Rich Experiential Education in a Remote Setting by NITARP

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Abstract

The NASA/IPAC Teacher Archive Research Program (NITARP) partners small groups of secondary school educators, high school students, and research astronomers in a year-long research project. The majority of the research is completed remotely and authentically, meaning there is no expected outcome or single correct answer. Students and teachers alike engage in modern research practices to better understand a guiding research question. In addition to hands-on research, the NITARP program meets and exceeds several national Next Generation Science Standards (NGSS), Common Core Reading, Writing, and Math standards, as well as standards outlined by the local regions of the participating NITARP teachers. Students that have participated in the summer research experience, coupled with the ongoing teleconferences, experienced a shift in their understanding of Science and scientists, as well as the process of doing science, especially as compared to a traditional classroom. Teachers that have participated have shown a renewed interest in both Science and improving pedagogy. In a historical moment when remote learning is under intense scrutiny, NITARP demonstrates that rich experiential education can take place in a primarily online context.The NITARP experience is a largely online collaboration that has had great success over the last fifteen years, and is an overall net positive for teachers and students.

Experiential Learning

The NITARP experience creates several learning opportunities for teachers and students alike by first establishing a baseline of knowledge and skills necessary to explore the research question. Learning outcomes are best when students are willing to fully invest in the learning activity and when the experiential learning is enjoyable (Dewey 1938). Through the opt-in, collaborative nature of the research experience, NITARP encouraged students to return to each telecon prepared to share and be celebrated for their individual work that fueled the collaborative goal. Furthermore, students created and reviewed light curves created by other students or teachers. Students' comprehension of graphs is closely tied to the process of constructing and explaining them (Berg and Smith 1994). Because students took an active role in the analysis of the archive data, they were better able to find and speak about patterns in the graphs.

Figure 1: We primarily used Google Classroom to store information and share announcements. We met weekly using the Cisco Webex video call application.

Nature of Science

Students often picture a man in a white lab coat when asked to describe a scientist and their daily work. Understanding the process and nature of science as consisting of only laboratory experimentation is a chronic limitation of Science courses nationally. This disconnect between the actual content and process of science limits students' understanding (Kastens 2008). NITARP allows students to experience the actual process of Science and to witness first hand how publishable content is discovered. As Bartos and Lederman outlined, a scientific investigation begins with a question, uses a variety of methods which are guided by the question asked, and that scientific knowledge is tentative and based on both empirical evidence and the human imagination and creativity of the actual scientist that is investigating (2014). Without an experience like NITARP, students are unlikely to have experiences with actual practicing scientists in such close proximity. Students are both witness to and active members of the entire process, from building background knowledge to understand the research question, all the way to analyzing data and forming conclusions.

Online Collaboration

"I have enjoyed seeing how actual scientific research occurs in real-time. For example, I like listening and being a part of the discussions of working through problems, both expected and unexpected. I like looking over potential sources and knowing that this data could actually lead to better models of AGN." - *Naleah Boys, Wisconsin Connections Academy*

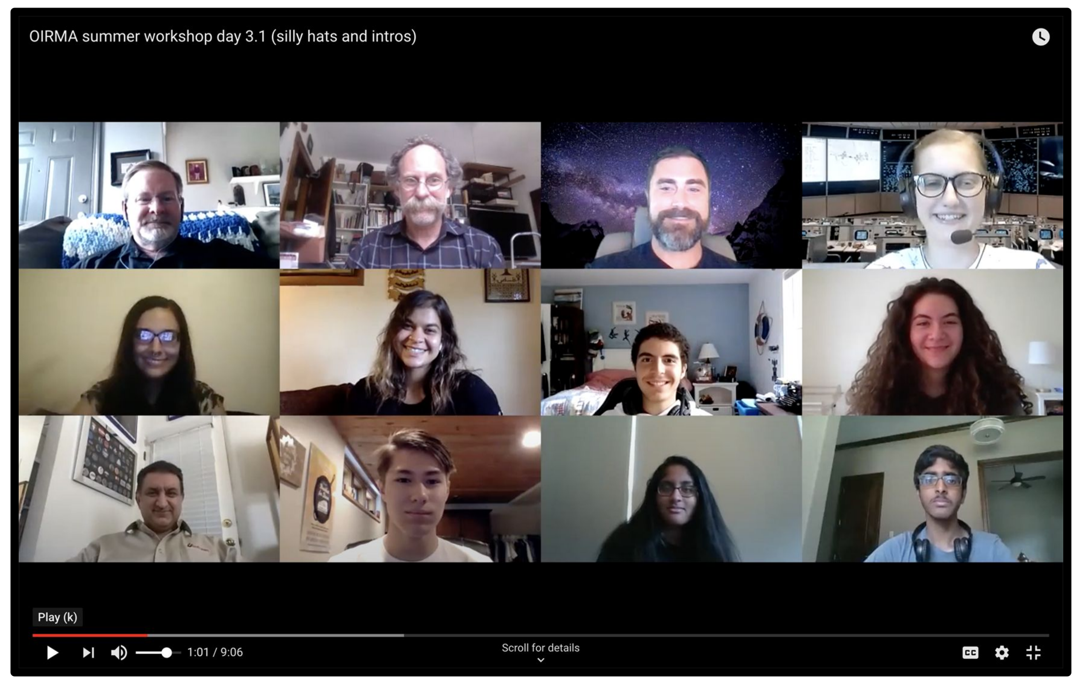

Figure 2: The OIRMA team researching remotely over Summer 2020.

