QuarkNet Teacher Interview Report

School Year 2012-13

*Data Gathered by Leadership Fellows*

*Compiled and Analyzed by Ginny Beal*

Following is an informal, internal report that will provide data about the impact of the QuarkNet experience on teachers who participate in the program at different centers. This report is not to be shared with an external audience.

 QuarkNet Leadership Fellows gathered interview data from teachers during spring and summer 2103, by telephone and in person at visits to classrooms and institutes. They used protocols that were updated from those previously used. Evaluators reviewed and revised the protocols during fall 2012, in an attempt to make them easier for fellows to use and help them provide complete data. The protocols have been used to assess QuarkNet programs for the past 13 years and were adapted from those developed for Department of Energy teacher enhancement programs.

**Findings**

Included here are sections with findings for each type of interview: teachers by telephone, teachers at classroom site visits and participants, teacher leaders and mentors at institute site visits. Following the findings are overall summaries and concerns that QuarkNet staff may want to address.

Telephone Interviews - Findings

This section relates findings compiled from telephone interview responses. During early summer 2013, four teachers from QuarkNet centers were interviewed by four leadership fellows. The initial plan for fellows gathering data was for each of the five fellows to interview four teachers per center from those they visited during the previous summer. The low number of interviews this year is explained below.

Teachers were chosen from the QuarkNet database. For two centers, after the institute visit and classroom visit interviews, only one teacher was found at each center to be interviewed by, one by phone and one in person. For one center the fellow did not make a classroom visit and instead found a teacher who agreed to be interviewed by phone. Another fellow interviewed one teacher and had others lined up for interviews, but there was a misunderstanding in communication with staff that prevented the other interviews from being completed. For one of the centers, all teachers were interviewed during institutes or classroom visits, and no phone interviews were conducted.

Rather than the sample of teachers being representative of all QuarkNet teachers, it represents those who responded to emails and phone calls, and had not been interviewed previously.

Following are data compiled from the fellows’ phone interviews with teachers.

***1. What course(s), grade(s) and level(s) do you teach?***

Teachers taught the following subjects and levels:

* Physics - 4
* General physics - 2
* Conceptual physics – 2
* AP physics – 2
* Honors physics – 2
* Biology - 1
* Mathematics – 1
* Astronomy – 1

One teacher started the year teaching AP and Honors physics without a contract and was laid off; then moved into a mentorship with biology students, and plans to return to school for graduate studies and a research job.

They taught the following grades:

* 9th – 1
* 10th – 2
* 11th - 4
* 12th - 4

***2. How many years have you been involved in QuarkNet?***

Years of involvement were the following numbers for each year:

* One: one year
* One: two years
* Two: six years

***3. a. In the past two years what workshops, including summer institutes or get-togethers during the school year, have you participated in at your QuarkNet Center?***

Three of the teachers said they had attended the summer institutes. One of those brought a student to the institute. One went to institutes for teachers and students. Another helped with two six-week student research workshops.

***3. b. What type of activity was provided; what happened at the workshop(s)/gathering(s)?***

Following are the types of activities that were provided, and the number of teachers who commented about each:

* introductory particle physics - 3
* Cosmic Ray e-lab - 2
* lectures – 2
* data collection and studies – 1
* implementing particle physics in the high school classroom - 1
* student research projects (on-going) – 1
* students published studies and made posters – 1

***3. c. What types of direct connections for how to use this in your classroom were introduced at the workshop(s)?***

Teachers responded in the following ways: the “let them make mistakes approach, ” made lesson plans and interactive games for students, as a group, information on fundamental particles, and one said they use the detector in after school club.

***4. Which QuarkNet activities have you participated in at the national level?***

* Cosmic Ray e-lab – 2
* Boot Camp - 2
* Masterclass - 1

***5. What are you implementing in the classroom and how often?***

All of the teachers interviewed reported implementing QuarkNet to some degree. Following are the responses for each topic and their frequencies. All engaged in implementing lessons, and none did longer projects.

|  |  |  |
| --- | --- | --- |
| **Topics** | **1-2 lessons** | **3-5 lessons** |
| **e-lab** | **1** |  |
| **Particle Adventure** | **1** |  |
| **Standard Model** | **2** |  |
| **“Sprinkling” Examples** | **2** | **2** |
| **Research with a Detector** | **3** |  |

***6. In what ways has your participation in QuarkNet events been helpful to your implementing QuarkNet in the classroom?***

Following are the responses from each teacher:

* I have discovered how easy it is to sprinkle HEP ideas throughout the year and plan to continue.
* I get a very good audience when I talk about HEP when I talk about our summer QuarkNet visits to the center.
* I now frequently reference the detector; mention when talking about relativity.
* I didn’t have a detector and I wasn’t teaching physics long enough to implement much.
1. ***Do you see an effect on students from using QuarkNet activities and topics?***

Following are the responses from each teacher:

* Yes, in fact the student I brought from my school said she thought the program was going to be one way, but it was totally different in a good way. Being able to talk to the professors about their research really opened their eyes to how engaging research can be. You are not locked in a basement somewhere.
* Students like me to talk about the summer science programs. They ask questions and interact. They are more attentive and science becomes “possible” for them.
* The main thing students learn is that science research is messy, and doesn’t always go according to plan. Teachers learn these same lessons! The club spent a month on the problem of counter consistency only to learn that they had a bad cable. But they had to figure that out. They have also spent quite a bit of time diagnosing and dealing with GPS problems.
* I think my time teaching was too short to see this.

***8. Since Participation in QuarkNet, have you:***

 ***a. been involved in giving workshops to other teachers and what was the topic?***

Three teachers responded “no” to this question. One has been an e-lab fellow and gave workshops at summer institutes and high schools.

***b. given a presentation and where?***

Three teachers responded “no” to this question. One has presented at AAPT and the Air and Space Museum in D.C.

***c. attended meetings of professional organizations?***

Two responded “no.” One teacher helped host an AAPT session and attended the NSTA meeting. One attended AAPT.

***d. been involved in leadership at the school or district level and in what ways?***

Two responded “no.” One discusses with colleagues at school. One teacher is busy with sports coaching duties.

***9. a. Do participants at your center meet regularly?***

***b. How often?***

***c. What kind of meetings?***

Following are responses from the four teachers:

* Through email, we bounce ideas off one another and share ideas about once a month. We have a shared folder in drop box that we are all signed up for sharing.
* Student research model; have met students at some science events.
* We meet during summer workshops and masterclass. Our mentor and QuarkNet Staff Teacher meet with teachers and students a couple times a year; also work with a sister school.
* I went to last summer’s workshop and I received an invitation to this summer’s workshop. I’m heading back for a Master’s in Bio-Lasers and a research job so I won’t participate.

