QuarkNet

Preliminary Evaluation Results

Kathryn Race

Race & Associates, Ltd.

race_associates@msn.com

QuarkNet

Evaluation Focus

Three Themes:

1. Development (and use) of a Program Theory Model (PTM) ✔
2. **Teacher**-level Program Outcomes (based on PTM)

   at National- and Center-level -- *on going*
3. **Center**-level Program Outcomes and Program

   Sustainability Assessment (based on PTM and Sustainability Framework) – *on going*

QuarkNet Partners

NSF: The National Science Foundation is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…" NSF supports basic research and people to create knowledge that transforms the future. QuarkNet is funded through NSF's Integrative Activities in Physics Program.

Fermilab: America's particle physics and accelerator laboratory whose vision is to solve the mysteries of matter, energy, space and time for the benefit of all. Fermilab, a co-sponsor of QuarkNet, hosts Data Camp held each summer and supports the cosmic ray studies program. Fermilab hosts DUNE and the Long-Baseline Neutrino Facility. DUNE brings together over 1,000 scientists from more than 175 institutions in over 30 countries.

Diversity – Women and Minorities: QuarkNet partners with other STEM organizations to reach more students underrepresented in STEM, either through their teachers or directly. Recent partners are *Step Up 4 Women,* an American Physical Society program to increase the representation of women amongst physics bachelor's degrees and *STEAM Workshop at NACA,* a program of the Native American Community Academy, Albuquerque, in which students create visual stories using projection art about ideas in Western science and indigenous culture. An example of being nimble to respond to opportunities is the *i.am. Angel Foundation,* transforming lives through education inspiration and thinking. Also, some centers partner with other organizations to reach beyond QuarkNet schools to students traditionally underrepresented in STEM.

Advisory Board: Seven or eight individuals both familiar with and new to the program meet annually to review QuarkNet program achievements and make recommendations for future plans and objectives. Members represent a diverse mix of high school physics teachers, education administrators, research physicists and physics outreach leaders.

QuarkNet: The QuarkNet Collaboration is a long-term, national program that *partners high school science teachers with particle physicists* working in experiments at the scientific frontier. A professional development program, QuarkNet immerses teachers in authentic physics research and seeks to engage them in the development of instructional strategies and best practices that facilitate the implementation of these principles in their classrooms.

QuarkNet Centers: Centers both form the essential backbone of and are partners in QuarkNet. A center is housed at a university or laboratory, serving high school physics and physical science teachers; active local centers number 50+.

U.S. ATLAS: A collaboration of scientists from 45 U.S. institutions. ATLAS is one of two general-purpose detectors at the Large Hadron Collider in Geneva, Switzerland. The ATLAS experiment investigates a wide range of physics, from the search for the Higgs boson to extra dimensions and particles that could make up dark matter. U.S. ATLAS is a co-sponsor of QuarkNet.

U.S. CMS: A collaboration of more than 900 scientists from 50 U.S. institutions who make significant contributions to the Compact Muon Solenoid (CMS) detector. Discoveries from the CMS experiment are revolutionizing our understanding of the universe. USCMS is a co-sponsor of QuarkNet.

Broader Impacts and Community Outreach: QuarkNet efforts extend beyond the program. Often, centers integrate QuarkNet in other community outreach and broader impact efforts. QuarkNet has led in facilitating the public use of large particle physics databases. QuarkNet staff and teachers attend and present at meetings of the American Association of Physics Teachers and the American Physical Society. At International Particle Physics Outreach Group (IPPOG) meetings QuarkNet presentations have highlighted how QuarkNet works, e-Labs, the Data Activities Portfolio and scientific discovery for students. QuarkNet has developed and coordinated the CMS masterclass, led the global cosmic ray studies project, and provided a wealth of information for other IPPOG members to consider in their own education and outreach programs.

QuarkNet Program Theory Model

Program Statement: The QuarkNet Collaboration is a long-term, national program that partners high school science teachers with particle physicists working in experiments at the scientific frontier. A professional development program, QuarkNet immerses teachers in authentic physics research and seeks to engage them in the development of instructional strategies and best practices that facilitate the implementation of these principles in their classrooms.

Centers: QuarkNet delivers its professional development program in partnership with local centers.

