Exploring NITARP's Impacts on Teacher's Knowledge, Attitudes, and Teaching

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Abstract

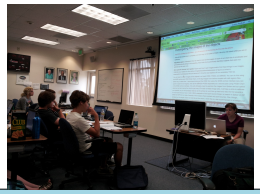
This qualitative study describes how the NASA/IPAC Teacher Archive Research Program (NITARP) changed teachers' thoughts about astronomy and what happened in their classrooms. Teachers reported increasing astronomy content knowledge, incorporating the use of real data, and implementing new skills, programs, and research into their curriculum. They also felt more confident in teaching how science is done. The results of this exploratory study showing positive impacts motivate us to more deeply study the underlying mechanisms in this and similar programs best poised to improve science education. Direct quotes from participants will be used as evidence to these findings.

NITARP Students at JPL

What is NITARP?

The NASA/IPAC Teacher Archive Research Program (NITARP) partners a group of teachers (typically grades 8-14 and informal educators) and their students with a research scientist. The teachers and their students collaborate on a unique research project for one year. The teachers and their students present the results of their work at the AAS.

Students at Caltech



Research Questions

1. How do teachers' attitudes toward science and scientific inquiry change after participating in NITARP?

2. How are teachers' classrooms different because of NITARP?

NITARP Timeline

January AAS Conference	February-March	March-April	May	June-July	August	Sept-Nov.	December	Jan. AAS Conference
-Incoming teachers meet mentor scientist and other teachers in group. -Teachers navigate their 1st AAS conference. -Discuss research ideas and astronomical targets.	-Teachers begin literature review on selected topic and target. -Teachers write research proposal and submit for peer review. -Peer review panel is composed of former NITARP teachers and astronomers.	-Teachers continue literature review. -Teachers select students to work in research group. -Practice accessing archival data. -Source matching, if applicable.	-Student research group reviews the literature. -Teachers and students work on background information and research skills. -Make Travel Arrangements	-Travel to Caltech for one week. Tour campus and JPL. -Attend lectures on background information. -Install required programs. -Continue data collection and analysis.	-Teachers and students work on research in earnest at home school. -Remote collaboration with other students, teachers, and mentor scientist via e-mail, telecons, and the NITARP CoolWiki.	-Obtain any additional data. -Continue analysis.	-Research concludes. -If the research is not completed, the incoming team may pick up where prior team left off. -Collaboratively work on science poster and an education outreach poster.	-Teachers and students present their results at the AAS. -Teachers' 2nd AAS meeting. -Teachers meet with incoming NITARP class to share their experiences

Results

How did teachers' attitudes toward science and scientific inquiry change after participating in NITARP?

New discoveries/Changes in science
Teachers often do not have the time to stay current with scientific discoveries.

"I felt wanting to stay on the cutting edge and keeping fresh in astronomy" (Participant 5).

The Language of Science
Each discipline has its own jargon. This can be intimidating for people outside of that discipline. For teachers to incorporate authentic research experiences, they need to be fluent in the language of science.

- "Certainly the different language that is spoken by scientists versus educators and learning to get more familiar with the scientific lingo and language was huge. That's something that happens by being together in a room and talking about stuff. As a teacher, being able to translate too. Translate what the scientist is saying to my students" (Participant 5).
- "The communication modality between the scientists and teachers. Scientists have a vocab and a modality where they verbalize and apparently their colleagues can just take that one or two verbalizations and then incorporate it into what they need to do, and execute it into what needs to be done. Educators present using a lot of modalities; visual, kinesthetic, etc." (Participant 2).

Astronomy Research Process

- "I came from industry and then I started teaching. And this whole idea that there's a scientific method, I had never even heard of until I started teaching. And it's like, the what? There's steps to the scientific method? …It [NITARP] gave me more confidence from someone outside the teaching field coming into teaching. …I need to get these kids to think and think logically and that's how you do science" (Participant 3).
- "I think the summer told me what astronomers do….At the AAS, you see the results of their work, but at Caltech, [our mentor astronomer] kept telling us at the AAS, don't tell them about APT [Aperture Photometry Tool], don't tell them about this, just tell them your final results. So the AAS gave us their final results, but it doesn't tell me what they do for a living" (Participant 3).

Remote collaboration/ Simulation of how scientists work

- "Having my students work in cooperative groups/research teams has added greatly to their research experiences. This modeling of how 'real scientists' work has turned out to be quite successful" (Participant 1).
- "I don't recall finding unexpected results. One data point confused [our mentor astronomer]. Thought maybe there was a ring. How it was resolved was how she collaborates with other researchers to find the answer" (Participant 2).

How are teachers' classrooms different because of NITARP?

Incorporate more real data
Traditional labs often have students verifying a known law.

"I use authentic data when I can and I have stopped pretending that the 'canned' labs we do really have any unexpected outcome" (Participant 3).

The scientific research process
Because of NITARP, teachers felt they were better able to explain the scientific research process. Often, the scientific method is taught as a series of linear steps as opposed to how the scientific research may not be linear and is often an iterative process.

- "I have discussed the methodology of our research regarding young stellar object detection, its purpose and relevance to astronomy, and how scientific research is conducted in my classes during my participation phase. Now that my participation phase is complete, I intend to incorporate our findings and more details of what we did in the Fall of 2013 class" (Participant 2).
- "The most recent project, it was surprising that everything we came upon was a unique situation and that was kind of frustrating. Because we weren't quite sure, we thought we had a good handle on the situation and we thought we knew what we were doing. But oh--that's a unique situation and that doesn't fit into our scheme. That was this year" (Participant 1).

Students' Use of Archival Data
Students can access research-quality data .

"We have 18-20 computers that have DS9 and APT installed. We use those programs to explore [archival] Spitzer data" (Participant 4).

Implement New (or more) Technology
Teachers learned new skills and programs that were then implemented in their classroom.

"I do a small amount of Python programming which I hope to expand" (Participant 3).

Conduct a research project
Teachers are conducting independent research projects with their students.

- Participant 3's students conducted an independent investigation of the light curves of an asteroid. Without NITARP, she would not have had the confidence to take this study farther. Her students completed the project, presented their results at an AAS conference, and were awarded a grant to pay for travel to the conference from the Soffin group .
- Participant 5's students have been involved in a variety of research projects. The participating students have won many awards and scholarships. His students have competed in two International Science and Engineering Fairs. One student finished fourth and another student won a $50,000 scholarship. Another student group was awarded 1st place for their research on cataclysmic variable stars.

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Conclusions

-All teachers changed their classrooms in some way because of NITARP. Examples of this change include incorporating real data into labs and inquiry-based activities, integrated computer programs into curriculum, instructing students on how to access archival data, and involving students in research projects.
-Because of NITARP, teachers changed how they taught the scientific process. They no longer taught it as the scientific method with a series of linear steps. It is a method with its own "language," it is often not linear, it may be an iterative process, and unexpected data may arise.
-Teachers realized scientists do not work alone; they collaborate, often remotely. The teachers modeled science as a collaborative effort with their students.
-To speak the language of science and to keep current with research, teachers must be immersed in the culture of science.

References

-Link to NITARP: http://nitarp.ipac.caltech.edu/
-Survey responses and personal interviews from five NITARP participants.

Implications

This preliminary study suggests that there is a correlation between the years involved with NITARP and level of research teachers involve their students in. This suggests that if teachers are to continuing to do research with their students, more experience is necessary than the first year. A mentorship program past the first year of NITARP may help teachers make that transition.