***10. Is there a learning community?***

One teacher was not aware of a learning community. One mentioned that professional development is encouraged and they have science department meetings; the other indicated there are ‘ongoing’ learning communities for teachers in the area that include a planetarium, a NASA project and other groups. One said they meet with other schools in the district.

***11. Who is in a leadership role at your center?***

The responses were as follows:

Mentor – 2

Mentor and teachers – 2

***12. Explain the roles (what tasks related to the QuarkNet center and institute) and what your interactions are with each of the following:***

***a. Who is the Mentor/Faculty/Scientist/Researcher, what are their tasks and how do you interact?***

Responses included mentors’ tasks and interactions such as;

* Coordinates/facilitates the workshop - 2
* Recruits teachers for the workshop - 1
* Lectures about his role and research at CERN – 1

(The teacher who responded that the mentor gave lectures said that the mentor is not a very good presenter, mumbles and goes off on tangents, talks to himself not to audience.)

 ***b.Who is the Teacher Leader, what are their tasks and how do you interact?***

Responses include the following:

* Coordinates/keeps on track – 3
* Don’t know/none - 1

***c. Who is the QuarkNet Staff Teacher assigned to your center, what are their tasks and how do you interact?***

Responses about Staff Teacher tasks and interactions include:

* Detector support – 2
* Moral support - 1
* Know who/no interaction – 1

***13. Is there other feedback you would like us to give to QuarkNet that might help improve the experience in the future?***

Feedback included the following comments and suggestions:

* I very much liked the idea of having high school students doing research.
* I think one of the reasons students don’t undertake big projects at the workshop is that their teachers are not there for them to bounce ideas off of that they are familiar with..
* What does QuarkNet Central want? Do other centers follow our model? What are other programs like?
* There are a lot of detectors sitting at high schools that are not being used. Why?

Teachers and students are very pressed for time with all kinds of initiatives. The interface between the board and the computers can be very daunting. It may lead some teachers and students to throw up their hands. The ideal would be to get a computer setup with your detector. Maybe a cheap ($200?) standardized computer could be added to the kit? This would also be helpful as schools sometimes shut their computers down, which kills data collection.

**Classroom Site Visit Interviews - Findings**

During spring of the 2012-2013 school year, four leadership fellows made classroom visits to nine teachers. Observations of their teaching, and interviews were conducted by the fellows. One fellow did not make a visit to a classroom, and instead interviewed the teacher by telephone (see Telephone Interviews section). The nine teachers interviewed represented four centers whose institutes were visited in summer 2012.

Following are data compiled from the fellows’ interviews with teachers conducted during classroom visits.

1. *What course(s), grade(s) and levels do you teach?*

Teachers taught the following subjects and levels:

* Physics – 8
* General – 4
* Conceptual - 4
* AP physics - 4
* Honors physics – 4
* Chemistry – 1
* Biology – 1
* Research - 1
* Other science – 2 (general science, modern mechanics)

They taught the following grades:

* 12th – 8
* 11th – 5
* 10th - 4
* 9th – 2

***2. How many years have you been involved in QuarkNet?***

Years of involvement with QuarkNet ranged from one to 10, with the following numbers for each year:

* 1 year – 4
* 3 years - 2
* 4 years – 1
* 10 years – 1
* 11 years - 1

***3.a. In the past two years what workshops, including summer institutes or get-togethers during the school year, have you participated in at your QuarkNet Center?***

Eight of the nine respondents reported that they have attended summer workshops at their centers. One is a teacher leader at the center who has helped run student summer workshops and masterclasses. Another has helped run masterclasses. One has attended Boot Camp and taken students to the university.

***3.b. What type of activity was provided; what happened at the workshop(s) /gathering(s)?***

* e-labs – 5
* building or maintaining detectors – 4
* particle physics lectures – 3
* tours -2
* planning and sharing classroom ideas – 1
* student research programs - 1

***3.c. What types of direct connections for how to use this in your classroom were introduced at the workshop(s)?***

Teachers’ responses included:

* e-lab – 2
* Independent research projects – 1
* Data analysis with detectors – 1
* Inquiry-based instruction - 1
* Modern physics topics – 1
* Videoconference - 1
* Using detectors – 1
* None - 1

***4. Which QuarkNet activities have you participated in at the national level?***

Eight responded that they have participated in QuarkNet activities that included:

* Cosmic Ray e-lab – 8
* Masterclass - 2
* Teaching & Learning Fellows – 2
* Boot Camp - 1
* LHC Fellows – 1
* Other - 1

One has not participated in national level workshops.

***5. What are you implementing in the classroom and how often?***

The following table shows the number of teachers who are implementing stated activities in the classroom and how often:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topics** | **1-2 lessons** | **3-5 lessons** | **1-2 weeks** | **Long-term Projects** |
| **e-lab** | **1** |  |  | **2** |
| **Particle Adventure** |  |  |  | **1** |
| **Standard Model** | **3** | **7** |  |  |
| **“Sprinkling” Examples** |  |  | **3** | **2** |
| **Research with a Detector** | **1** |  |  | **2** |
| **Other: science inquiry;** **after school club** |  |  |  | **2** |

***6. In what ways has your participation in QuarkNet events been helpful to your implementing QuarkNet in the classroom?***

Following are comments from the teachers:

* too new to get it together yet [and] did not have the equipment
* using a Cosmic Ray Detector
* Participation has shown me resources that are available and as I become familiar with them it helps me design curriculum.
* It inspired me to do “open instruction”
* It allowed me to add modern physics to what I teach.
* This was my first year in QuarkNet so the CR e-lab mostly helped to understand muons.
* Having the experience to use the cosmic ray detector with confidence is a great help in using it as a teaching device. It is reassuring when you know something well enough not to be wired about what to do if things don't work the first time it's tried. Also prepping for a masterclass is a great teaching opportunity for the students that are interested.
* teaches using inquiry based learning but has no program where other particle physics material can be used
* The equipment has been good for the after-school club.

**7. Do you see an effect on students from using QuarkNet activities and topics?**

* Those interested are looking to work independently.
* I can now just throw an open ended question on the board and the students can chase it down and try to find a solution.
* It is hard to say. The “modern stuff” was never in the course before. It changed so much.
* Students have shown a greater interest physics research; my enthusiasm has been transferred to some students. The e-Labs are also stimulating for some students because of my involvement.
* Students do not know I am involved with QuarkNet. They only get the benefit of my teaching technique.
* Students like the idea of international collaboration, of “being part of a larger whole.” They find contributing to a larger effort like that inspiring.
* Students have no interest in Quarknet; the opposite is true - many students know they do not want to pursue a career in space science or particle physics.
* n/a or not much – 2

***8. Since Participation in QuarkNet, have you:***

***a. been involved in giving workshops to other teachers?***

There were seven “No” responses. One mentioned giving workshops on computers and another has given mini-workshops and led a professional development session.

