ II: What changes in cognitive sub-scales on these instruments do we see between TPD pre- and post-data?

Results

Part I: A Validation of Five Instruments

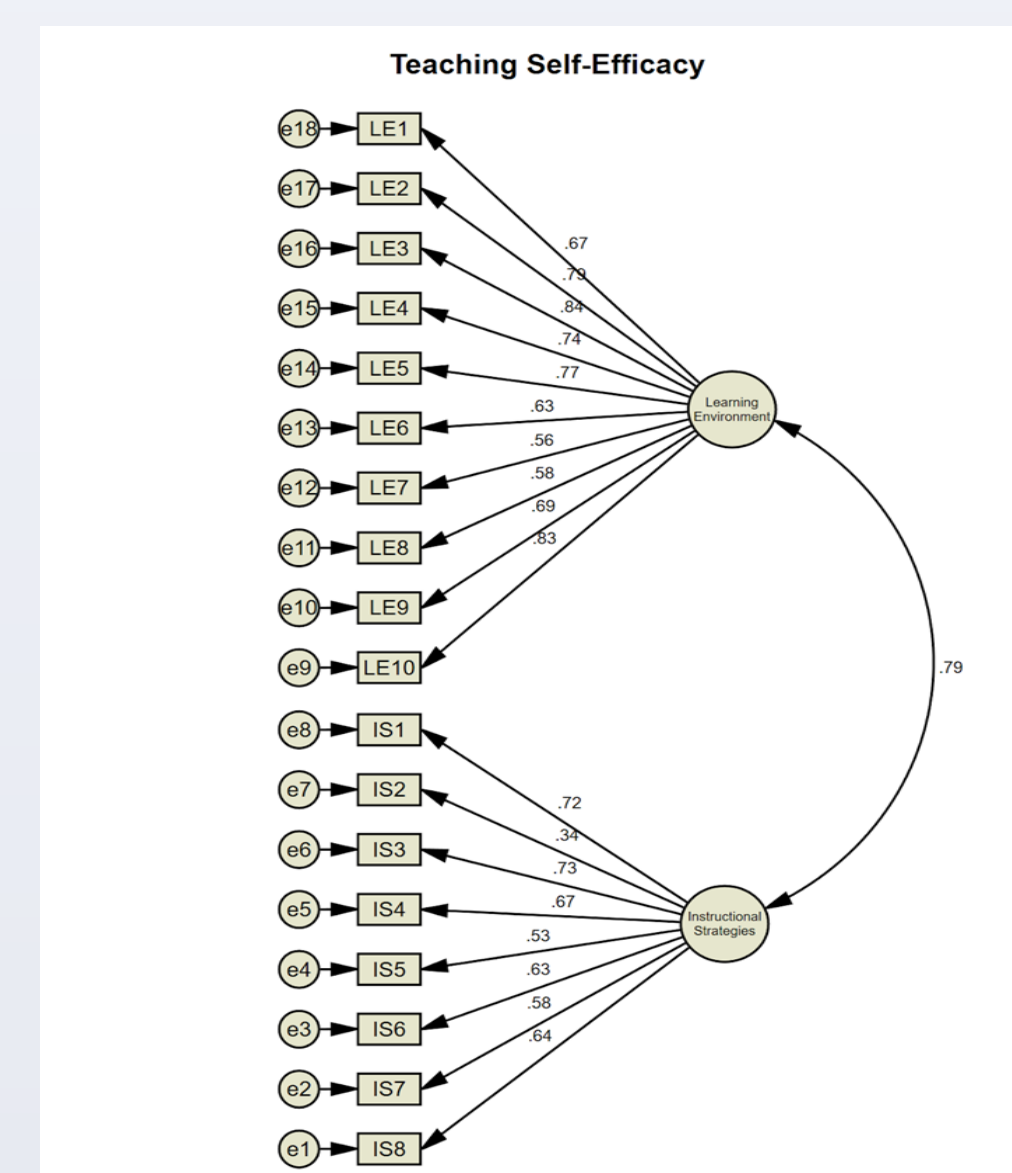


Figure 1: CFA of Teaching Self-Efficacy instrument. CFI= .66; RMSEA= .15; TLI= .57