Program

Program Goals	Participant Selection	Anchors	Structure	Strategies	Outcomes
Goal 1	Mentors	Effective PD	Data Camp	Teachers	Teachers
Goal 2	Teachers	NGSS Alignment	Data Activities Portfolio		Students
Goal 3	Fellows	Guided Inquiry	e-Lab	Local Centers	Local Centers
Goal 4			Masterclasses		
			Workshops		

Enduring Understandings

Sustainability

Antecedents

Outcomes

Core Values/Assumptions

QuarkNet

Teacher Outcomes

Measured Two Principal Ways:

1. Full Teacher Survey, and

2. Shorter Annual Updates

2019-2020 QuarkNet Teacher Survey

Focused on (Six Themes) based on PTM

1. ***Who are the teachers (e.g., number of years: in QuarkNet, teaching, at school; at what center; brief information about school, teaching physics)?***
2. ***Participation in QuarkNet: What does this look like?***
3. ***Use of materials in the Data Activities Portfolio in classroom.***
4. ***Program engagement opportunities align with Core Program Strategies.***
5. ***How has this translated to the Classroom and QuarkNet's contribution?***
6. ***How has QuarkNet supported teacher-observed student outcomes?***

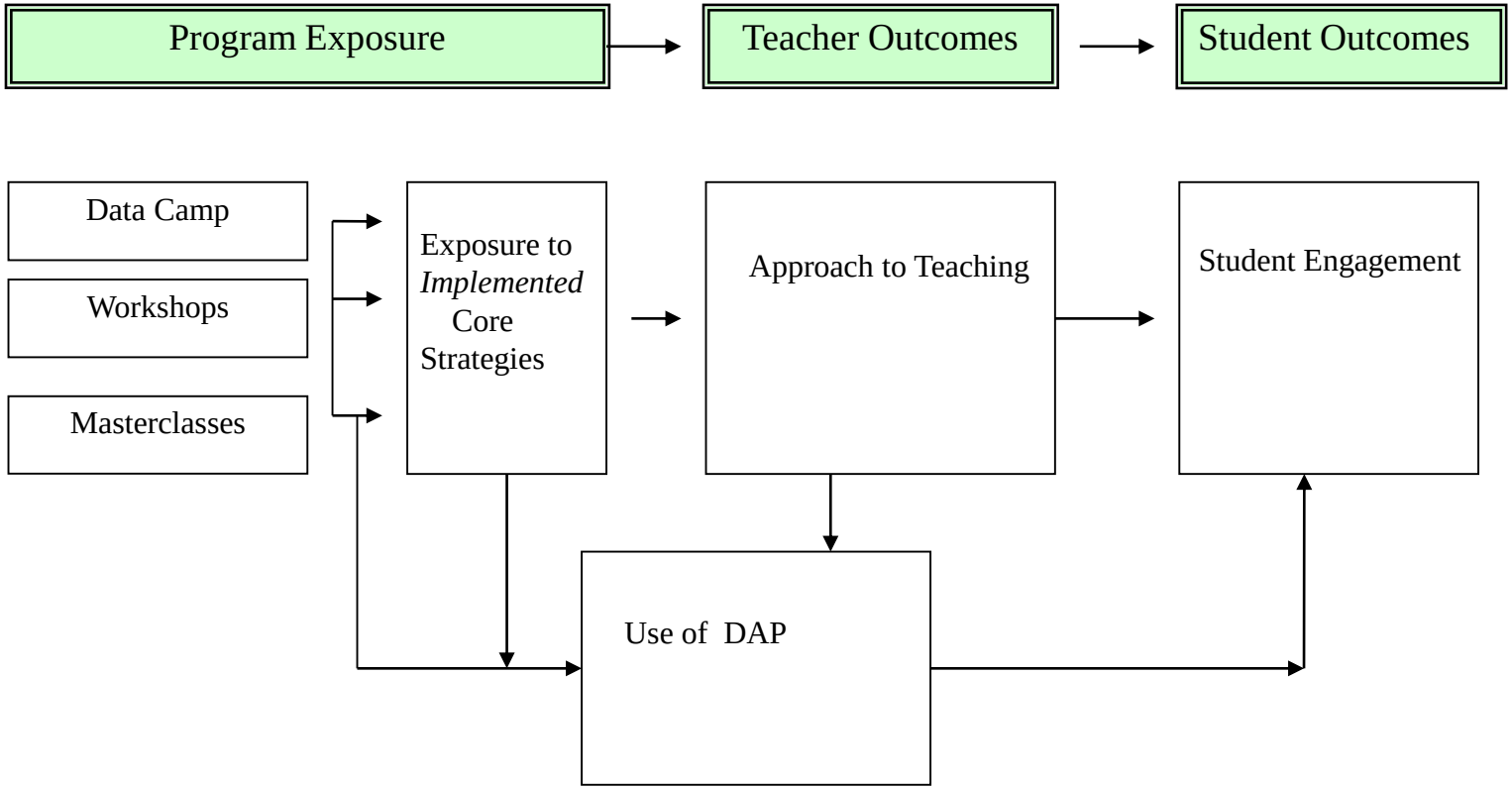
QuarkNet

Annual Updates

Focused on Implementation Plans:

1. **How teachers implemented or will implement QN content and practices in their classroom**
2. **Which DAP Activities?**

Overview of Analyses Related to Teacher (and their Students) Outcomes



QuarkNet

Scale Scores

Based on Teacher Responses:

Exposure to Core Strategies

Approach to Teaching

QN's Influence of Teaching

Student Engagement (SE)

QN's Influence on SE

Type of Program Engagement

Data Camp

Variety of Workshops

Masterclasses

and

Use of DAP Activities

Exposure to Core Strategies

In preliminary analyses (highlighted in Table 19 in Appendix) …..

Regarding **Core Strategies**, program engagement and measurement of exposure to core program strategies were shown to be related in a meaningful way (that is, the **more** engagement by type of event, the **higher** the perceived exposure to core strategies; and **more** reported use of activities from the Data Activities Portfolio in the classroom).

This speaks to the fidelity of the *implemented* program as compared to the program as *designed* as perceived by participating teachers who completed the Teacher Survey.

QuarkNet

Approach to Teaching

In preliminary analyses…..

Regarding, **Approach to Teaching,** teaching outcomes were shown to be related to *perceived* QuarkNet's Influence on Teaching and the Use of DAP activities in the classroom as reported by participating teachers. (See Tables 21 and 22 in Appendix.)

Use of DAP activities was shown to be related to exposure to Core Strategies, Approach to Teaching, and all of the types of QuarkNet program events (Data Camp, Variety of Workshops, and Masterclass engagement). (Summary statistics table is not shown.)

Student Engagement

In preliminary analyses (See Table 24 in Appendix)….

Regarding, **Student Engagement,** QuarkNet's Influence on Student Engagement and Approach to Teaching were related to perceived student engagement in inquiry-based science based on the perceptions of their participating teachers.

QuarkNet

In Summary

So far ….

the weight of these analyses suggests that there is a positive relationship between **Teacher Engagement** in QuarkNet and exposure to **Core Program Strategies;** and, that the type and degree of program engagement is related to teacher outcomes **Approach to Teaching**; the **use** of activities from the **Data Activities Portfolio** in the classroom; and teachers' perceptions of **Student Engagement** in inquiry-based science.

Building on These Analyses

We plan on adding information based on teachers' classroom implementation plans.

Buttress these analyses with information obtained from QuarkNet centers.

And add Sustainability Factors into the mix in the future analyses.

QuarkNet

Center Program Outcomes

Delivery of Program through Center Partnerships

Teacher Outcomes analyzed in relationship to program exposure

Center Outcomes used to determine *implementation* level of program and to better understand teacher outcomes, and

Centers assessed through Center Outcomes and Sustainability

Center Feedback Template

In Four Sections:

I. Who from the Center has participated

II. Past QN Programs last 2 year

III. Rating of Center-level Outcomes

IV. Review of Sustainability Factors

QuarkNet

Center Feedback Process

So far, 10 Centers have participated in gathering Center Outcomes

Center Feedback Process

Compare Teacher and Center Responses when possible, for example ….

Participating Centers report:

All or most teachers engaged as active learners (as students)

Teachers report:

The opportunity to engage as active learners (as students) was "Excellent."

QuarkNet

Multiple Sources ….

An example…..

Looking at the alignment of Next Generation Science Standards Practices and the DAP activities as:

Designed

***Implemented* (in workshops), and**

***Measured by Centers* based on**

in individual teacher engagement

Program and Evaluation Recommendations

Program:

1. **Continue to work with evaluator to embed evaluation requirements into the program as much as possible. -- Staff are doing a great job.**
2. **Use the Program Theory Model as helpful.**

Evaluation:

1. **Continue to be sensitive to QuarkNet staff program demands.**
2. **Simplify evaluation demands (for staff, teachers) as much as possible.**