***b. given a presentation and where?***

QuarkNet participants have given presentations at:

* State APT - 1
* High school - 3
* Community groups/clubs - 1
* Have not given presentations – 3

***c. attended meetings of professional organizations? (national, local)?***

QuarkNet participants have attended:

* AAPT – 3
* State AAPT – 4
* School group – 3
* Have not attended – 2

***d. been involved in leadership at the school or district level (curriculum committee, technology committee, department chair, teacher liaison, etc.), and in what ways?***

Seven gave “Yes” responses. They are involved in the following leadership positions:

* Department chair – 1
* Technology mentor/committees - 3
* Curriculum/science task force, policy review/site council - 2
* Recruit QuarkNet teachers and students - 2
* Not been involved in leadership at their school or district level - 2

***9.a.Do participants at your center meet regularly?***

***b. How often?***

***c. What kind of meetings.***

Three meet during the summers only, one twice a year, one emails bi-weekly, and four said they do not meet regularly. Three said they build CRDs and two engage in student research at institutes.

***10. Is there a learning community?***

Six of the teachers responded that they have a learning community. They types of communities are:

* QuarkNet group – 1
* Their school – 1
* Local area - 3
* Email exchanges - 1

***11. Who is in a leadership role at your center?***

Teachers responded that the following are in leadership roles:

* Mentor – 7
* Teacher leader - 2

***12. Explain the roles and what your interactions are with each of the following:***

***a. Who is the Mentor/Faculty/Scientist/Researcher, what are their tasks and how do you interact?***

Responses include:

* Arranges workshops – 7
* Troubleshoots cosmic ray detectors – 1
* No Interaction - 1

***b.Who is the Teacher Leader, what are their tasks and how do you interact?***

Teachers reported that their interactions with teacher leaders include:

* Organize workshops – 4
* Runs student research program - 1
* Minimal teacher leadership - 1
* No interaction/don’t know of any – 3

***c.Who is the QuarkNet Staff Teacher assigned to your center, what are their tasks and how do you interact?***

Teachers’ interactions with staff teachers include:

* Friday Flyer – 3
* Emails/Calls/Support - 2
* Helps with detectors – 2
* No interaction/don’t know of any - 2

***13. Is there other feedback you would like us to give to QuarkNet that might help improve the experience in the future?***

Two had no comments. Others responded in the following ways:

* I think that I could be more effective if we got to participate in the lessons that you are speaking of in question 5 [QuarkNet topics]. We need to see how it works and how we can adapt it to our own classroom. Also, we need labs that don’t require computers or special equipment, otherwise we have to buy it ourselves and we don’t have the money.
* QuarkNet could provide enrichment experiences, physics instructional skills and inquiry skills….Also they could help us understand the pure science applications and technology.
* It would be good to develop a QuarkNet community but that hasn’t happened yet.
* I’d like to do other stuff but with very limited resources I don’t know what I can do. I don’t think the cosmic ray detectors are very well suited for the class doing labs.
* The program is very worthwhile but funding cuts are counterproductive, since the only strong interaction the group has is the research program over the summer for the kids where funding is critical for them to have a successful experience.
* Maybe the students could get paid a little less each for the summer research program so that the money can be spread out to allow more students to be involved.
* It’s a great opportunity. I’m glad QuarkNet is there to push modern physics into the national education conversation.

Institute Visit Interviews – Findings

During the summer of 2013, leadership fellows visited institutes at four QuarkNet centers. One center had a teacher institute along with a student program. The centers were chosen based on QuarkNet staff’s view of them as struggling.

Fellows gathered data at the institutes by making observations and interviewing participants, teacher leaders and mentors. Nine teacher participants were interviewed using questions from a Participant Interview Guide that includes a focused form of the interview protocol. While the nine participants are included in the total teachers interviewed at the institute visit, they answered select questions and therefore results show only those responses. In-depth interviews using the complete interview protocol were conducted with three teachers who hold a leadership role at their center and with five mentors, one former and one new at one center, and three long-term at others. The teachers and mentors represent QuarkNet centers that were considered to be struggling.

Teacher Participants

Following are findings from the data gathered about the teacher participants from interviews conducted by the fellows using the focused Participant Interview Guide:

1. *Subjects Taught*

Teachers taught the following subjects:

* physics - 8
* chemistry – 6
* biology – 3
* mathematics - 1
* research – 2
* other (earth, life, physical sciences, astronomy) - 8
1. *Grades Taught*

They taught the following grades:

* 8th – 2
* 9th – 3
* 10th - 6
* 11th – 7
* 12th – 7
1. ***Years with QuarkNet***

Years of involvement with QuarkNet ranged from one to 12, with the following numbers for each:

* 1 year – 1
* 2 years – 1
* 4 years – 2
* 9 years – 2
* 10 years – 1
* 11 years - 1
* 12 years – 1
1. *Geographic Dispersement (Miles traveled to institute)*

The teachers reported traveling a range of 10 to 180 miles to attend the institutes. Four traveled 50 miles or more.

1. *Stated Reasons for Participating and how they found out about QuarkNet.*

Four teachers reported finding out about the program from the center mentor; two from emails, one by ‘surfing the web’ for two there was no data. Their stated reasons for participating include:

* ..felt up to challenge of something new; it makes a BIG difference when you have a student who needs to know how to use this stuff to do her research! We are getting a ton from this. I got nothing from the first workshop.
* encouraged by department
* returning… just the thing I do when another CRD workshop is held
* help me become a better teacher, more weapons in my teacher tool bag for cutting edge physics
* learn and improve, to help my students learn and improve
* wanted to know more about particle physics.
* program sounded interesting and useful for teaching about particle physics.
* started in the program to learn about physics, because had; the center keeps her up to date on different areas of physics and gives her info she can bring into her classes; learns about all kinds of interesting current research.
* liked the prospect of being able to learn more about physics—wanted to dive in; it fit with her concept of self as a lifelong learner
1. *What are you implementing in the classroom and how often?*

Teachers reported that after participating in QuarkNet, they are using the topics shown in the following table in their classes.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Topics | 1-2 lessons | 3-5 lessons | 1-2 weeks | Long-term Projects |
| e-lab | 2 |  | 1 | 2 |
| Masterclass | 2 |  |  | 1 |
| Particle Adventure | 3 | 1 |  |  |
| Standard Model | 4 |  | 2 |  |
| “Sprinkling” Examples  | 3 |  | 2 | 1 |
| Research with a Detector |  | 1 |  | 3 |
| Other: cloud chamber | 1 |  |  |  |

1. ***Since Participation in QuarkNet, have you:***
2. ***been involved in giving workshops to other teachers, and what was the topic?***

Three of the four answered that they have not. One presents a board game involving terminology of nuclear physics and new approaches to Rutherford’s experiment.