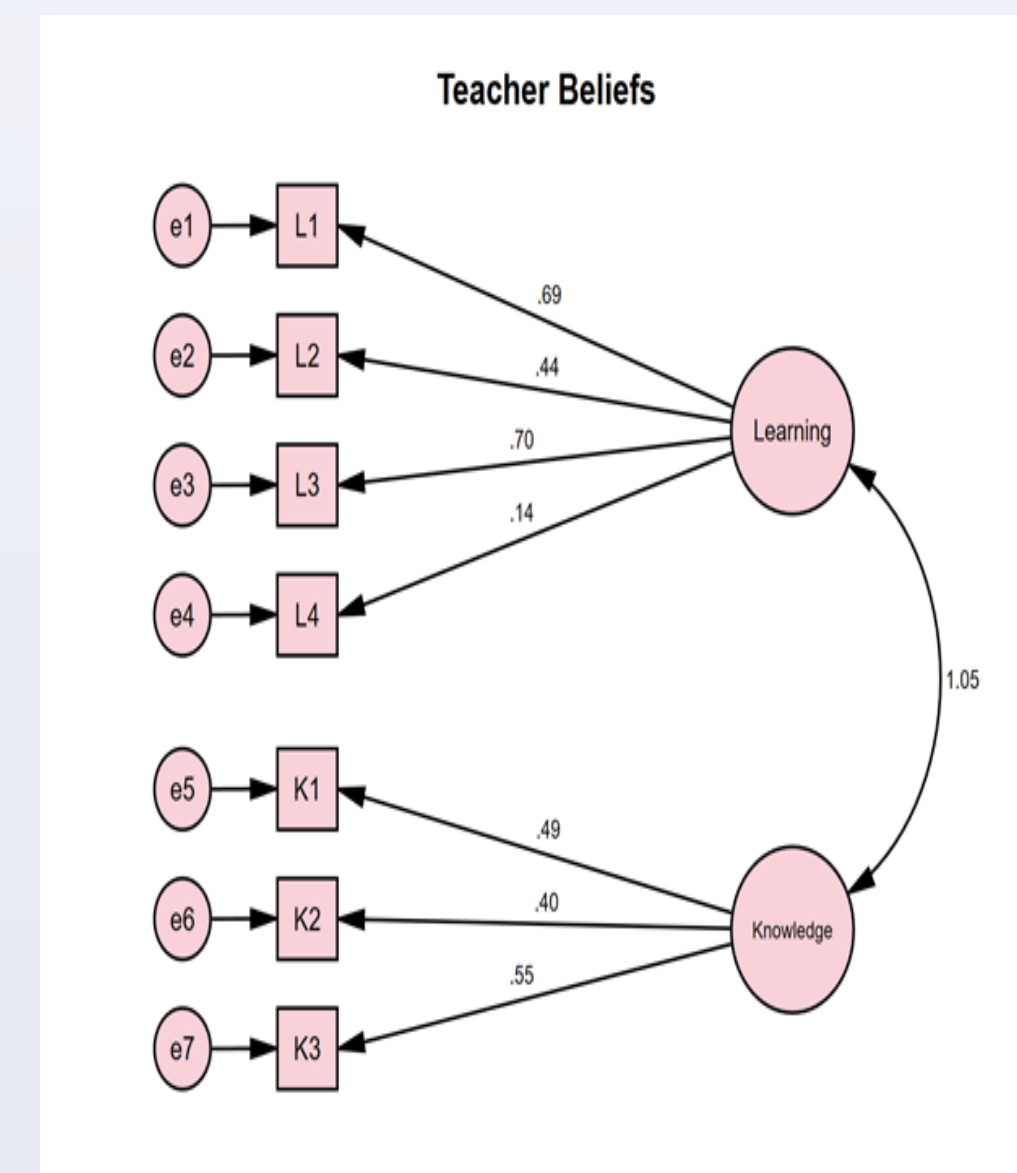


Figure 2: CFA of Teacher beliefs instrument. CFI= .81; RMSEA= .11; TLI= .58

Part II: Differences and Changes in Cognition Related to Teaching Research Question I:

