**QuarkNet Teacher Survey Report 2012 – 2013**

**September 2013**

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Following is an informal, internal report that provides 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.

For the 2012-2013 school year, from February to September 2013, QuarkNet teachers were asked to complete an online survey to provide information regarding their classroom practices, perceptions of QuarkNet, and report on their teacher professional activities.

Teachers were chosen from a database provided by QuarkNet staff. The database was said to have information on 574 “active” teachers. This number included retired teachers and those with no email addresses and with those subtracted the total was 561. Initially twenty per cent of the teachers were picked, for a total of 112 teachers. A response rate of 70% was needed to have the data represent QuarkNet.

Emails were sent to a total of 112 teachers requesting that they respond to the online survey. Evaluators were notified by five teachers that they were inactive or not participating, which resulted in the number of “active” teachers being 556.

Emails were sent on seven separate occasions, once to the whole group and then to subgroups who had not responded. Other individual and small group emails were sent. Participants were reminded that “Providing Information for Program Evaluation” is one of the participant expectations as stated on the web site: <http://quarknet.fnal.gov/tchr_respons.shtml>)

As an incentive for submitting a survey, teachers were told that their names would be entered into a lottery; one teacher received $100 for being the first to submit the survey and six other teachers received $50.00 for completed surveys.

When emails were returned as undeliverable in six cases, other teachers were chosen from the database. Valid responses were received from 60 teachers. The overall response rate is 54 per cent after exhaustive efforts to achieve a greater number of responses. The selection could not be considered random and fewer than the expected 70% responded, therefore the data cannot be said to represent QuarkNet. These data indicate that results are similar to past results.

**Survey Results**

This informal, internal report documents findings from the online teacher survey, followed by a summary of findings and concerns for QuarkNet staff to make decisions for improving the program.

**I. Demographics**

The demographics of the survey respondents are similar to results for the QuarkNet program in the past.

Table I.1 below gives a breakdown of the number of teachers participating by number of years. The average is 5.5 and the range is one to 14 years.

***Table I.1***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **# Years Participating** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **# Teachers** | 8 | 9 | 11 | 5 | 3 | 1 | 2 | 6 | 4 | 5 | 0 | 2 | 1 | 3 |

Of the teachers responding, a high number (28 or 47%), are considered new to QuarkNet at one to three years. Seventeen (28%) are mid-range at four to eight years, and fifteen (25%) are considered long-term or “experienced” at nine to 14 years. In the past, years of experience with QuarkNet have been seen to affect findings related to implementation of QuarkNet materials in the classroom. Teachers new to QuarkNet typically don’t implement to a large extent in the first few years after participation in their summer institute.

Table I.2 shows the number of teachers reporting in the categories: subjects taught, grades and levels.

***Table I.2***

Course Grade Course Level

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **7-8** | **9** | **10** | **11** | **12** | **General** | **Conceptual** | **AP** | **Honors** | **Regents** |
| **Physics** | 1 | 5 | 9 | 39 | 38 | 25 | 9 | 22 | 20 | 7 |
| **Chemistry** | 1 | 3 | 7 | 11 | 10 | 6 | 0 | 6 | 2 | 1 |
| **Biology** | 0 | 4 | 1 | 1 | 3 | 1 | 0 | 0 | 0 | 1 |
| **Mathematics** | 0 | 3 | 2 | 1 | 3 | 2 | 0 | 0 | 1 | 0 |
| **Research** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| **Other science** | 1 | 8 | 7 | 10 | 13 | 10 | 1 | 2 | 3 | 0 |
| **Non-science** | 0 | 0 | 1 | 2 | 3 | 1 | 0 | 0 | 1 | 0 |

Fifty-three of the teachers reported teaching physics. Three did not report grade and another three did not report level. Seven reported no grade or level. They taught largely in grades 11-12, general, AP and Honors. They also taught chemistry, biology, mathematics, research and other science classes. Four taught a non-science course at the grade levels 9-12.

There was a high number (33) of Suburban schools. Rural (11), Urban (8) and Urban-inner city (8) schools had the same or similar numbers for these teachers.

These results are typical of QuarkNet teachers, in that they usually teach mostly physics classes, with math and some other science~~s~~. The responses on research courses agree with past data when usually no more than one teacher devoted an entire course to research.

