Motivations and Evidence for Science Center-based Teacher Education

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- 4 sessions per year
  - 2 in summer (1 week)
  - 2 in academic year (6 days spread out over the year)
- 2 cohorts of ~64 participants each
- Most attend in pairs, teaching 4-8th grade
- Preference given to teachers in lower resourced schools and/or new to teaching science
- Support
  - Substitute teachers
  - Material resources
  - Busses for class field trips to Museum
  - Online professional learning community
  - Graduate credit at some local universities
  - PD hours toward state certifications

In this study, the subjects of the two courses were environmental science ("Expedition Green") and physical science ("Get Re-Energized"). About 50% of our participants reported no anxiety towards PD in general when they started the course. Asked separately, 49% also reported that they typically do not enjoy PD experiences.

Major Findings

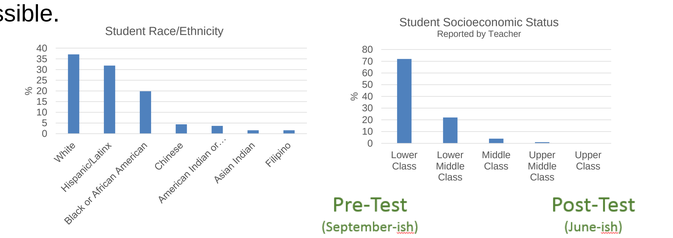
We found causal evidence that museum-based PD can impact both teacher and student learning.

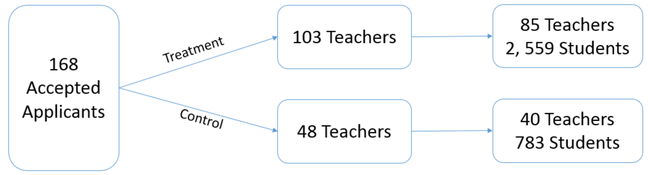
- We used instruments teachers and students often run across during standardized testing
- If item format includes open-ended answers, evidence of learning is even greater.
- Results were found across a diverse set of students, schools and school districts.
- Student attitudes towards science were not affected
- Teacher anxiety lowered and self efficacy increased
- Teachers report more engaging in more student-centered activities

Museums are an effective place for teacher education! Perhaps this is due to their available resources, teacher-centered strategies and that teachers may see them as more fun and accessible (less daunting).

Research Design

The study was designed as a randomized, controlled trial with ecologically valid instruments (i.e. test content and formats that teachers and students experience in the real world) and a wide, varied subject population so as to make it as causal, and generalizable as possible.





Instruments

A total of six tests were developed. One teacher test was developed for each of the two courses. It consisted of:

- Dimensions of Attitude toward Science (DAS) Instrument (van Aalderen-Smeets & van der Molen, 2013) – designed to measure science attitudes of teachers in PD courses
- Behavior Scale for Inservice Teachers (van Aalderen-Smeets, et al., 2013) – designed to measure teacher classroom actions
- Subject Content Knowledge (2)
  - ~17 items, multiple-choice with "Explain" prompts added to five of the items (constructed response)
  - Questions taken other established instruments (mostly state and national standardized and AP tests)

Four student tests were developed. For each course we developed a test for grades 4-5 and another for grades 6-8. It consisted of:

- Attitudes towards science of secondary school students (Barmby, Kind, & Jones, 2008) – a Likert scale self report measure
- Subject Content Knowledge
  - ~17 items, multiple-choice with "Explain" prompts added to five of the items (constructed response)
  - Questions taken other established instruments (mostly state and national standardized and AP tests)

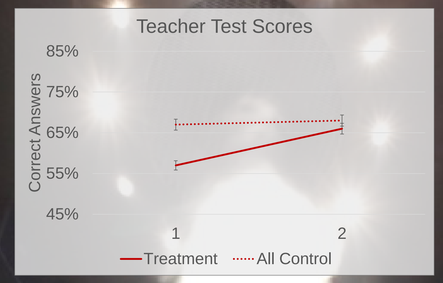
Experience Sampling – Changes *During* the School Year

In a separate study of 84 teachers in the 2017-2018 courses, we sent biweekly text messages to measure how attitudes/behaviors change in between our PD sessions. We found consistent change for the most part, meaning no specific changes associated with specific PD days. Anxiety dropped and the frequency teachers created their own 3D lessons increased consistently. We did find that "tension" around their upcoming PD session showed more variability towards the end of the year than the beginning. This may reflect that traditional end-of-year fatigue affects PD as well as teaching. (This data is still being analyzed.)

All differences are statistically significant, p<.05

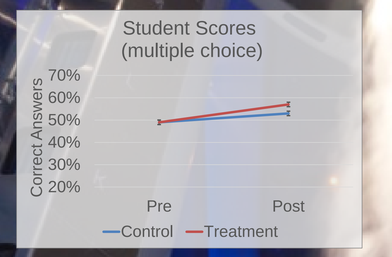
Teacher Test Scores

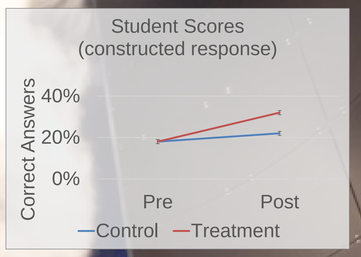
Teachers in the treatment group showed a 7% gain in subject content knowledge over the control group. All differences are statistically significant.



Student Test Scores

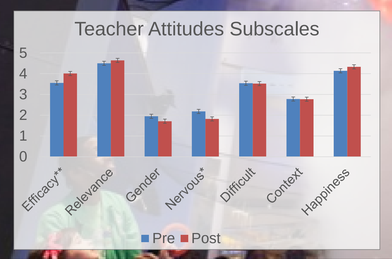
Students of teachers in the treatment group showed a 4% gain in subject content knowledge over the control group on multiple-choice items and an 11% gain on the constructed response items. All differences are statistically significant.

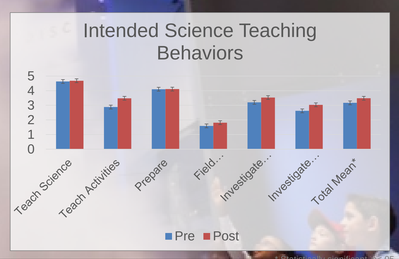




Behavior and Attitudes

There was no overall change in science attitudes of teachers or students over the control groups but we did find differences in teachers' reported self-efficacy and teaching anxiety levels, plus PD teachers reported doing more student-centered activities than the control group. All teachers came into the PD with high initial excitement, perhaps reflecting its context within an informal learning environment. Marked items are statistically significant, *p<.05, **p <.01.





*Statistically significant results

Next Steps

Study details and results have been published under an open access license, meaning anyone can access and share the article for free. Download it at **https://tinyurl.com/museumPD2**

Price, C. A. & Chiu, A. (2018). An experimental study of a museum-based, science PD program's impact on teachers and their students. *International Journal of Science Education, 40* (9), 941-960. doi:10.1080/09500693.2018.1457816

We are planning a 2-year follow up study this spring with the same teachers and their current students to measure how the impact changes over time.

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