1. ***given a presentation and where?***

Two teachers answered “no” and three have given presentations that include: TEDex talk, university presentation, labs from school presented at QuarkNet center; lessons to QuarkNet students; Boot Camp poster; power point summary of student research with students and QNet at two center; presentation at NSTA.

***c. attended meetings of professional organizations? (national, local*)?**

Teachers have attended the following:

* NSTA – 4
* Local APT - 4
* State STA - 1
* University meeting – 1
1. ***been involved in leadership at the school or district level (curriculum committee, technology committee, department chair, teacher liaison, etc.), and in what ways?***
* Department Chair/Co chair - 4
* Mentor for new teachers - 2
* Faculty Representative – 1
* District Science Curriculum Chair – 1
* Robotics coach - 1
* Staff development - 1
* Committees – 1
* Student research leader – 1
1. ***Which QuarkNet activities have you participated in at the national level?***
* Cosmic Ray e-lab – 5
* Masterclass – 3
* CMS e-lab – 3
* LIGO e-lab – 3
* Boot Camp – 2

***9. Comment on the support you receive from the following:***

***a. Teacher Leaders***

* set up detectors - 3
* contact - 2
* how to implement - 2
* none – 3 (1 willing to help)

***b. Mentor/Faculty/Scientist/Researchers***

* organizes meetings - 4
* repaired equipment/answered questions – 3
* arranges trips – 3
* new mentor – unknown - 1

***c. Staff Teacher(s)***

* set up detectors - 3
* technical support – 3
* content - 4
* masterclass - 2
* helped at school – 1
* no answer – 1

***10. Other Comments that will help staff improve the program***

* QN needs to build relationships with local teachers like my Staff Teacher did. They need to go to the sites (schools) and offer assistance
* if there were a way that Quarknet material could match more with what the state requires, I could use it more. It would be good to have a few examples. I am going to be assigned to teach 8th grade next year and would like to work in some particle physics, but not sure how.
* I really love QNet for staff development. I am very happy with QNet. Perhaps student trips.
* I like the program. It motivates me. I always include particle physics in my classes. It gets students involved.
* I don’t know what other centers do, and wish I knew more about that. I enjoy that we get to do a variety of things, since physics is the only thing I teach.
* It’s nice to know that we’re “being invested in.” It helps, but it’s more important from a professional standpoint. It speaks to the importance of what we do in the classroom, and says we’re worth investing in.

Teacher Leaders

Following are findings from interviews with teacher leaders at three institute site visits.

1. ***What course(s), grade(s) and level(s) do you teach? Please indicate if the courses are General, Conceptual, Honors, AP, Regents. Check all that apply.***
* Physics - 3
* General physics - 2
* AP physics - 2
* Honors physics - 3
* Chemistry - 2
* AP biology - 1
* Research - 1
* Other science (pre-engineering) – 1

***Grades***

* 9th – 1
* 10th – 2
* 11th – 3
* 12th - 3
1. ***How many years have you been involved in QuarkNet?***
* 8 years - 1
* 12 years – 2
1. ***a. In the past two years what workshops, including summer institutes or get-togethers during the school year, have you participated in at your QuarkNet Center?***

Two teachers said they have attended summer institutes, one attended four meetings per year and one each have attended Boot Camp and masterclass.

1. ***What type of activity was provided; what happened at the workshop(s) /gathering(s)?***
* CR detectors - 2
* CMS e-lab - 1
* Equipment building - 1
* Lectures – 1
* Tours – 1
* Classroom implementation - 1
1. ***What types of direct connections for how to use this in your classroom were introduced at the workshop(s)?***
* Student generated research with two detectors - 1
* Instructions for building equipment, ie. CR Detectors - 1
* Demonstrations by professors for classroom transfer – 1
* Lab applications – 1
* Rutherford’s model simulator - 1
1. ***Which QuarkNet activities have you participated in at the national level?***
* Masterclass - 2
* Boot Camp - 3
* Cosmic Ray e-lab - 3
* CMS e-lab - 2
* LIGO e-lab - 2
* Teaching & Learning Fellows – 1
* Other: which one(s) CERN, CMS Fellow -1
1. ***What are you implementing in the classroom and how often?***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Topics | 1-2 lessons | 3-5 lessons | 1-2 weeks | Long-term Projects |
| e-labs CR & LIGO | 1 |  | 1 |  |
| Masterclass | 2 |  |  |  |
| Particle Adventure | 2 |  |  |  |
| Standard Model | 3 | 2 | 1 |  |
| “Sprinkling” Examples  |  | 2 | 1 |  |
| Research with a Detector | 3 |  |  | 2 |
| Other: engr. design |  |  |  | 2 |

1. ***In what ways has your participation in QuarkNet events been helpful to your implementing QuarkNet (using resources, sprinkling HEP topics, using a Cosmic Ray Detector, etc.) in the classroom?***
* It makes it possible to offer extensions to what is generally taught as physics; to create a student generated research program.
* Quarknet supplied me with a great deal of confidence to be able to apply all aspects, and applying inquiry ideas across the board.
* [has provided] resources such as cloud chambers, lab activities, web simulations, materials or e-labs for classroom use and field trips.
1. ***Do you see an effect on students from using QuarkNet activities and topics? (do they have a greater interest in science/physics/research, change in goals)***
* It gives students much frustration, which is very good; they become excited about what they are working on; understanding the interface (setting up the CRD to take data and upload) loses a lot of kids.
* Definitely, they want to talk about Higgs because it is in the news. Plain old velocity and acceleration are not very exciting, current research in the news adds a new hook for students to get interested in.

