Center-Level Portfolio: University of Cincinnati

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 Cincinnati Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
University of Cincinnati	2019	2023	2024	2025
	Not as yet, but plan to when school resumes. Provides in-depth information. Provides more "college ready" physics applications and topics of study, other than the traditional kinematics. Looking forward to participating in this learning environment. Method of teaching. QuarkNet was interesting but I am not sure how useful it will be right now without developing the pedagogy behind it.	Have not used as yet but plan to implement. I think everything was covered well and is very applicable to my classroom		
	Have not had a chance to implement this into my teaching. I think after this year if I can use this in my classroom I would recommend it, but I would like to see the material have more of a storyline in how one thing leads to another. I would like to see the material develop more pedagogy and the sites to be updated to html5 so that they would be more usable. The pedagogy needs to develop and I would recommend incorporating the Modeling Instructional			
	None yet - just took the class. It's an area I haven't studied before, so it's useful from that perspective. I think I needed a bit more background before coming to the workshop to make the best use of it. This is my first workshop, so it's really hard to say how it will affect my students' learning. I think the idea is good, but as a teacher of modeling instruction (https://modelinginstruction.org), I need to make sure there's a clear storyline for students to have a good way to develop their understanding of particle physics.			
	The neutrino camp, probably, but that may be simply because each time I take a class or workshop it makes a little more sense. The masterclasses have been great for my students to introduce them to current research in physics. I have used Rolling with Rutherford (to practice with histograms) and the Top Quark activity. The problem is always time. I feel like I have to do spend some time - can't just do the activity without much background. I like Rolling with Rutherford for practicing histograms. There's just not time in our year to really give particle physics the time I think it deserves and is needed for understanding, so that's been hard... I really think it's important to show them what's going on in physics research, and it really does spark interest for some of them, even just the masterclass and especially the CERN videoconferences that accompany them. These workshops are important for teachers like me - the more I understand the better I feel like I can actually attempt this in my classroom. Resources are good, though, and there are people to help - please continue to do these!			

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 Cincinnati Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
University of Cincinnati	2019	2020	2023	2024	2025
	Summer Program-active research is vital to teach science appropriately. Rolling with Rutherford; helps collaborative problem solving. QuarkNet has been vital to my relationship with my students as a science educator. I love QuarkNet and it has been instrumental to my improvement as a science educator. The QuarkNet community has been wonderful to me. QuarkNet has been vital to my relationship with my students as a science educator	Analyzing J/Psi data with students	Penny Mass Activity: The idea that measurement effects, histogram construction, and drawing conclusions about material composition can be done with such simple equipment makes it an activity appropriate for all levels with lots of room for supplementation.	We (The Cosmic Club and the University of Cincinnati) will use activities from the data portfolio to warm up for WWDD, where we will video conference. We will then turn our focus to Cosmic Ray data using our detector to present at International Muon week. Finally we will participate in the masterclass being held at the University of Cincinnati. Rolling with Rutherford, Z Mass, Shuffling the Particle Deck Every student is capable of wrestling with this content, and I appreciate the other Cincinnati QuarkNet teachers who bring a variety of experiences and levels where this content was implemented.	We have a Cosmic Club in our school that meets once a week. We participate in masterclasses, use our Center's cosmic ray detector, upload data and results to e-lab, and discuss current events in Particle Physics while also using the data activities portfolio. Z-Mass Rolling with Rutherford Particle Physics Cards. Using real data, collaborating with real scientists, working on active research, all while using concepts that are fundamental (in more than one sense of the word) to Physics is the most relevant, exciting, and effective teaching I have ever done.
	The cosmic ray activities have been the most useful because the CRD's give students a chance to do physics beyond the regular curriculum. I have used Rolling with Rutherford to show the idea of indirect measurement and histograms. The materials are well thought out and often use data analysis techniques that the students are not familiar with.				In class, I incorporate particle physics in several ways. In my AP Physics C class, we have already looked at muon time of flight data from our cosmic ray detector. That also brought up a discussion of muon lifetime and relativity. I have also used the Mass of a Z Boson activity from the Data Portfolio. My opening class activity in College Prep Physics was an old QuarkNet activity illustrating the idea fundamental particles and fundamental forces. Finally, my colleague and I run a Cosmic Club. Rolling with Rutherford, Mass of the Z boson. I have been doing QuarkNet for nearly 20 years. It is one of the best physics professional development opportunities out there. You can always learn more about particle physics and find new ways to work it into the classroom.

