Report on the TRESTLE mini seed grant proposal for attending the Early Career Geoscience Faculty Workshop: Teaching, Research, and Managing Your Career in July 2016

Objectives: Attending the early career geoscience faculty workshop was very worthwhile, and I very much appreciate the TRESTLE mini-grant, which allowed me to attend. Before attending, my main goals for the workshop, as described in the TRESTLE mini-grant proposal, were:
1. Gain more in-depth knowledge on the best way to implement evidence-based teaching techniques, in particular on how to actively engage students in small and large classes
2. Learn how to bring real data to the classroom
3. Exchange teaching ideas and experiences with other geoscience faculty members interested in teaching techniques.

I feel that I achieved all three goals. In particular, we didn't just learn about active teaching techniques, but were directly exposed to several active learning techniques during the workshop, as they were used to teach us about active learning. This means we actually got to experience them, which was very helpful to fully understand how they can be used and how to best implement them in a class. This was very effective, and made me excited to try them, much more so than just reading about them. It was also great that we had time at the workshop to work on our own teaching strategies, which allowed us to personalize the content we learned and work on designing activities we want to try, before we were back in our busy life's at home and forgot about them. That really helped to actually have an initial plan to implement this fall in the first class. There was also a session on using real data in the classroom at the workshop, and through that session and discussions with other participants I decided I could actually have the students learn how to use a supercomputer to analyze real climate model output for homework questions and for a class project, something I would not have dared to try before. As a result of the workshop, I applied for a classroom allocation on a supercomputer, taught the students how to work with real data on that supercomputer, and tried many new evidence-based teaching techniques in my small (10 student) graduate level class (ATOC5051 – Introduction to Physical Oceanography). Before the workshop, I had only used clicker questions and some think-pair-share. After the workshop, I felt empowered to try "harder" techniques, such as actual group work in class on whiteboards, many group discussions, some all class discussions (since it was a small class of 10 students), Gallery walks, and worksheets in class. They all worked really well, and while I found that thinking of ways to implement them took more time than making a traditional lecture, whenever I took the time to design active learning activities class was better, students were more engaged, they retained the concepts better that they had explored in active learning activities, and class was just a lot more fun and rewarding. As a result, when I teach this class again next fall, I will try and use more elements of a flipped classroom, so I can include even more active learning elements by shifting more of the content delivery to pre-class readings, so we can use the class periods as times to review and practice the topics rather than hearing about it for the first time. Working with the climate model output on the supercomputer also worked out really well, and the students appreciated learning some real skills in class that they can use for their

research in the future (some basic unix commands, how to write code to analyze netcdf data and make plots in matlab, strategies of how to work with big-data (20+TB)). It was time-intensive to set-up the homework assignments using the model output, but I feel it was totally worth it, as the students all learned a lot (and enjoyed it). And the final class projects, where they all picked an ocean topic of their choice and investigated it with the model output, blew me away, as they all did such great research, most of them entirely on their own, with impressive results. For this graduate level class, working with real data really paid off, as it taught them real skills and gave them an opportunity for their ATOC1060 recitations, preparing them for their PhD research. And they noted on the final evaluations that they really enjoyed this aspect of the class and learned a lot from it.

Assessment: To assess the effectiveness of my teaching, and the use of the active learning techniques in particular, I solicited stop-go-change midterm evaluations as well as a specifically designed end of semester evaluation from the students. On these, all students reported that they liked the active learning techniques used in class, as it helped them stay engaged and dive deeper into the topic rather than just absorbing it passively. It took some of the students a while to come out of their shell and participate in the in-class group work, but all of them reported that they benefited from that, and in their advice to next semesters students, they often wrote variants of "Talk to peers and ask questions". In terms of which active learning techniques were most helpful for their learning, students differed somewhat, but think-pair-share and clicker questions were helpful for everyone, and the students actually asked for more clicker questions to test their knowledge. Most found the group discussions and group work on the boards helped them learn, and many commented that they were very useful and there should be more of them. However, 2 students circled that these two activity were not helpful for their learning, but those same two wrote elsewhere that they grew to enjoy these as the semester went on and made them more comfortable talking to classmates and asking questions. So I feel encouraged to use these learning techniques even more next semester, even if some students initially do not enjoy them, as I think all of them benefited from them. Seeing that they work and are largely appreciated by the students helps to justify the increased time it takes to design such active learning activities.

Broader impacts: As promised, I shared the knowledge about active learning techniques that I gained at the workshop with the TRESTLE scholar community this fall. During the first week, I shared the handouts on the active learning techniques with them, and gave a short report on the workshop in this setting. I also frequently referred to experiences from the workshop during the fall TRESTLE meetings. I also attended ~50% of the annual TRESTLE workshop at CU this fall.
By using the active learning techniques in ATOC5051 this fall, I also impacted the student's learning experience in this class. As the COPUS class observation of activities in class showed, it reduced the amount of lecturing I probably would have done otherwise (~80% or more) to about 40% on average. In individual classes the lecture portions varied widely, from 2% over 53% to 67% in in the three observed classes, depending on the topic and how much time I had to prepare for class. Group activities took on average 28% of class time, and thinking 11%, which is probably also a lot higher than what it would have been otherwise.

In the next semester, I will try and implement active learning techniques in the 100-student non-science major science class I will teach. And in particular, I will design the recitations to be active learning experiences, rather than just another lecture. To achieve that I will develop activities to share with the TAs and LAs teaching these recitations, as well as teach the TAs and LAs about active learning techniques. We will see how it goes, as I think it will be more difficult in a larger class, but I am motivated to try, and excited to have the TAs and LAs learn about active learning techniques. And next fall, when I teach ATOC5051 again, I hope to reduce the lecture portion even further, and include even more active learning activities.

Summary: I think participating in this workshop at the start of my teaching career really paid off, as it made me more comfortable trying new things, having talked to others who had make it work and having a good understanding of the effectiveness of the different methods. I therefore highly recommend this workshop to others in the geosciences and have already encouraged a new hire in my department to apply to the 2017 edition (http://serc.carleton.edu/NAGTWorkshops/earlycareer/index.html).