***8. Since Participation in QuarkNet, have you:***

***a. been involved in giving workshops to other teachers, and what was the topic?***

* local physics gatherings – 2
* State STA – 1
* AAPT – 1
* At the district for teachers - 1
* LIGO -1
* Partners in Science/Murdock Foundation - 1
* particle physics workshops -1

***b. given a presentation and where?***

* AAPT -1
* Math, science and physics conference - 3
* State STA - 1
1. ***attended meetings of professional organizations?***
* AAPT -1
* NSTA – 1
* State APT - 1
1. ***been involved in leadership at the school or district level (curriculum committee, technology committee, department chair, teacher liaison, etc.), and in what ways?***
* modeled the approach for physics learning and sharing - 1
* department chair - 1
* liaison for middle school science – 1
* curriculum and technology Committee – 1
* field trips to CERN with students – 1
1. ***Do participants at your center meet regularly?***
2. ***How often?***
3. ***What kind of meetings?***

All three teachers responded yes. One meets twice per year, one five days in summer and several days during the year, one each semester and summer, two have masterclass and summer workshop, one has general meetings to catch up, share activities and troubleshoot equipment and another has lectures, labs, scientist research presentations.

1. ***Is there a learning community?***

One teacher said they have a learning community through the center, one said there was one and it ended a couple years ago and another teaches at a private school and there is a ‘disconnect to the public school arena.’

1. ***a. Who is in a leadership role at your center? (state the leader’s name and role, e.g. mentor or teacher)***
* Mentor – hosts annual field trip here including several tours
* Teacher leader – helps teachers
* two mentor and two teacher leaders – setup workshops and help with equipment
1. ***Explain the roles (what tasks related to the QuarkNet center and institute) and what your interactions are with each of the following:***
2. ***Who is the Mentor/Faculty/Scientist/Researcher, what are their tasks and how do you interact?***
* mentor does it all - 1
* mentor puts together our speakers, teacher leaders coordinate our plans - 1
* mentors and teacher leaders communicate via email and EVO, and arrange meetings - 1
1. ***Who is the Teacher Leader, what are their tasks and how do you interact?***
* There is no Teacher Leader.
* Teacher leader coordinates workshops – 1
* Two leader leaders help teachers – 1
1. ***Who is the QuarkNet Staff Teacher assigned to your center, what are their tasks and how do you interact?***
* made inventory of detectors which were spread out over 20 schools; many have left the program and retired with their detectors becoming lost - 1
* comes to part or all of our institute week; helpful with detector set up; enjoy the Friday flyer; also staff and Fermi fixed a part -1
* no name; get emails, runs masterclass, and presents at QNet meeting - 1
1. ***Is there other feedback you would like us to give to QuarkNet that might help improve the experience in the future?***
* Bootcamp was awesome! The CRDs are a good idea but they don’t fit into the curriculum or the day to day teaching. Bootcamp provided for great sharing between the teachers. I like the concept of having us work in teams with different problems assigned to us to solve.
* Quarknet flexibility is great. The mentor and I enjoy being able to plan an agenda each year that takes advantage of new opportunities at the [center] that Quarknet may offer. The professors are very giving of their time. I definitely think Quarknet has the right idea. If I needed something I could call the staff teacher and get help.
* I would like to learn more about other centers and I would like them to know more about us. What do they learn from us? Friday Flyer is a good start. When there are meetings at FermiLab I would like to hear from our mentors and I would like to hear from other mentors.
* Student trips to institutions nearby which have a great science center are great and very useful for making contacts.
* There is competition for state science teachers at summer NSF workshops that include housing and tend to be more focused on biology. Biology is the tested State science and physics is not.

Mentors

Following are interview responses from Mentors at institute visits.

1. ***What is the extent of QuarkNet activities at your site?***

Responses from mentors follow:

* Former mentor at site with new mentor: nothing until this week!
* New mentor at site in transition: masterclass and now this workshop involving 4 schools!
* variety of activities: built a large telescope from scratch; built CRD and exposed our teachers to high energy experiment; video connections to CERN; e-lab; hands-on building or repair of equipment project that is beyond what they do in their classroom.
* tour labs; make connections to other university personnel; make connections to society of physics students; HS students get exposure to college physics students
* new research updates
* MasterClass (5 yrs.)
* summer Workshop (10 yrs.)
* Summer grant for high school teacher and 2 students (5 yrs.)
* teacher trips to national labs
* one-week summer workshop. During the school year, I take the CRMD from school to school and set it up so the teachers and students can use it.
1. ***What are you doing to continue QuarkNet?***
* no longer my task
* trying to coordinate the activities with the QuarkNet staff and the schools and teachers. It requires building confidence. The center did this before and we have some returning teachers and one new one. We want to expand to more teachers and activities.
* Link new astrophysicist to Quarknet; [hope to] to extend our current star party at the observatory to Quarknet teachers, students and parents; working on the CMS detector and trying to build up some new detectors for the future; may try to incorporate high school teachers and students next year to help us, and make a bridge between QuarkNet and university.
* Would like to find a smart high school student to do a live QuarkNet Web page for [the university] that would be live wireless data from the cosmic ray detector
* DOE grant has been discontinued and will try to maintain the program.
* Have been working to recruit more teachers; got a good influx a few years ago.
1. ***Do you have or seek funding for additional activities?***
* No longer his role
* I don’t know what is possible
* right now only QuarkNet; I am the research data faculty member, we can sometimes share funding sources; if group number is bigger we can think about travel money; teacher leader and I have talked about STEM money but here the math and engineering departments have gotten all the money.
* No
* Almost all funding is from QuarkNet. Got a little bit of supplemental funding from an NSF grant that has supported two weeks of co-mentor’s time.
1. ***Who is in a leadership role at your center and what is/are their role(s)?***
* the leadership has changed to a new mentor;
* the way QN runs is that leadership is on their own. QN imposes no structure or plan a site must follow. QN did set us up with new (CRD) boards; we were always having problems and constantly doing checks. I’m the leader.
* the teacher leader is doing very good job; we sit down in the spring, and decide and finalize; then he sends out an email with the agenda and asks potential candidates “what is the best time for workshop?”
* Leadership falls on the mentor. Teachers take the lead at times.
* the mentor; he is considering working to develop a teacher leader, but is not sure who it should be.
1. ***a. How do you recruit teachers for QuarkNet activities at your site?***

***b. Are the same teachers returning, or are there new teachers?***

***c. How many teachers make up the participant base? Is it stable?***

* It was by word of mouth. Yes, some have been with us 10 years.
* We have two sources: we informed old QN teachers. There are also other community college teachers who have been involved in the past. There is an issue about QN funding college teachers, but some of the students they teach at college are actually high school students taking advanced courses. And one university in particular recruits Native American high school students.
* trying to connect to STEM and we also opened up our advertising to science teachers in general, biology, chemistry, physics. We found out that this wider range of teachers had already been contacted by STEM so they felt they did not need us.
* This year we have 4 teachers on the books, slender pool to draw from. Our 4 have been very stable.
* Presently 6 teachers; 5 are active and 1 are emeritus. I use Departmental funds to support the emeritus teacher.
* Primarily through email to area teachers. It is mostly the same teachers returning. 10 or 11 teachers in the base, and it’s very stable.
1. ***What support do you get from the QuarkNet staff?***
* at first it was mostly the funding.
* Everything!...since I’m new. I first thought the goal was for students but now know QN works via teachers. (The staff person) helped with understanding the mission, how to do QN; helped writing a proposal for this center, how to operate using activities, providing all the details, arranging for the staff to do the workshops.
* regular support teachers for 5 days, 500/teacher; 3 years ago we asked for special fundsfor trailer and parts to build telescope; Great support.
* Masterclass each year is very popular with teachers and students, less so CRD, and e-labs.
* The staff teacher has been pushing the masterclass, but I haven’t been able to drum up interest.

