Center-Level Portfolio: University of Illinois/Chicago State University

The following table, proposed implementation plans by participating teachers, and when available other examples are intended to provide an overall narrative about how and in what ways program participation has influenced teachers in using QuarkNet content and materials in their classrooms (and in-after class events). The value of these qualitative reviews is to expand on the instructional practices measured quantitatively via Teacher Survey responses to specific sets of questions/self-reported by teachers providing narrative examples of implemented or planned instructional practices in teachers' classrooms and in schools. This evaluation approach is consistent with the use of *authentic assessment* to evaluate performance, "teaching for understanding and application rather than for rote recall" (Darling-Hammond & Snyder, 2000, p. 523).

In keeping with Darling-Hammond, Hyler and Gardner (2017), we do not naively expect a single workshop (or event) to have a measurable impact on teachers' knowledge and subsequent classroom implementation. A characteristic of effective professional development is a program of sustained duration, providing "multiple opportunities for teachers to engage in learning around a single set of concepts or practices; that is rigorous and cumulative" (Darling-Hammond, et al., 2017, p. 15). As such, the table summarizes responses by teachers over the course of several program years and likely several QuarkNet programs and/or events.

These responses come from the Teacher Survey (either the full or update version) where each row represents the responses to open-ended questions from the same teacher over time. Also, each row starts with the original responses to the first time a teacher completes his/her full teacher. If a particular box in the table is blank, it likely means that that teacher did not participate in an event for that program year (or, the center may not have had a major event that year). The table provides the essence of these responses; a given response, as presented, may be a direct quote, a paraphrase, or lightly edited; the intent is to convey the overall idea or its essence from that particular teacher.

Because these are responses to open-ended questions, teachers are free (and encouraged) to provide information that he or she thinks most relevant. Each highlighted response is intentionally anonymously to respect the principles of collecting evaluation data (*Guiding Principles for Evaluators*, American Evaluation Association) and to help encourage teachers to respond frankly to these questions. If a reader is familiar with a given center, it may be possible to "reverse engineer" the identify of a particular teacher. We encourage readers to respect this anonymity. At various times, we may have identified a given teacher by name and/or school; when this happens the written approval of that teacher has been obtained. It is also important to note that the full breath of a response by a given teacher may not be fully articulated in this table. For example, responses related to how QuarkNet may have advanced the knowledge of a given teacher or bolstered a collegial network among participants are likely discussed elsewhere in subsequent evaluation reports.

The table is followed by examples of implementation plans, and at times teacher presentations and student presentations when available. The intent of providing these examples is to deepen the narrative as to what and how teachers have planned (and have used) QuarkNet content and materials in their classrooms and in-after class events (e.g., Physics Club). Examples from Annual Center annual reports may be highlighted as well.

Table

Self-reported Use of Data Activities Portfolio Activities: Based on Responses from the Full Survey and then Responses from the Update Survey in Subsequent Years **University of Illinois at Chicago**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	
University of Illinois at Chicago	2019	2021	2022	
	Throughout the years (19), the QuarkNet program (the UIC at Chicago group and the Fermilab group) provided for me and my students access to science that inspires creativity, importance, challenge, and contact with experiments that normally will be accessible only through internet. The hand on activities provided by this program inspired me to enhance my curriculum and change my approach to classroom instruction. Maybe my students will not go to study particle physics but definitely they are more creative thinkers because of this program. Participating in this program gives me personal satisfaction, energy to conduct more classroom (and extra) experiments, access to educational science resources, and exposing students to real science			
	Hard to tell there is so much there and I have so little time to do anything after 1870. Anyone who has more time should use it.		Python training, individual mentor visits for trouble shooting hardware. Rolling with Rutherford.	
	Most helpful would have been either data camp or CMS masterclass. This was early on when I was still learning how the equipment and particle accelerators worked. The CERN program was the most rewarding and allowed me to engage in the material at a much more advanced level, as well as allowing me to network with other physics teachers and physicists from around the world. I have students participate in QuarkNet as an Independent Study Program, Most helpful when QuarkNet staff comes to mentor students in person. Other workshops have been helpful too. I use the portfolios for students to use as tutorials to learn about possible data collection experiments. They are a good resource and help make decisions as to what labs to perform and tips about procedures. These modern topics in physics are applicable to the current high school curriculum and gives a context in which to apply what is being learned. The resources are really great!	I use it as an independent study class to study cosmic rays. Examples: Depends on where the student questions go. Sometimes they fit and other times not so much.		
	CERN summer program. The immersion at CERN gave information, connections to teachers worldwide (I am still in touch with several), and a more global outlook. Histograms (penny, dice, Rolling with Rutherford), particle cards of standard model, cosmic ray e-Lab, quark workbench, mean lifetime, top quark. I recommend them (DAP) due to their usefulness. There are sub groups of schools in the Chicago section that do experiments together.			