Table I.3 below shows the ethnicity and socioeconomic levels of schools where the respondents teach.

***Table I.3***

|  |  |  |  |
| --- | --- | --- | --- |
| **Average percent of teacher responses:**  **rough estimate of ethnicity** | | **Average percent of teacher responses:**  **rough estimate of socioeconomic level** | |
| Native American | 4% | Free/Reduced Lunch | 23 % |
| Asian or Pacific Islander | 8% | Low income | 19 % |
| Hispanic (regardless race) | 12% | Middle income | 32 % |
| African American | 11% | Upper-middle income | 17 % |
| White (not Hispanic origin) | 65% | High income | 9% |
| TOTAL | 100% | TOTAL | 100% |

The table shows that 65 per cent of the students were reported as white; the total minority population was reported to be 35 per cent. Socioeconomic levels are dispersed with high income the lowest, at nine per cent. Three did not respond to socioeconomic questions and five did not respond to either, ethnicity or socioeconomic questions. These responses are similar to previous years’ surveys.

**II. Classroom Practices**

Respondents were asked to rate a series of 17 classroom practices according to frequency of use. Table II.1 shows the responses.

The column headed ND shows those who did not respond. Traditional practices, those that if overly-used are shown to be ineffective (do not support inquiry-based teaching and learning), are in boldface.

***Table II.1***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Almost**  **Every**  **day** | **Once or**  **twice a week** | **Once or**  **twice a month** | **Once or**  **twice a semester** | **Never,**  **hardly**  **ever** | **ND** |
| a. work in groups | 32 | 28 | 0 | 0 | 0 | 0 |
| b. work on long-term projects | 4 | 48 | 0 | 0 | 7 | 1 |
| **c. listen and take notes** | 31 | 29 | 0 | 0 | 0 | 0 |
| d. write a report/paper | 2 | 51 | 0 | 0 | 6 | 1 |
| e. write in journals or logs | 9 | 23 | 0 | 0 | 27 | 1 |
| f. collect and interpret data | 15 | 44 | 0 | 0 | 1 | 0 |
| **g. follow procedures to do an**  **investigation or solve a problem** | 20 | 40 | 0 | 0 | 0 | 0 |
| **h. review homework in class** | 25 | 35 | 0 | 0 | 0 | 0 |
| **i. complete worksheets or**  **answer written questions in class** | 19 | 34 | 0 | 0 | 5 | 2 |
| j. give oral reports or  presentations of their work | 4 | 48 | 0 | 0 | 7 | 1 |
| k. design experiments or solve  novel problems | 3 | 51 | 0 | 0 | 4 | 2 |
| l. use a computer for other than word processing | 16 | 41 | 0 | 0 | 2 | 1 |
| m. use manipulatives/equipment  (not calculators) | 12 | 43 | 4 | 0 | 0 | 1 |
| **n. use a textbook to do assignments in class** | 10 | 32 | 0 | 0 | 16 | 2 |
| **o. read a textbook in class** | 2 | 29 | 0 | 0 | 29 | 0 |
| p. discuss a science/mathematics/  technology related news event | 2 | 56 | 0 | 12 | 2 | 0 |
| q. use critical thinking skills such as problem-solving and/or decision-making | 35 | 25 | 0 | 0 | 0 | 0 |

Table II.1 shows that ten, compared to six last year, of the eleven practices that support inquiry-based learning, collaboration and research were used at mid to high frequency (‘Almost every day,‘ ‘Once or twice a week,’ ‘One or twice a month’).

* work in groups – 60 (100%)
* work on long-term projects – 52 (87%)
* write a report/paper – 53 (88%)
* collect and interpret data – 59 (98%)
* give oral reports or presentations of their work – 52 (87%)
* design experiments or solve novel problems – 54 (90%)
* use a computer for other than word processing – 57 (95%)
* use manipulatives/equipment (not calculators) - 55 (92%)
* discuss a science/mathematics/technology related news event – 58 (97%)
* use critical thinking skills such as problem-solving and/or decision-making – 60 (100%)

Only one of the practices that support inquiry-based learning, collaboration and research were used almost equally at mid to high frequency and at low frequency:

* write in journals or logs – 31 (52%) “almost every day” and 27 (45%) “never or hardly ever”