**b.Is it the level of support you expected?**

* yes, what we expected, which wasn’t much
* yes, we have a small center; I am happy with the money they provide. The processing time at QuarkNet for funds is much faster than funds requested from university
* Very happy with support.
* Support is sufficient.
1. ***What is your expectation for how teachers will implement what they learn at your center in their classrooms?***
* I approve of teachers keeping the equipment and uploading data. But it is important that students learn to do the whole science. We had old cosmic ray detectors which needed much work and (literally) polishing. So that was much of what the students did.
* Not yet, but know some of what the returning teachers have been doing
* I have not been in their classroom, but I always encourage them to incorporate what they learn here to their kids. I try to expose the teachers to inquiry instruction. It is not easy since teachers and students are both new to the process. Need pretest for participants’ physics students; then they get taught using this methodology and give a post test.
* I believe they make a good effort if I supply background materials.
* My hope is that they will put a little particle physics in at the end, after whatever big exam they happen to have. I would like to have them do something with the counters.
1. ***What do you hear from participants about how they are implementing what they learn?***
* We have used local teacher input to decide what to do at the workshops. One teacher has a physics club use the detectors. Two teachers have kept their detectors going, gathering and uploading data; the problem was that students weren’t involved in analyzing, comparing, and using the data, or looking for correlations.
* Brett talks about what he does in his classroom all the time. Do you remember the bubble chambers and cloud chambers we built I have them mounted in my room the kids love it. I am mentoring several students who are doing research with the cosmic ray detectors. A few years ago he brought his son in to show a research project he did. Katrina is long distance.
* Not discussed a lot. More of QuarkNet’s job in my view.
* Most of them do something with the cosmic ray detectors.
1. ***Is there any other feedback you would like us to give to QuarkNet that might help improve the experience for future mentors?***
* This stuff (Cosmic ray e-lab and CMS e-lab) is good for students who are creative and will provide feedback. But I think it is awkward to have 2 workshops back to back like this: 3 days then 2 days. The teachers don’t need to understand the basics but fill in holes in their understanding. I note on the e-lab posters, there needs to be a way to compress and put multiple figures on the same page to allow visual comparisons. There needs to be more flexibility for presentations. One issue is it isn’t open source. Physicists like to tune stuff to their needs. As for the first workshop, I’d advise it isn’t good to deprecate (Microsoft’s) Windows; it is OK to have a personal preference, but if QN is going to support it as a platform, then it shouldn’t be deprecated during a site presentation or talks.
* The quality of the (e-lab??) experiments is quite variable; we need to develop seeds to sow for educating the next generation of scientists and citizens.
* I’d like to recruit college undergraduates and graduates as QuarkNet assistants, as TAs for QN. They could visit schools and help correct and redirect so we will get more. They could also help with technical problems, help trouble shoot why a detector isn’t working, maybe exchange a wire or something if that is what is needed. It would do the university student good to get an idea what it is like in the high school classrooms, and they could help busy teachers. It would be good for the college students and give them an opportunity to do community service. And there remain (e-lab) interface issues too. (Several new bugs appeared during both workshops.)
* Wish list for QuarkNet. Better to have a brand new QuarkNet webpage. Things have been the same for ten years. I realize they have updated it. The front page is not user friendly, and needs to be updated. All the information is in there, but it is hard to find. I would like to see other people’s activity. List of centers perhaps with pull down menu to be able to see what is being done at other centers. Access to documents in pdf file format. We can download a form now, so that is old style. A live pdf file would be better. Log in on the computer. Dates on the file could be put in on the computer.

Give me a password protected file to update my teachers file on the web rather than updating an excel file. Excel is cumbersome.

Also on teacher file: PI can have ability to modify in addition to teacher. Sent to their mobile phone to update their QuarkNet status information. This could be used for QuarkNet students also.

Posters that come from QuarkNet, Higgs or standard model, could we give a poster to QuarkNet teachers to hang in their room or a CD with video clips, pictures. Like CMS video clip of different particles travelling through the detector. People in the industry know where that clip is and that it is useful, but average teachers do not know so make it easier for them with a package of some sort that they receive at their center during the week at the institute.

Create a web page with a collection of urls to access specific data or video for a specific topic, update it once or twice per year.

* Need lots of hands-on experiences for teachers and students.
* Very happy with the program. There is a problem with the connection between the board and the Cockroft-Walton in the base of the PMT. Problem may be with the cables and connectors instead of inside; haven’t quite figured that out yet. Process of putting next year’s budget in right away can be a little silly, especially in a transition year, when the current mentor might be committing a future mentor to something he might not be up for.

**Summary**

Following are summaries of the teacher and mentor interviews. Based on findings, these centers are found to be meeting success factors to some extent, except in the case of participants meeting regularly and centers forming learning communities.

**Teacher Interviews**

This section summarizes the findings, for all types of teacher interviews (telephone, classroom site visit and institute site visit) combined.

The numbers of teachers who were interviewed were: by telephone, four; class visits, nine; institute participants nine; and institute teacher leaders, three, for a total of 25. There were five mentors interviewed during institutes. The plan for leadership fellows would have them interviewing a total of at least 20 by telephone, 10 in class visits, five teacher leaders at institutes. The number of institute participants varies, depending on the number of attendees. The sample of teachers was not random because of the difficulty in finding teachers to interview, but based on responses, the teachers appear to represent QuarkNet, in that some are highly involved and others are less so.