"Learning through NITARP is much more interactive than learning science through school. While in school, we are mostly given lectures and required to accomplish assignments on our own, whereas in NITARP we are able to work with other students and mentors to help each other understand our research and actively create our project. " - *Nitya Jagarlamudi, Longview High School*

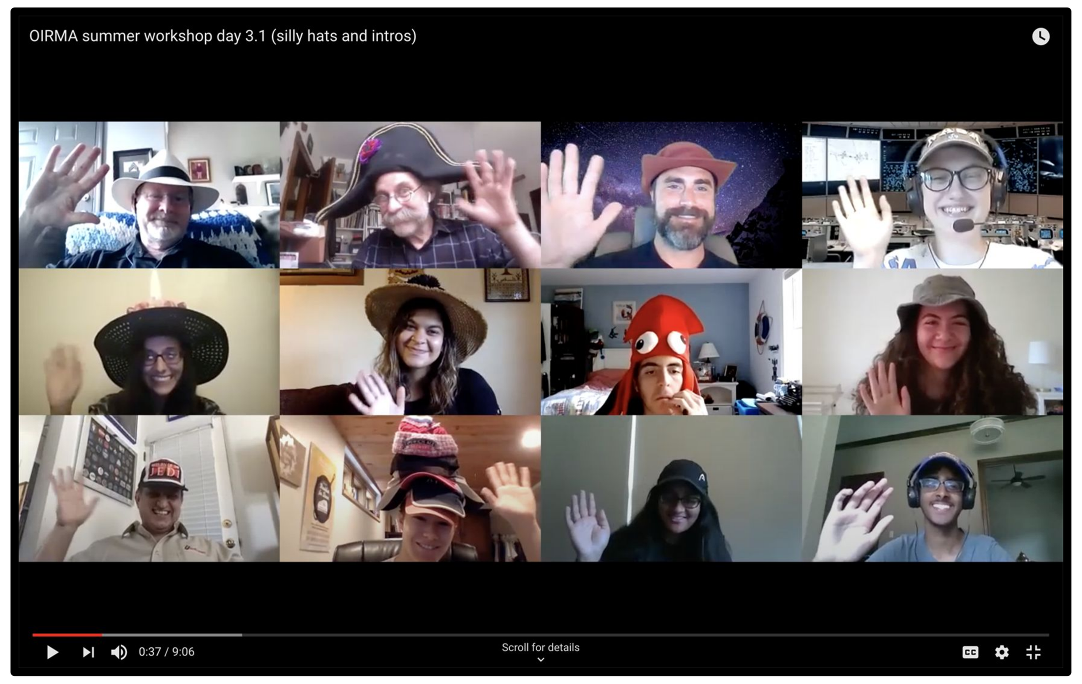

Figure 3: Even serious research can make time for fun.

"I feel NITARP has given me a starting point to what online learning should be. It should be an experience where everyone is responsible for their own learning with a guide to help direct you to the end goal" - *Alyssa McElroy, Houston Middle School*

Standards

The United States relies heavily on standards-based systems to construct curriculum and assess student learning. Alignment to standards is an important practice that strengthens systems and focuses them on intended goals (Contino 2013). The NITARP experience lends itself well to meeting the following standards:

- NGSS
  - Performance Task: HS-ETS1-3 Engineering Design
    - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
  - Disciplinary Core Idea: ESS1A: The Universe and its Stars
  - Crosscutting Concept: Patterns
  - Practice: Developing and Using Models, Analyzing and Interpreting Data, Using Mathematics and Computational Thinking
- NY State
  - Adopted NGSS
    - HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
  - Standard 4
    - 4. Energy exists in many forms, and when these forms change energy is conserved.
  - Standard 5
    - 1. Engineering design is an iterative process involving modeling and optimization used to develop technological solutions to problems within given constraints.
    - 3. Computers, as tools for design, modeling, information processing, communication, and system control, have greatly increased human productivity and knowledge.

References

- Bartos, S. A., & Lederman, N. G. (2014). Teachers' knowledge structures for nature of science and scientific inquiry: Conceptions and classroom practice. Journal of Research in Science Teaching, 51(9), 1150-1184.
- Berg, C., and Smith, P., 1994. Assessing student's abilities to construct and interpret line graphs: disparities between multiple-choice and free-response instruments. Science Education, 78(6). 527-554.
- Contino, J. (2013). A Case Study of the Alignment between Curriculum and Assessment in the New York State Earth Science Standards-Based System. Journal of Science Education and Technology (22.1), 62-72.
- Dewey, J. (1938). Experience and Education. New York : Macmillan.
- Kastens, K. A. and Rivet, A. (2008). Multiple modes of inquiry in Earth Science: Helping students understand the scientific process beyond laboratory experimentation. The Science Teacher, 75(1), 26-31.

Future Work

NITARP endeavors to continue providing authentic experiential education to students and teachers alike.

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