Four practices that ***do not*** support inquiry-based learning, collaboration and research were shown to be used frequently, and two are used at mid to high frequency and at low frequency:

* listen and take notes - 60 (100%)
* follow procedures to do an investigation or solve a problem - 60 (100 %)
* review homework in class - 60 (100%)
* complete worksheets or answer written questions in class - 53 (88%)
* use a textbook to do assignments in class – 42 (70%) high and 18 (30%) low
* read a textbook in class - 31 (52%) high and 29 (48%) low

While most of the practices that support inquiry-based learning, collaboration and research were used at high frequencies, those that do not support were also used at high frequency. Data from the large number of year-one teachers who responded would be expected to contribute to higher frequency of use of practices that do not support inquiry-based learning, collaboration and research. However, this year’s data show more frequent use of those practices by more experienced QuarkNet teachers.

Verbatim comments that followed the Classroom Practices questions include:

* I use the modeling method for teaching physics
* In our Physics classes, the students are almost always involved in lab investigations.
* Research class develops and executes a project. This year cosmic rays versus solar flare activity.
* Since I teach mainly math courses, many of the above questions are skewed to the more abstract nature of that subject. The Chemistry and Biology courses students take under my supervision are in the computer based Pearson's Gradpoint program.

**III. Continuum of Pairs**

Following are five pairs of statements. Each pair represents opposite ends of a continuum in approaches to teaching. Below each pair of statements is a table with the sum of total responses for each number. All teachers responded to all the pairs.

**Pair #1**

B. My primary goal is to help students achieve a deeper understanding of key science/mathematics/technology concepts and principles.

A. My primary goal is to help students learn terms and formulas and to master science/mathematics/technology skills.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Continuum** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **Responses** | 2 | 1 | 2 | 4 | 15 | 21 | 15 |

**Pair #2**

B. In my science/mathematics

/technology course, I aim for *comprehensive* coverage even if means sacrificing in-depth study.

A. In my science/mathematics /technology course, I aim for *in-depth* study of selected topics and issues, even if it means sacrificing coverage.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Continuum** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **Responses** | 6 | 15 | 11 | 9 | 12 | 6 | 1 |

**Pair #3**

B. My students generally learn basic scientific terms and formulas *while* learning under-lying concepts and principles.

A. My students generally learn basic scientific terms and formulas *before* learning under-lying concepts and principles.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Continuum** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **Responses** | 3 | 2 | 2 | 2 | 9 | 30 | 12 |

**Pair #4**

B. In my science/mathematics

/technology class, laboratory investigations and problem solving are used to confirm and explore concepts.

A. In my science/mathematics

/technology class, laboratory investigations and problem solving are used to introduce previously-learned concepts.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Continuum** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **Responses** | 1 | 2 | 3 | 13 | 17 | 15 | 9 |

**Pair #5**

B. I primarily assess my students' learning based on their ability to answer questions about specific content and processes.

A. I primarily assess my students’ learning based on their ability to apply their knowledge to new situations.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Continuum** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **Responses** | 2 | 13 | 15 | 14 | 11 | 5 | 0 |

Responses for three of the five pairs indicate support for inquiry-based teaching to some extent. In Pairs # 1, #3 and #4, the responses fell on the continuum from the middle to the right, indicating they are using practices that supported inquiry-based learning, collaboration and research. In #2 and #5 numbers fell in the middle and on either sides, indicating a wide range of practices.

**IV. Perceptions and Use of the QuarkNet Program**

Respondents were asked about their participation the QuarkNet program. Below, the sum of responses for each activity is listed.

**1. Interactions with QuarkNet Center:**

* + 49 (82%) have attended a QuarkNet Center meeting within the current year.
  + 12 (20%) are Lead Teachers at their QuarkNet Center.
  + 2 (3%) are QuarkNet Fellows
  + 20 (33%) have students who have participated in masterclass

2. **Since Participating in QuarkNet:**

* + 48 (80%) have shared what they learned in QuarkNet with colleagues.
  + 19 (42%) have become involved in reform efforts at the school or district level (curriculum, standards).
  + 45 (60%) have developed new materials for the course(s) they teach.
  + 14 (23%) have become a mentor teacher and/or department chair at their school.
  + 10 (17%) have given a workshop or presentation at a local or national meeting of a professional organization (e.g., AAPT) that is QuarkNet-related.