The table below shows combined data for the grades, courses and levels taught by the teachers interviewed.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 8 | 9 | 10 | 11 | 12 | General | Conceptual | AP | Honors | Regents |
| Physics | 2 | 7 | 14 | 19 | 22 | 8 | 6 | 8 | 9 |  |
| Chemistry | 0 | 1 | 2 | 3 | 2 | 9 | 0 | 0 | 0 | 0 |
| Biology | 0 | 1 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 0 |
| Mathematics | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 |
| Research | 0 | 1 | 1 | 1 | 2 | 3 | 0 | 0 | 0 | 0 |
| Other science: | 0 | 2 | 3 | 2 | 3 | 6 | 0 | 0 | 0 |  |

Most of the teachers taught higher grades, 10-12, and a high number taught AP and Honors classes. This is typical for QuarkNet teachers and would indicate a higher likelihood of the teachers being better able to implement QuarkNet in their classrooms than those who teach lower grades and levels. Those teaching lower grades implemented topics such as Particle Adventure and the Standard Model in one or two lessons rather than long-term projects, and tended not to be involved in professional activities as much as those who teach higher grades.

Twenty-three of the teachers interviewed taught physics, eight each general and AP, nine Honors and six, conceptual. Discrepancies between these reported numbers and those in the table occur when not everyone specifies the level of physics taught, such as the nine participants who are not asked to specify, and for those who teach more than one level. Two teachers did not teach physics, and instead taught chemistry or other sciences. There were no non-science teachers.

 In the past two years, 12 of the teachers said they had attended the summer institutes. One is a teacher leader who has helped run student summer workshops and masterclasses. Two have attended Boot Camp, masterclasses and taken students to the institutes. Another helped with two six-week student research workshops. One attended four meetings per year.

Teachers said the types of activities provided at institutes included building/maintaining Cosmic Ray detectors or other equipment, lectures, tours, introductory particle physics, implementing particle physics in the classroom, planning and sharing teaching ideas, Cosmic Ray e-labs and ongoing student research projects.

Direct connections for how to use QuarkNet activities in their classrooms varied from making lesson plans and games as a group to learning information on fundamental particles. Direct connections also included independent research projects, data analysis with detectors, inquiry-based instruction, modern physics topics, videoconferences, using detectors, demonstrations by professors for classroom transfer. When institutes provide meaningful activities and make direct connections for implementation, such as reported by these teachers, the success of the center is more likely.

 Teachers attended the following national level QuarkNet activities:

* Cosmic Ray e-lab - 18
* Masterclass - 8
* Boot Camp - 8
* CMS e-lab - 5
* LIGO e-lab - 5
* Teaching & Learning Fellows – 3
* LHC Fellows – 1
* CMS Fellow – 1
* Other: trip to CERN - 1

Typically, teachers who are involved with the QuarkNet program for longer periods are found to participate at the national level more.

Because of their participation in QuarkNet, teachers are implementing activities in the classroom at the following frequencies, as shown in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Topics | 1-2 lessons | 3-5 lessons | 1-2 weeks | Long-term Projects |
| e-lab | 5 (20%) |  | 2 (8%) | 4 (16%) |
| Masterclass | 4 (16%) |  |  | 1 (4%) |
| Particle Adventure | 6 (24%) | 1 (4%) |  | 1 (4%) |
| Standard Model | 10 (40%) | 2 (8%) | 3 (12%) |  |
| “Sprinkling” Examples  | 5 (20%) | 3 (12%) | 6 (24%) | 3 (12%) |
| Research with a Detector | 4 (12%) | 1 (4%) |  | 7 (28%) |
| Other: | 1 (4%) |  |  | 2 (8%) |

There were 42 total instances of teachers implementing QuarkNet activities at lower frequencies of one to two or three to five lessons compared to 29 instances of longer durations of one to two weeks, or long-term projects. Other topics included scientific inquiry, cloud chambers and engineering design. QuarkNet teachers who teach grades 10-12, and higher level classes tended to engage students in lessons or projects of longer duration. Those teaching lower grades implemented topics such as Particle Adventure and the Standard Model in one or two lessons rather than long-term projects, and tended not to be involved in professional activities as much as those who teach higher grades.

Teachers commented on their participation in QuarkNet events being helpful to their classroom implementation: it’s now easier to “sprinkle” HEP ideas throughout the year; students want to hear about HEP and the summer QuarkNet experience; the experience opens their eyes to how engaging research can be; students are more attentive and science becomes “possible” for them. Others commented on the confidence gained by being able to apply all aspects and create a student generated research program.

 Compiled data for this group of QuarkNet teachers show a higher than usual percentage (46%) of teachers experienced with QuarkNet. Based on past data, teachers who are more experienced in QuarkNet usually participate in activities that indicate a high degree of professionalism which is known to contribute to successful QuarkNet centers. Twelve (40%) have given workshops that include local and district physics gatherings, mini-workshops, professional development, State STA, AAPT, LIGO and particle physics workshops. There were 13 (43%) teachers who said they have not been involved in giving workshops to other teachers or given presentations.

Twenty-two (88%) of the teachers have attended meetings of professional organizations such as AAPT (One helped host an AAPT session), NSTA, State STA, State APT, School & university meetings. And four have not attended such meetings. Twenty-one have been involved in leadership at the school in the following capacities: department chair, technology mentor/committees, curriculum/science task force, policy review/site council or recruiting QuarkNet teachers and students. Four have not been involved in leadership at their school or district level.

 When QuarkNet centers hold regular meetings for the teachers, it has been found to contribute to the overall success of the centers. For the teachers interviewed, only about one quarter (six or 24%) say that teachers at their centers meet regularly. The frequencies of meeting include: two by email once or twice a month, three meet twice a year, one several times a year. One said the mentor and QuarkNet staff teacher meet with teachers and students a couple times a year. Others have general meetings to catch up, share activities and troubleshoot equipment or have lectures, labs, scientist research presentations. One center has a student research model and they meet at science events. Four said they meet during summer workshops and three at masterclass.

Related to meeting regularly, it has also been found that when teachers form learning communities, the centers are more successful. Notably, over the years teachers have commented that one of the most important features of QuarkNet is meeting and collaborating with other teachers. From the teachers interviewed, it is not clear that QuarkNet teachers participate in learning communities at their own or other schools. Only 10 (30%) responded that they have learning communities. One mentioned that there are ‘ongoing’ learning communities for teachers in the local area that include a planetarium, a NASA project and other groups not related to particle physics. One mentioned that professional development is encouraged and they have science department meetings. Eight of the teachers responded that they have the following types of communities: QuarkNet group, other schools, their district, local area and email exchanges. One said there was a learning community, but it ended a couple years ago and another teaches at a private school where there is a ‘disconnect to the public school arena.’ One teacher was not aware of a learning community being a goal for the center. It’s not clear that the teachers know what learning communities are, or that the fellows and staff understand the importance of them.

