Modeling Science Practice with Secondary School Teachers, Informal Educators and High School Students.

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Abstract

The NASA/IPAC Teacher Archive Research Program (NITARP) annually recruits secondary school STEM teachers and informal educators to participate in astronomical research under the direction of NASA scientists. The educator participants are, in turn, authorized to invite students to participate as well. For a more detailed description of the program please visit Rebull et al.

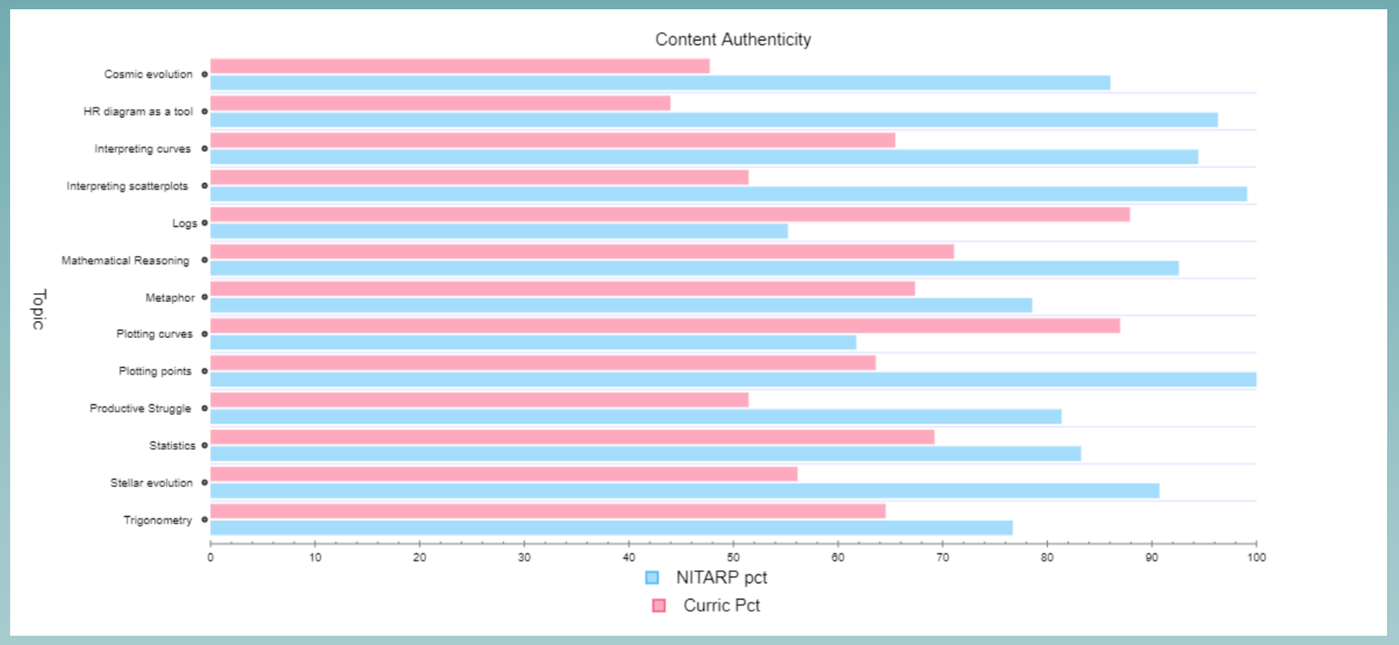
The authenticity of this science experience far exceeds that of "teacher-scientist partnerships" and other professional development opportunities generally available to secondary school teachers and informal educators. Using qualitative methods, we discovered that this authenticity was key to improved teacher practice in two areas: increased breadth of context for STEM support topics such as general science and math, and increased depth of content where astronomy was specifically taught.

NITARP educators and students working literally side-by-side, crafting filters against Gaia data in TOPCAT.

Breadth: STEM and Beyond

While learning to use some of modern astronomy's fundamental tools, such as SEDs, massive data archives and color-color plots, teachers learned to think in new ways and see connections across curriculum.

Math: In astronomy, logs comprise a system of intuitive convenience. In high school math, logs are taught with limited applications. A NITARP teacher explains, "We were discussing the properties of logarithms in my algebra class, specifically log(a)-log(b)=log(a/b) and I was able to use color being defined as a ratio of fluxes at different wavelengths, expressed as a difference of logs to bring this out."



Qualitative comparison of ultimate classroom authenticity in High School STEM topics and experiences, as reported by NITARP participants.

General Science: NITARP immerses teachers in the culture of science and research, which "broadens my perspective on astronomers and their work." NITARP participants read papers, write abstracts, experience distance collaboration, and learn how human knowledge propagates through publication, conferences and discourse. "These things show students how science actually functions; that science is not a collection of facts to be memorized but an ongoing process. I've been searching for a way to get this across for years, and with NITARP I have had more success than in any other approach."

Statistics: High school statistics problems are often built on contrived data sets. A NITARP teacher says, "Knowing how to access data on IRSA will allow me to generate enormous data sets that have real meaning to play with. This is certainly more authentic than most data sets that show up in textbooks."

Art: NITARP participants learn that "color" is a ratio of fluxes at different wavelengths. A NITARP teacher explains, "getting comfortable with invisible wavelengths leads to productive conversations with art teachers about visible wavelengths and visible colors as a social construct."

Depth: Tools of Astronomy

The NITARP research project is authentic in many ways, from the datasets and tools to the fact that the outcome of the research is unknown.

"NITARP has provided resources to do things I had not thought of with my intro to astronomy classes. I have students who understand how to make 3 color images, how to look at different images in different wavelengths and make inferences as well as given me a way to introduce data in large amounts to class."

"I think that the failure of our original data set and cuts was actually really helpful for the students to understand that not everything works out as you had originally planned. They were disappointed and frustrated for a few days but then started suggesting things that we could do and try to attempt in order to find some scientific value from our work. At this point I am honestly glad it happened."

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