**3. The following numbers of teachers have participated in these QuarkNet programs:**

**39 (65%)**  a. Cosmic Ray e-lab

**22 (37%)**  b. Teaching and Learning

**21 (35%)**  c. Boot Camp

**23 (27%)** d. Masterclass Orientation

**11 (18%)** e. Other: Two have been to CERN; one participated in CMS e-lab, one conducts student research.

**4. The following table (Table IV.1) shows the numbers of teachers who have used these QuarkNet-related resources with one or more of their classes, at the specified frequencies.**

Those who did not respond are designated in the table under “ND.” It is assumed that where there are no data, those teachers did not use QuarkNet resources.

***Table IV.1***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Did Not Use** | **1-2 Lessons** | **3-5 Lessons** | **1-2 Weeks** | **Long-term Projects** | **ND** |
| **Cosmic Ray Detector** | 21 (35%) | 19  (32%) | 4  (7%) | 0 | 10  (17%) | 6  (10%) |
| **Cosmic Ray e-lab** | 28 (47%) | 11  (18%) | 2  (3%) | 3  (5%) | 7  (12%) | 9  (15%) |
| **Particle Adventure** | 21  (35%) | 16  (27%) | 7  (12%) | 2  (3%) | 3  (5%) | 11  (18%) |
| **Standard Model** | 10  (17%) | 21  (35%) | 12  (60%) | 4  (7%) | 6  (10%) | 7  (12%) |
| **LHC Web Site** | 24  (40%) | 19  (32%) | 3  (5%) | 1  (2%) | 3  (5%) | 11  (18%) |
| **CMS e-lab** | 34  (57%) | 8  (13%) | 3  (5%) | 1  (2%) | 3  (5%) | 11  (18%) |
| **LIGO e-lab** | 40  (67%) | 1  (2%) | 0 | 1  (2%) | 1  (2%) | 17  (28) |

Table IV.1 and related comments show moderate to high use of QuarkNet-related resources. Mention of additional resources such as videos, activities and other included:

* Videos and simulations – 9
* Particle Hunters - 2
* Top Quark - 5
* Bubble Chamber - 2
* CERN rap - 2
* Rolling with Rutherford - 3
* Quark Puzzle - 1
* One each: Quark workbench, tour Fermilab, cloud chamber

**5. The following table shows the numbers of teachers who have used these QuarkNet-related topics when they teach, at the specified frequencies.**

Those who did not respond are designated in the table under “ND.” It is assumed that where there are no data, those teachers did not use QuarkNet resources.

***Table IV.2***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Did Not Teach** | **Used One Example** | **Used Some Examples** | **Used Many Examples** | **ND** |
| **Conservation Laws** | 6 (10%) | 16 (27%) | 11 (18%) | 23 (38) | 4 (7%) |
| **Momentum** | 6 (10%) | 11 (18%) | 23 (38%) | 15 (25%) | 5 (8%) |
| **Vectors** | 10 17%) | 12 (20%) | 14 (70%) | 16 (27%) | 8 (13%) |
| **Energy** | 7 (12%) | 6 (10%) | 25 (42%) | 19 (32%) | 3 (5%) |
| **Nuclear/Energy** | 12 (20%) | 8 (13%) | 23 (38%) | 13 (22%) | 4 (7%) |
| **(E=mc2)** | 12 (20%) | 9 (15%) | 22 (37%) | 13 (22%) | 4 (7%) |

Table IV.2 shows a high frequency of use of particle physics topics. Comments about other topics used included:

* E fields, B fields, scientific method, data collection
* light energy conversion, gravity and the Higgs collision analyses Triggering
* magnetic fields, circular path of charges in field

**6. Respondents were asked to rate aspects of their QuarkNet Center and QuarkNet in general by giving a rating of: (1) Positive, (2) Neutral or (3) Negative.**

Following in Table IV.3 are the responses.Those who did not respond are designated in the table under “ND.”