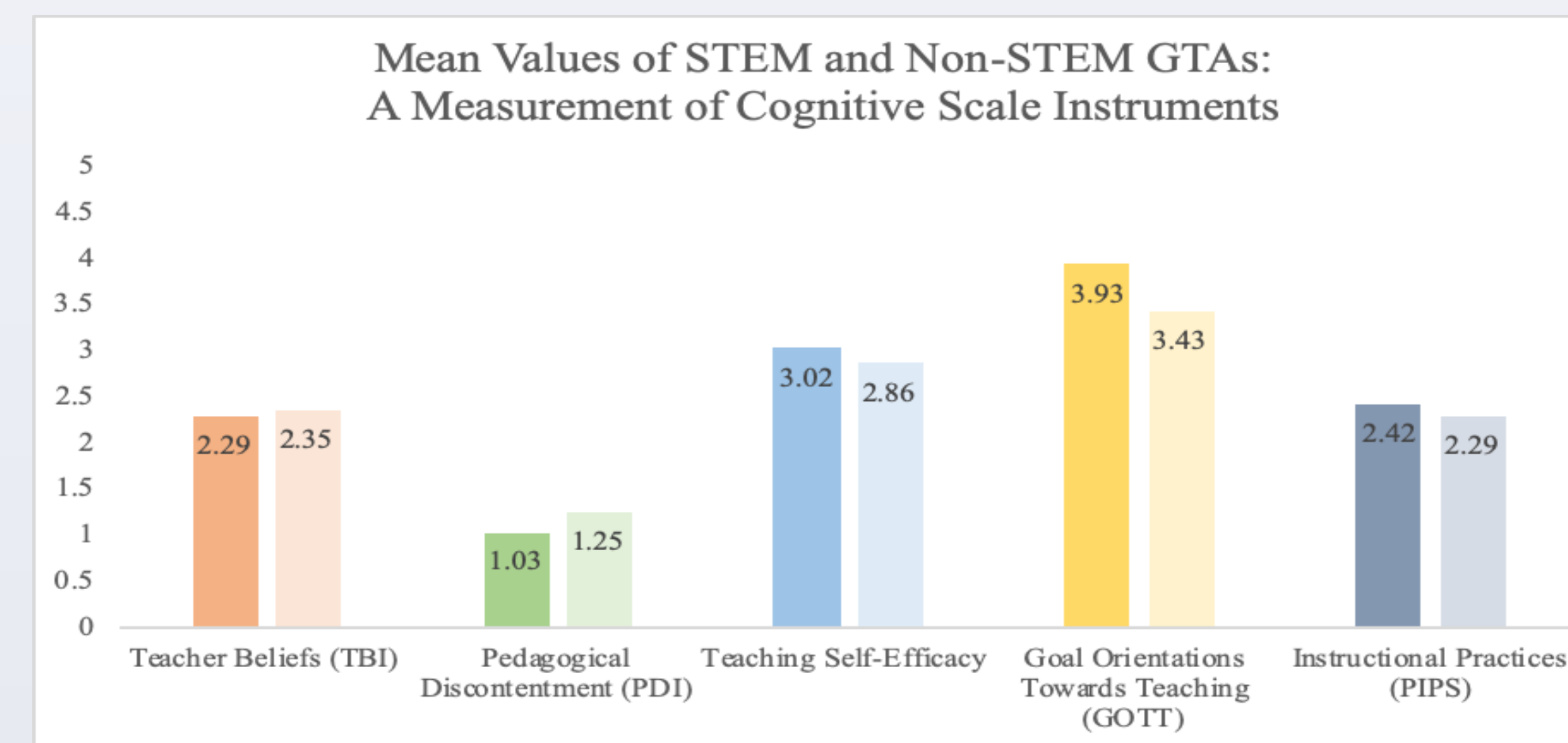


Figure 3: Teacher Beliefs, $p=.693$; Pedagogical Discontentment, $p=.246$; Teaching Self-efficacy, $p=.646$; Goal Orientations Towards Teaching, $p=.132$; Instructional Practices, $p=.455$

Research Question II:

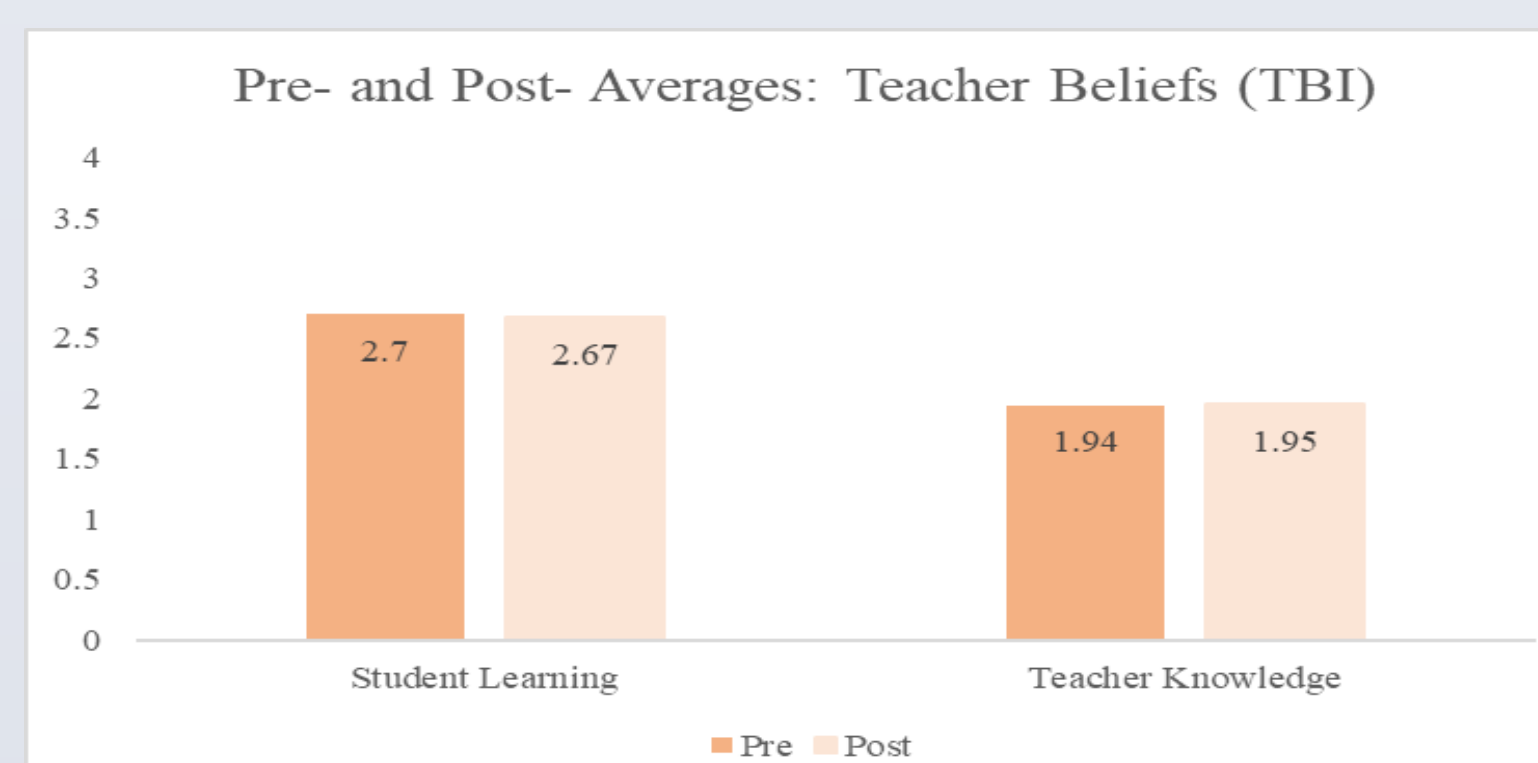


Figure 4: Student Learning $p=.195$; Teacher Knowledge, $p=.694$

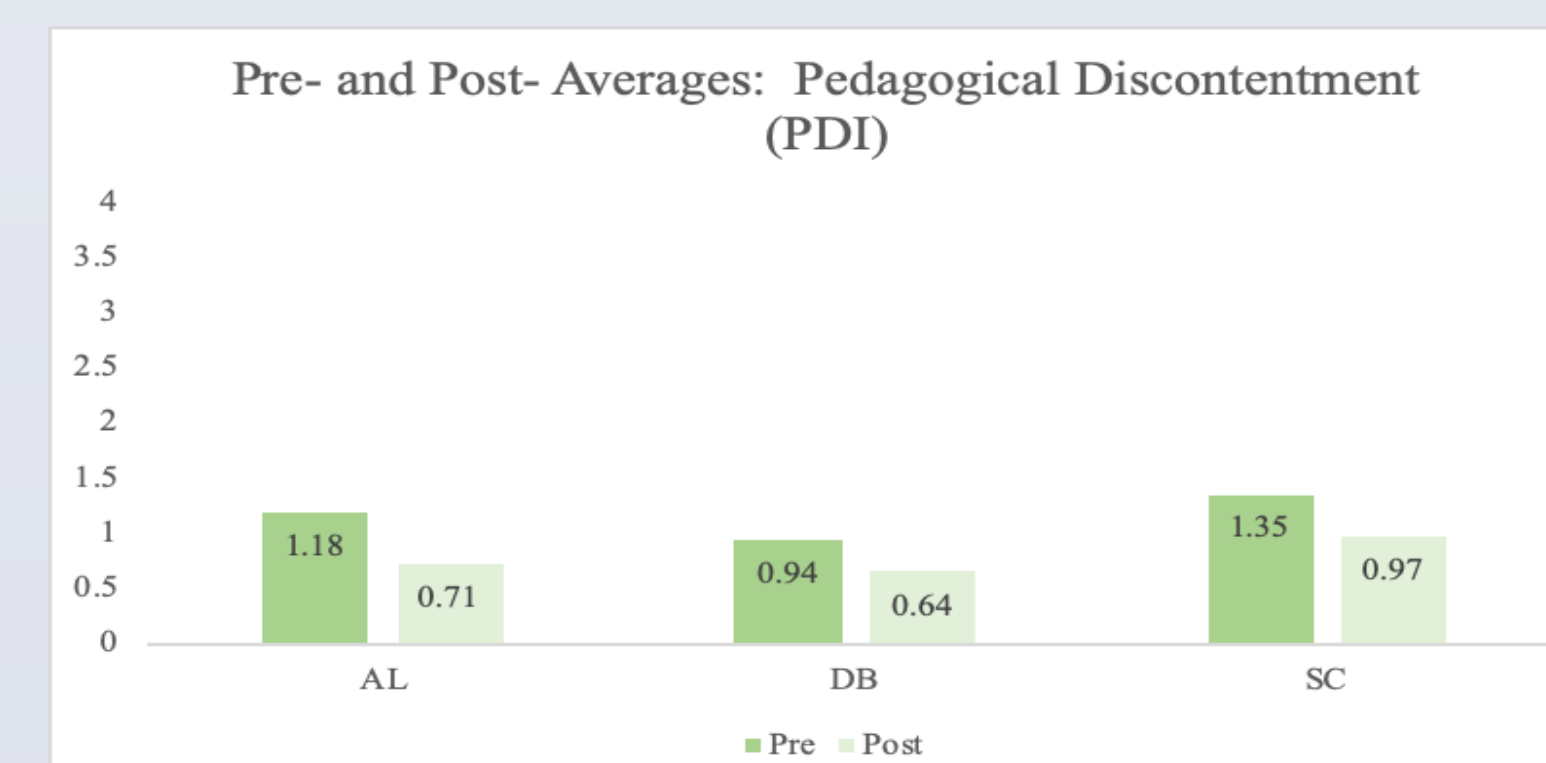


Figure 5: Ability to Teach All Students Science, $p=.347$; Balance Depth vs. Breath of Instruction, $p=.674$; Science Content Knowledge, $p=.153$

