**QuarkNet Site Visits Report 2012-2013**

**September 2013**

*Data Gathered by Leadership Fellows*

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*September 2013*

This is an informal, internal report for the purpose of providing data about QuarkNet teachers and how they are influenced by their QuarkNet experience. It is not to be shared with an external audience.

QuarkNet Leadership Fellows gathered site visit data from teachers during spring and summer 2013, in person at visits to classrooms and institutes. During the site visits, observations were made using the Classroom Visit or the Institute Visit protocol. The site visit questions are based on accessing information using protocols that help determine the extent to which the success factors are being achieved.

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.

Interview data are reported in the QuarkNet Interview Report, September, 2013.

**Classroom Site Visits**

During spring of the 2012-2013 school year, four leadership fellows made classroom visits to nine teachers. For two of the teachers, three or more class periods were observed. Observations of their teaching were conducted by the fellows. The teachers represented four centers whose institutes were visited in summer 2012. Teachers were chosen from the QuarkNet database and contacted by email and phone to set up visits. In all but one case, fellows visited three or more classrooms per QuarkNet center. One fellow did not visit a class.

This report documents findings from fellows’ observations followed by a summary of findings and concerns to be noted by QuarkNet staff.

Institute Site Visits

During the summer of 2013, leadership fellows visited institutes at four QuarkNet centers. One center had a teacher institute and a student program. The centers were viewed by staff as struggling.

A total of 19 teachers, with a range of two to nine at each center, participated in the four institutes. Six high school students attended with their teachers. The institutes were led by a total of four mentors, five assistant mentors (other professors), four teacher leaders, nine student assistants at one site, two e-lab fellows and one QuarkNet staff member. The number of teachers normally participating at the centers was reported to be four at two sites, none at one site and for one there were no data. The “none” refers to a center that is restarting and while it has not had teachers participating recently the mentor is enlisting the help of former teachers and hopes to recruit new ones.

**Findings**

Classroom Visits: Observations

Following are findings from the data gathered by leadership fellows about the classroom visits from observations of the teachers, students and classroom environment.

The nine teachers whose classes were observed were teaching the following topics:

* lenses and image formation
* practical applications of a particular crystal family
* analyzing time-of-flight data from the QuarkNet CRMD
* AC/DC circuit lab using computer simulation of circuits and current
* introduction to light; senior projects with advanced topics ranging from sound to computer simulations, electric motors and many more
* prep for amusement park physics outing; special relativity; thermodynamics
* optics; microwaves
* electricity and graphing using circuit wiring lab kits
* Snell’s Law

Lessons were introduced in the following ways:

* Provide overview – 8
* Explain activity - 8
* Relate this lesson/activity to previous lessons/activities – 6
* Provide rationale for doing the activity -6
* Assess prior knowledge – 4

The following modes of instruction were observed:

* Lecture – 5
* Demonstration by instructor – 5
* Whole class discussion - 6
* Peer instruction – 3
* Review homework – 4
* Students solving (addressing) problems or questions in small groups - 7
* Students working in groups to answer teacher-posed problem; reporting out - 1
* Students solving (addressing) problems or questions independently – 7
* Students developing questions or problems - 1

Students were engaged the following activities:

* Listen and take notes - 4
* Complete worksheets or do practice problems in class - 3
* Give presentations - 2
* Write in journals or logs – 4
* Take a test/quiz/exam - 1
* Self-assessment - 3
* Read a textbook, other book, article, or hand-out in class- 1
* Laboratory or hands-on activity - 4
* Work on computer - 4
* Out-of-class activity - 1
* Other – 4

create product ad; build simulated circuit and test its functioning; senior project

Assessment strategies included:

* Test or quiz - 4
  + short-answer questions
  + essay-type questions
* Discussion responses - 7
* Observations of group work (assessing students' understandings; facilitating) - 7
* Journals or log entries - 2
* Oral reports or presentations by students - 1
* Report out after small-group discussions - 1
* Peer review - 4
* Other (describe): 1 computer feedback

The types of materials used included:

* Published materials - 3
  + textbook, web based
* Teacher-developed - 9
  + worksheets, laboratory investigation, demonstrations
* Technology-based - 9
  + video/CD, computers, computer simulation, programming software, cameras, calculators, cell phones
* Instrumentation - 9
  + demonstration models, laboratory equipment, lenses, laser, student built equipment
* Presentation equipment - 9

i.e. whiteboard, LCD projector, smart board

When asked to note what support the QuarkNet Center might provide for the teacher, based on their observations, the leadership fellows responded in the following ways (summarized):