Table (con.t)

Self-reported Use of Data Activities Portfolio Activities: Based on Responses from the Full Survey and then Responses from the Update Survey in Subsequent Years **University of Illinois at Chicago**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
University of Illinois at Chicago	2021	2022	2023	2024	2025
	Cosmic ray, since I have specialized in that. Examples: Rolling with Rutherford, golden flies, Mass of pennies, histograms. Excellent stuff.	We do a unit on modern physics. We will use the classroom cosmic ray detector as an introduction into subatomic particle physics, getting to an understanding of the Standard Model. Examples: Penny histogram, Rolling with Rutherford, Particle cards, half life/lifetime, curated data. Mentoring teachers from different centers has been rewarding. Just this morning I helped someone from Albuquerque and the UIC (Chicago) center.	Particle deck, rolling with Rutherford, several with histograms, golden files, and others.	Cosmic ray. Creating, planning, executing, analyzing, and reporting experiments. Particle cards, pennies, rolling with Rutherford, and others.	I have a GoCosmic club of students. After looking at the standard model, we talk about "How do we know?" This includes sample size, error analysis, experiment design, controls, how to find signal in noise, etc. We do exercises from the Portfolio to introduce histograms, including the penny exercise, Rolling with Rutherford, and Lifetime. We talk about the nature of Cosmic Rays and often look at interactions between magnetic fields and charged particles (cosmic rays). We do studies using the Cosmic Rays.
	School has not started yet (*first year).* It's a great way to discuss and analyze real data with students. (DAP)				
	This current workshop on coding will have the largest change in my day to day teaching. Using the muon counters for research has had the biggest impact for students who are part of our cosmic ray club.				
	Program Year (Year of Full Survey)				
	2022				
	It is a great opportunity to get in touch with other teachers and learn, share and discuss the activities. Learning new things is always nice. Example: Rolling with Rutherford. It (DAP) is a great resource. It was an awesome experience.				
	Program Year (Year of Full Survey)				
	2024				
	Data camp taught me a lot about modern physics, what physics research looks like in practice, and what Fermilab does (I teach about 25 minutes away from Fermilab), so I can share and connect those things with the work we do in class. I love the data portfolio as an extracurricular activity to enrich the science experience of highly motivated students! However, they require a lot of upfront work to introduce topics beyond the scope of my classroom curriculum like what cosmic rays and muons are, how to navigate the website, how to interpret the data in the unfamiliar graph and data file types, etc. The technology, data collection, and experiments I use in class are much more user friendly, less time consuming, and more directly related to my learning targets. QuarkNet is almost exclusively an extracurricular organization for my students and me. It makes me a more knowledgeable scientist in general in my classroom, but I don't use QuarkNet materials or content in my physics class. One of my favorite parts of QuarkNet! I have a lifelong local community of fellow science pedagogy nerds. I also consider my QuarkNet fellow one of my best and closes mentors as a physics teacher. He supported me through early career struggles, changing schools, and models professional engagement as I am gaining experience as a teacher leader. The survey asks about students in my classroom. If you ask the same questions about students in my research club the answers would show much more significant impact; a huge benefit to the students in my club, and a modest impact on the students in my classroom.				

Note: Each row presents responses from the same individual teacher from a given center. Empty table cells indicate that the teacher did not participate in QuarkNet in that subsequent program year(s). Or, less likely did not complete the Update Survey; or did not answer specific questions about the use of DAP activities in their classrooms.

Examples of student work and analyses conducted during workshops (2024-2025) are presented in a supplemental document to this portfolio.