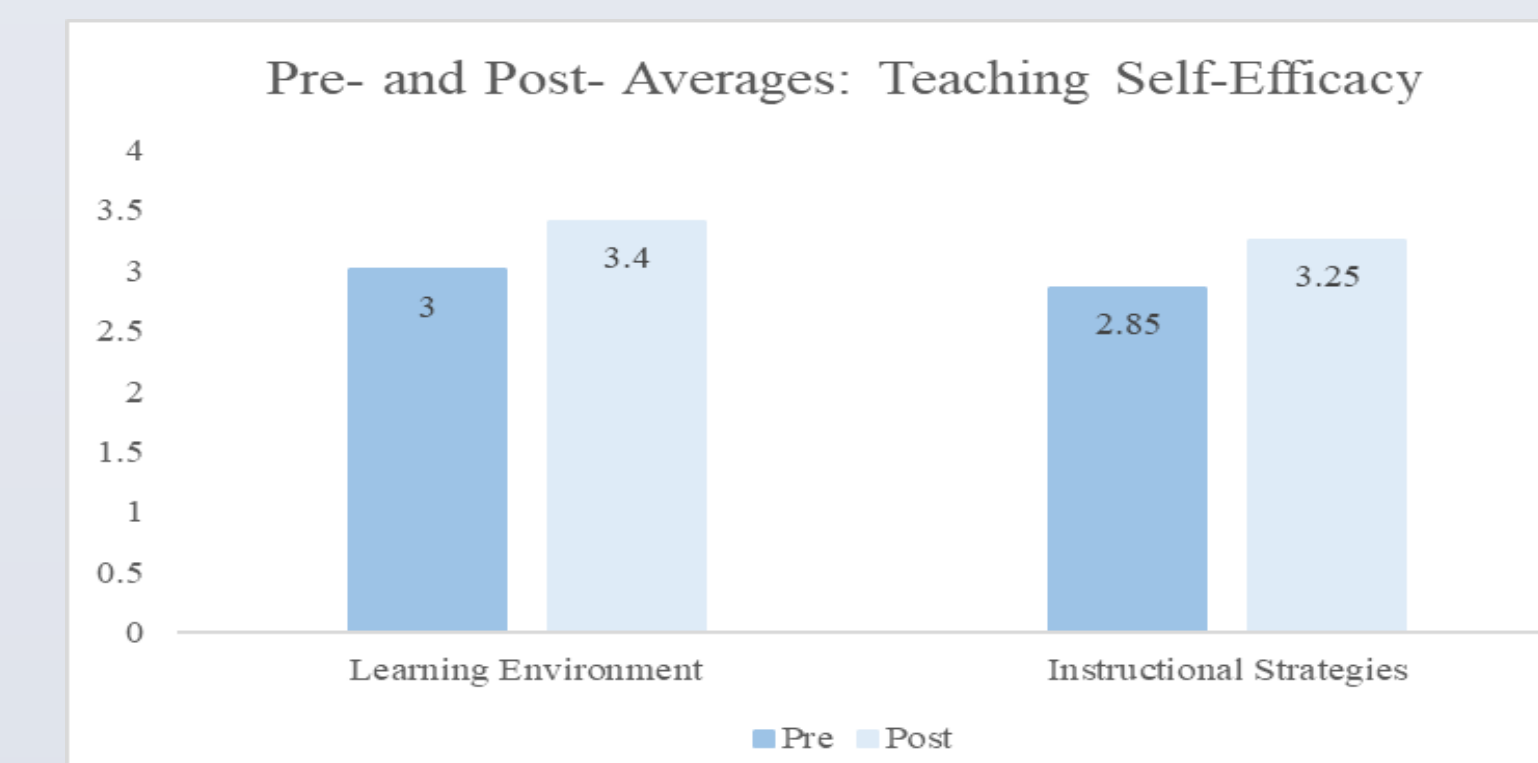


Figure 6: Learning Environment, $p=.146$; Instructional Strategies, $p=.056$

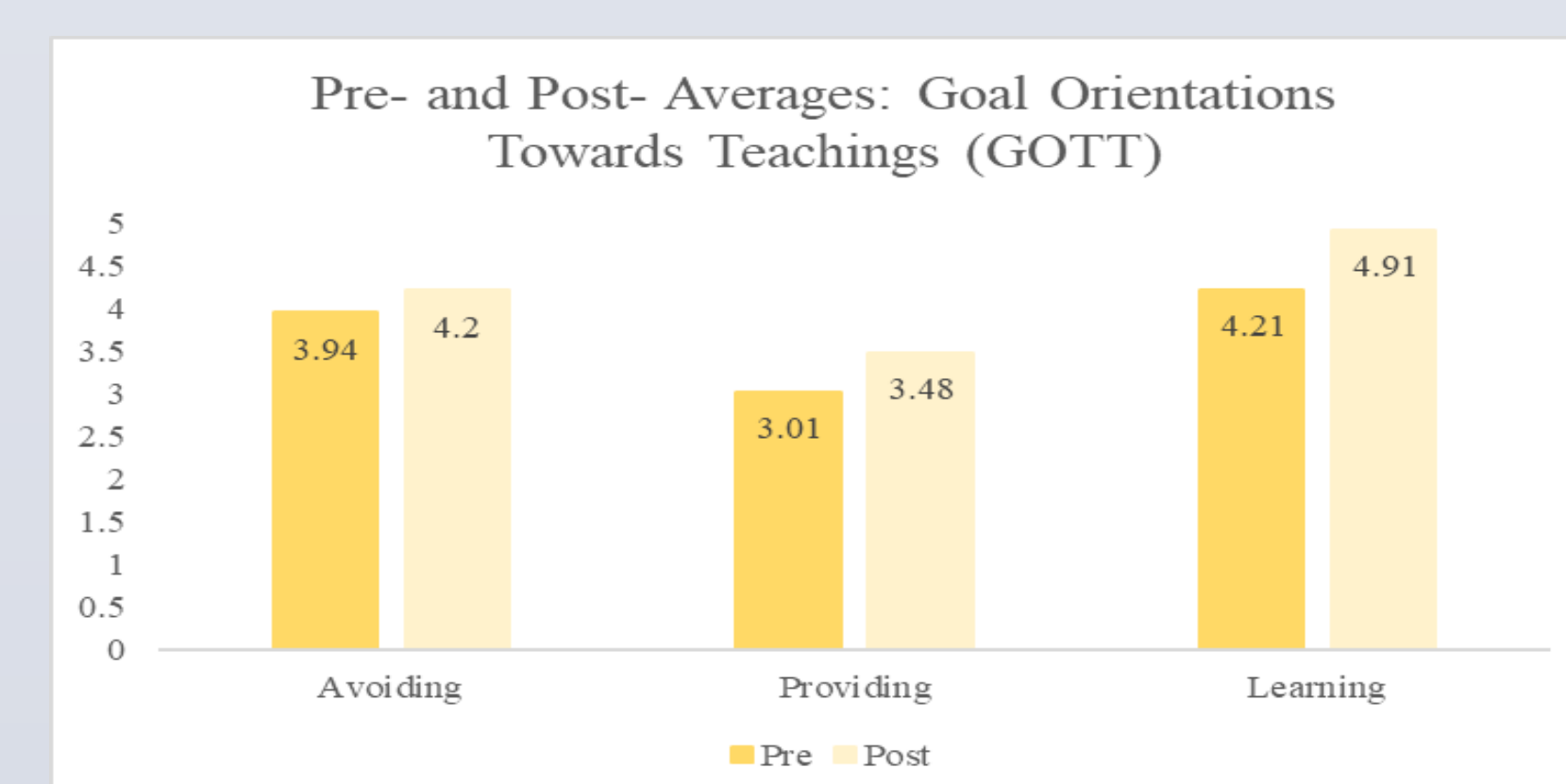


Figure 7: Avoiding, $p=.100$; Providing, $p=.116$; Learning, $p=.007$

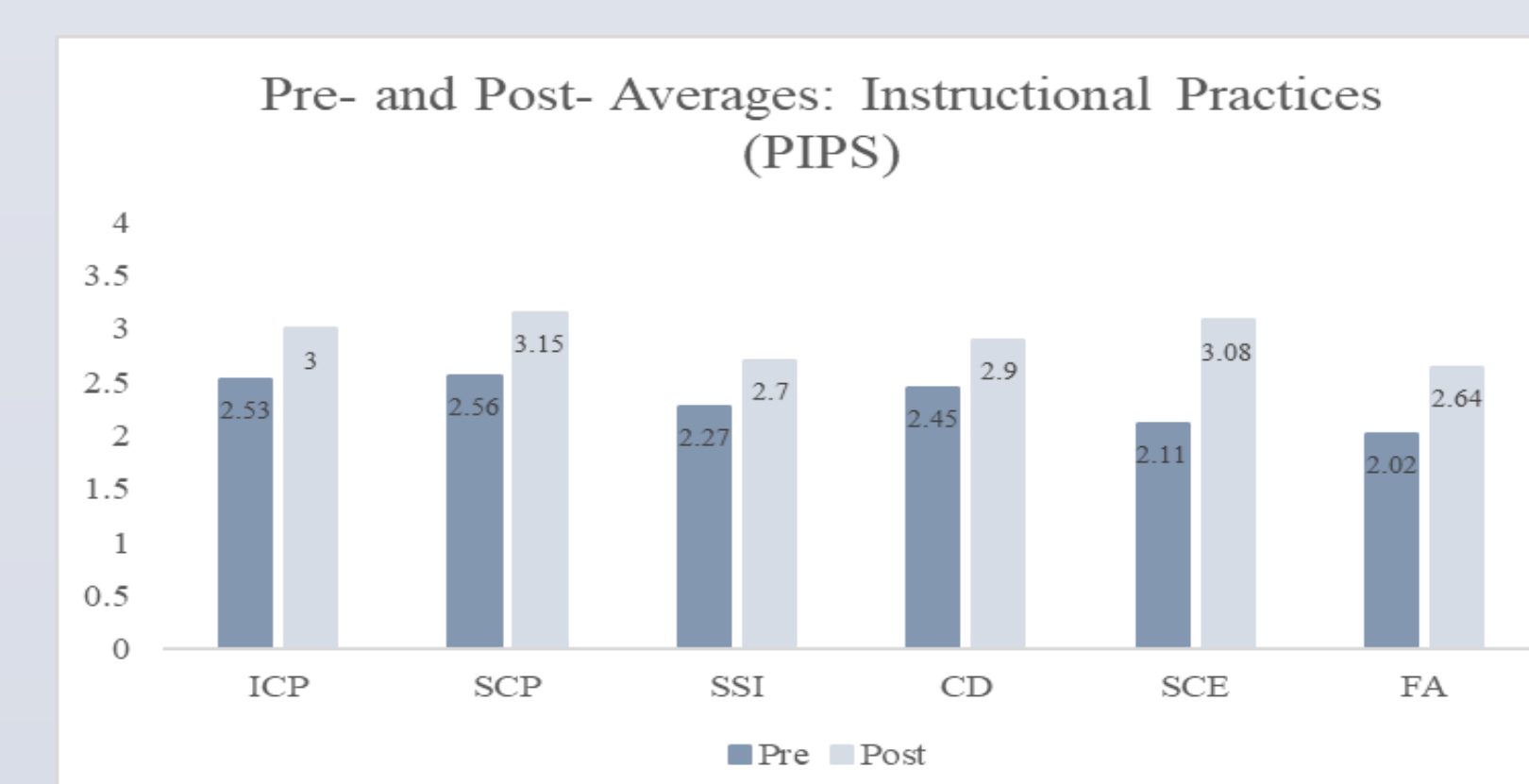


Figure 8: Instructor-Centered Practices, $p=.064$; Student-Centered Practices, $p=.003$; Student-Student Interactions, $p=.061$; Contact Delivery, $p=.053$; Student-Content Engagement, $p=.003$; Formative Assessment, $p=.033$

Part III: GTA Interviews - Attitudes and Beliefs Towards Teaching:

GTA 1: Sociology, 4 Semesters of Teaching

❖ “I really liked one session where they brought in professors from different backgrounds...English, science departments, history, and they all gave tips as to how they keep their students engaged, and the different types of methods they use. Every student is different”.

GTA 2: Chemistry, 4 Semesters of Teaching

❖ “I always feel like there is another way I could teach something different...It helped me the most when we did actual teaching demonstrations...I liked that the other GTAs in the program...were not STEM at all...I liked to see how they taught...it made me think, ‘how do I relate this to them’”.