***Table IV.3***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Ratings** | **1** | **2** | **3** | **ND** |
| **Support from QuarkNet staff teacher** | 48 (80%) | 7 (12%) | 1 (2%) | 4 (7%) |
| **Support from QuarkNet lead teacher(s)** | 44 (73%) | 10 (17%) | 0 | 6 (10%) |
| **Support from QuarkNet mentor(s)** | 41 (68%) | 12 (20%) | 0 | 7 (12%) |
| **Support for transfer to the classroom** | 43 (72%) | 12 (20%) | 1 (2%) | 4 (7%) |
| **Quality of workshops** | 52 (87%) | 6 (10%) | 0 | 2 (3%) |
| **Quality of resources provided** | 50 (83%) | 8 (13%) | 0 | 2 (3%) |
| **Compare with other teacher enhancement programs** | 49 (82%) | 6 (10%) | 1 (2%) | 4 (7%) |

Results were highly positive, or neutral. There were only three negative responses, one each for “Support from QuarkNet staff teacher,” “Support for transfer to the classroom” and “Compare with other teacher enhancement programs.” For these ratings, results are similar to past years.

**7. Comments**

Respondents were asked to comment on any aspect of QuarkNet they would like the staff to know about. Below is a summary of comments received from 17 teachers.

Nine of the comments were of a positive nature, related to interaction with other teachers (3), and the overall quality of the program (6). The positive comments highlighted the benefits of participating, such as “One of the most positive experiences is the ability to work with teachers/students from other schools and other QuarkNet centers.”

Favorable verbatim comments follow:

* I really enjoy learning the new information that is presented at the workshop. It is exciting to explore and discuss the mystery of our universe with other colleagues and also hear of the new findings.
* Overall my last 5 years has been an amazing experience. Some of experiences have not been thrilling, but as I reflect on my particle physics knowledge base and my ability to teach current science to my students, I am nothing short of astounded by the wealth of knowledge and understanding I have achieved and been able to deliver to my students. Thanks for the great opportunities!
* One of the most positive experiences is the ability to work with teachers/students from other schools and other QuarkNet centers. The exchange of ideas across "institutions" is highly valuable. The QuarkNet workshops are great, and the meetings at our QuarkNet center are productive.
* Very good program and I have learned a lot about particle physics. Taking one workshop was not enough for me to feel comfortable teaching my students, but after being at a couple weeklong workshops and Fermilab boot camp, I tried the masterclass with my AP students. This year is my third year of masterclass and I am feeling much more comfortable with the subject. I think it's hard for teachers to really teach this in their classes because so many of us have not learned any of this ourselves! Also, it's not a part of the state standards, or in the AP Physics curriculum, so we have to make extra time for it. (totally worth it, by the way). I like exposing the students to CURRENT physics research and maybe inspiring some to go into physics for a career.
* I totally love the idea and the concepts and plan on applying them this next school year.
* My wife and I have attended Quarknet and have received countless new ideas and information that we have used in our classes. Also it has given us the opportunity to network with other teachers in our teaching areas that has been a great asset. I have attended Boot Camp and enjoyed bringing back new info for my classes. Being from a small rural school we do not get the chance to participate in many science activities during the summer --this one is the exception to that. We both sincerely hope that this program will continue in the future both [here] and at other colleges. It has been a wonderful event that we both look forward to each time we attend.
* I take my students to Fermilab almost yearly and this is an excellent experience. I want more communication from Quarknet people at Fermilab and classroom teachers. I love QuarkNet! I got involved with it the summer before my first real teaching assignment and it has helped me a lot as a teacher. As a science enthusiast, it has helped me keep involved and informed of new developments. I would not be able to teach some of the things I do about matter and the Standard Model without the resources that QuarkNet provides. Thank you Fermilab!
* My participation in the Quarknet program has been one of the most rewarding and stimulating experiences in my 30-plus years of teaching.
* [The mentor] does a great job getting people excited about physics.

Of the eight comments that were less positive, four were about needing help with detectors and one, needing a detector. Two were about the state/school/district situations affecting the teachers’ ability to implement QuarkNet related topics and one was about classroom transfer being difficult.