* The teacher needs computers and more equipment; is VERY interested in incorporating particle physics in a unit on nuclear physics, but currently has no equipment and no budget.
* More lab equipment would be, but the supplemental support for equipment was not turned in by the mentor so [there is] no equipment money for this summer. [This Quarknet center needs a more involved mentor to have a chance of reaching its potential.]
* Teacher has old, slow computers; needs direction on structuring an efficient unit of study.
* There remains a strong need to develop a QuarkNet community. The perception is that the scheduled 2013 summer workshop is what they already accomplished in 2012 so nothing will be lost in not attending. There is a perceived need to have other QuarkNet activities beyond the cosmic ray detector (which was never received) [such as] Masterclass or CMS e-lab. A chance to share problems and solutions with colleagues would be appreciated.
* Concerned that they hadn’t realized that one goal was to start developing a QuarkNet support community where they could share ideas, concerns, and solutions. It could probably happen if non-repetitive activities were planned by the center.
* There was no perception of a QuarkNet community yet and 2012 participants didn’t realize that is a goal. They did think QuarkNet could provide much to help them and their students if different activities were planned each summer and they developed a community for sharing. For example they needed more ideas how to implement use of the cosmic ray detectors. There was a need to learn about low cost activities they could have the students do, such as MasterClass, CMS or LIGO e-labs, and possible visits to the center.
* QuarkNet has helped this teacher develop his skills as a teacher; continues to help by allowing him to run masterclass sessions during the year and having him help run the student research program during the summer workshops. He mentioned needing an increase in funds so that he and more students could be involved in the summer workshops.
* Financial aid would help so the teacher could have lab equipment to smooth out the lesson without the students in a group waiting for a piece of equipment in order to finish their lab.
* A teaching and learning workshop might increase creativity a bit.

**Institute Site Visits: Observations**

Following are summaries of observations from leadership fellows from the four institutes.

**Mission and/or Focus of the Center**

a. Center model for sessions

* Being revived and the focus is on CRDs and e-labs
* Varies activities, in response to teacher needs within QuarkNet goals, and takes advantage of university activities that are going on at the time of the institute. There were lab tours, lectures by post docs and professors, a video link to a series of live CMS updates, use of Quarknet inquiry processes and participants collected data
* Has lectures on modern physics, hands-on lab ideas related to talks and teachers share ideas for implementation
* Has lectures, work with cosmic ray detector, and a “field trip”

b. Overall goal or mission: (i.e use and share cosmic ray detector data)

* revive center
* increase teachers knowledge of particle physics and cutting edge research, hands on opportunities to build equipment and/or collect data from existing equipment and time to make links for their own classroom use.
* teachers sharing ideas for implementation; keeping current on particle studies and LIGO.
* help teachers incorporate particle physics into their classrooms, particularly through use of the cosmic ray detector.

c. Focus of the session:

* flux & shower studies
* lab tours, lectures by post docs and professors, a video link to a series of live CMS updates, use of Quarknet inquiry processes and participants collected data.
* neutrino oscillations, LIGO, finding Higgs particle
* study of the effects of altitude on flux.

**Activities**

a. Key Activities observed:

* flux & shower studies Cosmic Ray Detector workshop led by QuarkNet staff, LHC talk, CMS e-lab and comparison with Cosmic ray e-Lab, CMS Data Express, QuarkNet internet accounts: e-Lab & Drupal, LHC data sets, use of CMS e-lab in the curriculum
* scientist presentation on the next update proposals to the CMS detector; research in progress and participated in data collection; tour of physics lab
* teachers sharing, sample labs to demonstrate neutrino oscillations, cosmic ray studies, use diffraction of laser beam to determine hair shape, and construction of a vibration damper related to LIGO
* a study of the effects of altitude on flux; participants took data at the university and then drove to a cabin near the top of the highest peak in the Appalachians; spent the last day of the workshop drafting sections of a paper on the study.

b. Materials Used

* cosmic ray detectors, cloud chamber, teacher and student lap-tops
* video link and projector, computers, cosmic ray detectors, data analysis software, electronics deck
* coupled tennis ball pendulum oscillator, and torsion spring, as examples of neutrino oscillations; berkley detectors for angular dependence of cosmic rays, laser pen with useful idea of a clip holder, wooden blocks and springs for interferometer damping like LIGO, oscilloscope.
* CRMD and concrete slabs used to simulate the increased atmosphere at the university vs the highest peak

c. Next Steps

* a plateauing party, a mountain CRD expedition
* Quarknet e-Lab II, discussion session for physics Olympics, a medical physics tour discussion session on; how to improve the center’s QuarkNet program
* no data
* The next step is for the group to compile, edit, and publish the paper.