Discussion & Implications

Based on this sample, we conclude,

there is *no* statistically significant *difference* between *STEM and Non-STEM* GTAs' cognition related to teaching.

there *were* statistically *significant* changes between pre- and post-surveys before and after the teaching professional development program.

All changes that did occur, proceeded in a positive direction, with increases in,

- ❖ overall confidence in their teaching self-efficacy
- ❖ all subconstructs measuring Instructional Practices
- ❖ their learning orientation towards a certain task or goal

Directions for Future Research

Currently, qualitative interview analyses are being done with STEM and Non-STEM graduate teaching assistants which will allow us:

- ❖ to gather qualitative data, that is directly related to *their* experiences, which will help us understand how the beliefs, goals, efficacy, pedagogy, and practices toward teaching compare between STEM and Non-STEM GTAs.

Acknowledgements



❖ This research is funded by an Undergraduate Research Experience and Creative Activity (URECA) Grant.

References Cited

- DeChenne, S.E., Enochs, L.G., & Needham, M. (2012). Science, Technology, Engineering, and Mathematics Graduate Teaching Assistants Teaching Self-Efficacy. *Journal of the Scholarship of Teaching and Learning*, 12(4), 102-123.
- Kucsera, J.V., Roberts, R., Walls, S., Walker, J., & Svinicki, M. (2011) Goal orientation towards teaching (GOTT) scale. *Teachers and Teaching*, 17(5), 597-610. DOI: 10.1080/13540602.2011.602212
- Southerland, S.A., Sowell, S., Blanchard, M., & Granger, E.M. (2010). Exploring the Construct of Pedagogical Discontentment: A Tool to Understand Science Teachers' Openness to Reform. *Research in Science Education*, 41:299–317. DOI 10.1007/s11165-010-9166-5
- Walter, E.M., Henderson, C.H., Beach, A.L., & Williams, C.T. (2017). Introducing the Postsecondary Instructional Practices Survey (PIPS): A Concise, Interdisciplinary, and Easy-to-Score Survey. *Life Sciences Education*, 15(4). <https://doi.org/10.1187/cbe.15-09-0193>
- Luft, J.A., Roehrig, G.H. (2007). Capturing Science Teachers' Epistemological Beliefs: The Development of the Teacher Beliefs Interview. *Electronic Journal of Science Education*, 11(2)