Verbatim comments that were less positive follow:

* Since we were added in late in the planning process, we did not receive a set of detectors and are physically far from those who did. So, we have been unable to implement experimentation in our courses.
* The biggest concern that I have implementing QuarkNet into my classroom is following my corporation policies/state standards. I have worked high-energy particle physics into lessons over the years that I have been involved, and I am grateful for this awesome resource to further develop my understanding of current research.
* I really enjoyed the workshop. I am limited in the amount of material I can use from Quarknet due to the number of learning targets we are expected to teach in our district.
* I feel that there is a lack of communication in our state between our Quarknet leaders and the teachers whom have attended the workshop. I had trouble using the muon telescope and could not get help when I called your center at Fermilab.
* It is a challenge at our school to connect the detector due to the building being so old and no windows. We will be building a new high school and hope this situation will improve.
* I find the transfer piece difficult and not facilitated as extensively as other content-based professional development in which I've taken part.
* I have moved into a new facility at our school and would really like someone to help me get the detectors going again I would like someone to contact me so I can get going with e-labs again
* I am eager to use the detector with my students during this upcoming school year. I have not yet been able to do so. Next summer, I hope to have much more to say!

**Summary**

This section summarizes the findings and addresses concerns to be considered by QuarkNet staff.

***Demographics***

The demographics of the survey respondents are similar results for the QuarkNet program in the past. Fifty-three of the teachers taught one or more physics classes across the levels from general to regents. Seven reported no grade or level. They taught largely in grades 11-12, general, AP and Honors.

Of the teachers responding, a high number (28 or 47%), are considered new to QuarkNet at one to three years. Seventeen (28%) are mid-range at four to eight years, and fifteen (25%) are considered long-term or “experienced” at nine to 14 years. In past years, the teachers’ years of experience with QuarkNet have been seen to affect results related to implementation of QuarkNet materials in the classroom.

***Classroom Practices***

When asked to rate the frequency of use of classroom practices, results show that the survey respondents use ten of the eleven practices that support inquiry-based learning, collaboration and research (a primary goal of QuarkNet) at mid to high frequencies. Only one of the practices that support inquiry-based learning, collaboration and research were used almost equally at mid to high frequency 31 (52%) “almost every day” and at low frequency 27 (45%) “never or hardly ever.”

Four practices that ***do not*** support inquiry-based learning, collaboration and research were shown to be used frequently, and two are used at mid to high frequency 42 (70%) for one and 31 (52%) “almost every day” and at low frequency 18 (30%) for one and (48%) “never or hardly ever.”

It is unusual that both the practices that support inquiry-based learning, collaboration and research and those that do not support were used at high frequencies. Data from the high number of year-one teachers who responded would be expected to contribute to higher frequency of use of practices that do not support inquiry-based learning, collaboration and research. However, this year’s data show more frequent use of those practices by more experienced QuarkNet teachers, possibly indicating a decline over time.

On the continuum of practices, three out of five had responses that indicated teachers were using practices that are supported by QuarkNet. In two of the five pairs, numbers indicated a wide range of practices.

***Perceptions and Use of the QuarkNet Program***

Teachers participate in programs and activities that support learning communities and professional development as evidenced by the numbers of teachers who have made QuarkNet-related presentations (10 or 17%), shared information with colleagues (48 or 82%), developed new materials for courses (45 or 60%) and held leadership roles in their schools and districts (14 or 23%).

As in past years, teachers have attended a high number (116) of QuarkNet programs other than their local summer institute: Cosmic Ray e-lab and Teaching and Learning workshops, masterclass and Boot Camp. Therefore, programs offered national and not only center-related, are being attended at high rate.

Responses indicated that teachers used resources and topics in the classroom that included Cosmic Ray Detector, Cosmic Ray e-lab, Particle Adventure, Standard Model, LHC Web Site, CMS e-lab and LIGO e-lab. Teachers widely used particle physics examples such as Conservation Laws, Momentum, Vectors, Energy, Nuclear physics/energy and Energy–Mass conversion (E=mc2).

***Concerns***

Teachers who responded to the survey engaged in numerous QuarkNet activities and used resources provided by QuarkNet. Positive and less positive comments about the program were nearly equal. There are comments that have recurred from year to year regarding the difficulty in implementing QuarkNet in the classroom. While the numerical data and comments are largely quite positive, there were a few concerns noted regarding the teachers needing detectors or help setting them up and using them.

Staff could more broadly inform teachers that there are ways to get help with detectors and implementing QuarkNet , especially with a cadre of fellows who are available to assist.