**Comments**

a. Extent to which the session furthers QuarkNet goals:

* QuarkNet approach and philosophy was recognized by all participants as important for high school physics instruction.
* Participants were exposed to cutting-edge physics research presented by researchers; participants made links to their own classroom practice and participated in data collection themselves; an interesting discussion after the live video presentations implying a design imperfection in the proposed update - post discussion of this centered around the fact that these scientists, while colleagues, are also competitors, and you have to respond quickly and stand up for your research point of view to silence naysayers. Even though scientists publish and share data a reality of science research is the competition aspect.
* Modern physics updates with lab ideas and teaching ideas, but light on effective classroom practice,
* This session was an excellent representation of QuarkNet goals: teachers working on real research in ways that model what they can do in the classroom.

1. Balance of content and transfer to the classroom

* skills for using the cosmic ray and CMS e-lab and Data Express in the classroom and sharing problems, solutions and group plans via Drupal
* very good balance of participants being exposed to research and making links to the classroom
* good ideas for practical labs
* no data

1. Characterize attitudes/interactions between the participants and scientist(s)

* The mentor/scientists freely made pertinent comments and suggestions, offering their insight and deeper understanding to help both teachers and students. The teachers freely asked questions of the scientists. A couple of the students asked questions that the mentors found amazingly deep.
* Total mutual appreciation of the role/work done by the mentor and the commitment of the participants.
* Several from physics faculty stopped by. They and the teachers knew each other and were comfortable and respectful with one another.
* Professional and collegial.

1. Characterize attitudes/interactions among participants (including the teacher leader):

* They have a sense that a community has not yet jelled but there are signs of it beginning to form; feel that this site is in transition from a group which was collecting data for the mentor to one focused on supporting teachers in their classrooms.
* Excellent camaraderie among participants, mutual respect and understanding. All are willing and have in the past helped each other during the school year. These participants respect their mentor beyond measure and he them.
* Cordial
* The teachers worked well together and are very familiar with one another.

**Summary**

**Classroom Visits**

When fellows observed their classrooms, only one of the nine teachers was implementing particle physics. Through fellows’ observations and discussions, it was obvious that all of the teachers were dedicated to introducing particle physics content or current topics in science and research in their classrooms, barring equipment and technology challenges.

While in most cases, the topics introduced were not related to particle physics, the teachers stated that their intended outcomes were related to physics (5), particle physics (2), and research projects (2).

According to the leadership fellows’ observations and rating of the teachers’ practices, all nine of the teachers engaged in instructional strategies, and seven of the nine focused on instructional emphases that reflected inquiry-based teaching and learning. Five out of the nine closed the class with a summary of the day’s lesson, and four related the lesson to what comes next. Seven of the teachers had students work in groups or pairs, indicating collaborative efforts. Based on the ratings of their students’ classroom habits and class activities, five to seven of the teachers included inquiry. About half (4 - 6) involved inquiry in their discussions and hands-on work. These observations indicate that the teachers are attempting to meet the QuarkNet objective of implementing inquiry, to a large extent.

Concerns expressed by the fellows about the centers have to do with the needs of the teachers in terms of technology and equipment; also funding and maintaining communities.

It should be noted that the day of observation was a ‘glimpse’ of their teaching and does not fully represent their teaching style or the topics they cover related to particle physics.

**Institute Visits**

Based on the fellows’ observations of the summer institutes, these four centers are following the model for these types of workshops, and attempting to achieve overall goals that are aligned with the goals of the QuarkNet program.

The activities/projects offered at the four institutes give the teachers an opportunity to explore research, inquiry practices and classroom implementation.

This is a small sampling of centers, and while they were chosen because they were viewed by staff as ‘struggling,’ the leaders at the centers appear to be making great efforts to keep the programs going and increase the numbers of participants. They are providing opportunities that contribute to success factors such as meaningful activities and addressing classroom implementation. They face obstacles that are common to many QuarkNet centers, in terms of mentors’ time and access to supplemental funds.

Concerns

Based on fellows’ observations, following are issues and concerns:

* Teachers need technical support (see Classroom visits, support needed).
* Teachers need assistance and encouragement in forming learning communities
* Centers need help with recruiting teachers.
* Mentors need help with finding funding sources.
* The web site needs to be updated to be more user friendly and to contain more content (see Classroom visits, support needed)

Recommended areas of focus would be:

* suggest ways mentors can supplement their programs, especially for technical support;
* facilitate teachers’ forming learning communities, in person and online;
* assist mentors with recruiting new teachers and
* develop the QuarkNet web site so that is easier to use (find things) and contains useful content.