Strong mentors contribute greatly to successful centers. It appears that the mentors at these centers contribute to the success of the programs. Leadership at the centers is mostly done by the mentors. Of the 17 responses related to leadership, 10 were mentors, four were mentors and teachers and three were teacher leaders. There were only seven responses about center mentors’ activities and interactions with the teachers. They included coordinating/facilitating workshops (3), recruiting teachers (2) and one giving lectures on his role and research at CERN (this mentor was “not a very good presenter”). One communicates via email and EVO and one “does it all.” One mentor is working to revive the center.

 There were twenty-three comments about teacher leaders. The support they offer is in the form of organizing workshops, setting up detectors, contacting participants, instructing on how to implement QuarkNet and running a student research program. One said there is minimal teacher leadership and eight said either there is no interaction or they don’t know of any. One who said there is no teacher leader is willing to help.

A success factor related to QuarkNet staff support is indicated to be met, according to teachers interviewed. Twenty commented on interactions with QuarkNet Staff teachers and all but three knew who they are. Interactions and support include: detector support, moral support, Friday Flyer, Emails/Calls/Support, runs masterclass and presents at QuarkNet “meeting.” One did an inventory of detectors which were spread out over 20 schools; many teachers have left the program, with their detectors becoming lost. Three had no interactions.

Teachers were asked to provide feedback to QuarkNet staff that can be found at the end of each of the findings above in the following question numbers:

Question #13: Telephone, Class Visits, Site Visit Teacher Leaders

Question # 10: Site Visit Teacher Participants

**Mentor Interviews**

This section summarizes the findings, for mentor interviews at the four centers where fellows visited summer institutes.

 According to the mentor interviews at four centers, all have summer institutes of some type. The extent of QuarkNet activities varies and includes: masterclass, build a large telescope from scratch; build CRDs and exposing teachers to high energy experiments; video connections to CERN; e-lab; hands-on build or repair of equipment project that is beyond what they do in their classroom, tour labs; make connections to other university personnel; make connections to society of physics students; HS students get exposure to college physics students, new research updates, student research and trips to national labs.

 To continue QuarkNet, mentors are engaging in different activities, such as, coordinating the activities with schools, teachers and QuarkNet staff to revive a center; involving other professors and students to extend the program to families; involving a high school student to do a live Quarknet Web page that would be live wireless data from the cosmic ray detector; working to recruit more teachers; trying to sustain now that DOE funds are gone.

 All four have QuarkNet funding. One doesn’t know what is possible related to additional funding, another is considering STEM funds but they are scarce at the institution and one received a small amount of supplemental funding. Another said they are doing nothing to seek additional funds. It has been found that additional funding supports center success, and only one of these centers has done that.

 All four mentors see themselves in the leadership role, and appear to be strong mentors, which is a critical factor in the success of centers. Two mentioned having help from teachers. One would like to develop a teacher leader but is not sure who it should be. The original QuarkNet model would have the mentors also relying on teacher leaders more than we see in these mentors.

Mentors recruit teachers by word of mouth, emails and contact with returning teachers. One is reviving the center and is trying to reach teachers who will return that include college teachers. Another is trying for teachers in other disciplines and another has a small pool to draw from. Three of the four have a stable base of teachers returning.

 Types of support from QuarkNet staff include funding and masterclass. One said that the CRD and e-labs are not popular and another says there is no interest in masterclass. All feel the level of support is sufficient.

 Mentors’ expectations for how teachers will implement what they learn in their classrooms include: having teachers keep the equipment [CRMDs] and upload data, having students learn to do the whole science, engaging in inquiry instruction, having a pre- and post-test for participants’ physics students, putting a little particle physics in at the end after whatever big exam they happen to have and having them do something with the counters.

Mentors mentioned that they hear the following regarding what teachers are doing in the classroom: teachers have kept their detectors going, students are gathering and uploading data. One said the problem was that students weren’t involved in analyzing, comparing, and using the data, or looking for correlations. One is mentoring several students who are doing research with the cosmic ray detectors. One hopes they do something with the CRDs. One said that this topic is not discussed a lot and it is “More of QuarkNet’s job in my view.”

Mentors were asked to provide feedback for the QuarkNet staff which is found at the end of their interview findings above, Question # 9, Site Visit Mentors section. Some interesting feedback from the mentors is summarized here:

* This stuff (Cosmic ray e-lab and CMS e-lab) is good for students who are creative and will provide feedback. But I think it is awkward to have 2 workshops back to back like this: 3 days then 2 days. As for the first workshop, I’d advise it isn’t good to deprecate (Microsoft’s) Windows; it is OK to have a personal preference, but if QN is going to support it as a platform, then it shouldn’t be deprecated during a site presentation or talks.
* The quality of the (e-lab??) experiments is quite variable. We need to develop seeds to sow for educating the next generation of scientists and citizens.
* I’d like to recruit college undergraduates and graduates as QuarkNet assistants, as TAs for QuarkNet. And there remain (e-lab) interface issues too. (Several new bugs appeared during both workshops.)
* Wish list for QuarkNet. Better to have a brand new QuarkNet webpage. Things have been the same for ten years. I realize they have updated it. The front page is not user friendly, and needs to be updated.
* Create a web page with a collection of urls to access specific data or video for a specific topic, update it once or twice per year.
* Need lots of hands-on experiences for teachers and students.
* Process of putting next year’s budget in right away can be a little silly, especially in a transition year, when the current mentor might be committing a future mentor to something he might not be up for.

**Concerns**

This section addresses concerns for QuarkNet Staff, based on the interview data.

Unusually low numbers of teachers, four instead of 20, were interviewed by telephone and slightly lower numbers were interviewed at class visits, nine instead of 10, and institutes, three instead of five. Some of the deficiency in data was related to confusion in communication between the leadership fellows and QuarkNet staff, related to their assigned tasks. The relatively low numbers of teachers and choosing from centers that are viewed as struggling made it difficult to have a representative sample from which to gather data, but the responses are aligned with those from a broader, random selection. Because in the past telephone interviews have been found to provide very useful information to the staff, it would be helpful to increase the numbers in the future, especially in light of the fact that classroom visits are being removed from data gathering.

Based on these findings, recommended areas of focus for the QuarkNet staff are to:

* ensure that leadership fellows gather more data through interviews, particularly by phone;
* make certain there is clear communication between QuarkNet staff and leadership fellows regarding their assignments and tasks;
* define learning communities for QuarkNet teachers and emphasize their importance to staff and leadership fellows;
* encourage center mentors to enlist the help of teacher leaders and
* disseminate information on QuarkNet in general: what the QuarkNet model is and what centers are doing.