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 Cincinnati Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
University of Cincinnati	2020	2021	2022	2024
	I'm new to QuarkNet and haven't had a chance yet, If it's as good as what I've seen so far in the Workshop, then it's going to be useful both for me and for my colleagues (DAP). In a way I would rather have these workshops last 1/2 day for more days so I had more time to mull over what I learned and be able to ask more questions/get more help. This was a wonderful opportunity and experience! It's going to be a bigger challenge this year to collaborate, but our leaders are being especially proactive and helpful - they are wonderful!			
	I like the idea of using modern physics data in the classroom. The Jupyter Notebook activities allowed me to explore program-ming and modern physics data in a safe environment. I appreciate being part of this group - the depth of knowledge is tremendous. I'm definitely going to use the muon mass activity this year.			
	I have yet to have had the opportunity to use these activities in my classroom, but perhaps I will this Fall. The portfolio has unique activities that may be difficult to find/create and will likely engage students in a manner that is unique and intriguing.			
	This present workshop has been good as a new teacher to AP Physics. I plan to use this year. I think this can be very helpful to teachers to help motivate the students and excite them more about learning physics.			

Table (con't.)
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Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
University of Cincinnati	2020	2021	2022	2024	2025
	I always enjoy the more advanced lectures even though I would not actually use them in my classes, having the higher level background knowledge gives me more confidence in introducing modern physics topics to my classes. I just haven't tried it yet due to time constraints in my curriculum		Currently using: Python activities learned in coding camp, data activities from QuarkNet, World Wide Data Day Plan to use the cosmic ray detector and explore the idea of doing a masterclass. I incorporate material into my curriculum via modern physics put into the units, coding for lab data analysis, coding to explore physics concepts (kinematics, momentum, etc.)	Cosmic ray detector, Shuffling Particle Deck, Rolling with Rutherford, Histograms, Calculating the Z Mass, Google Colab Notebooks, World Wide Data Day. Examples: Rolling with Rutherford, Coding exercises, Calculating Z Mass, Histograms: The Basics. QuarkNet has been the single most helpful PD in my teaching career and I have had students decide to pursue further studies/careers in physics based on the QuarkNet material I have used in class.	I have, and intend to keep using, World Wide Data Day, coding notebooks created by coding fellows, and many activities from the Data Portfolio. In addition, this year I am teaching a modern physics mini-mester (experiential learning) and plan to use the cloud chamber activities we did at Cincinnati, e-labs with Cosmic ray studies, and perhaps some of the neutrino activities. Finding mass of Z boson, rolling with Rutherford, particle deck, histograms, mass of pennies. I have been teaching 21 years. QuarkNet is consistently the most helpful teacher PD in terms of giving me resources that I can immediately implement in my curriculum. Nothing else has ever come close!

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 Cincinnati Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year
University of Cincinnati	2021	2022
	Program Year (Year of Full Survey)	
	2022	
	Round the bend.	
	Program Year (Year of Full Survey)	
	2023	
	Z Mass. It incorporates particle physics while allowing students to practice their vector skills	
	I plan to use the roll a dice half-life activity.	
	Seem pretty good	
	I haven't, but I plan on in the future. (first year)	
	This was my first QuarkNet experience.	I will use a few of the activities on the quark net site with my freshmen to learn process. I will use finding the top quark with my physics class. Examples: Dice roll part A, Rolling with Rutherford (possibly) and intro to histograms for my freshman. Finding the top quark with my physics class.

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 years. Or, less likely did not complete the Update Survey; or did not answer specific questions about the use of DAP activities in their classrooms.

The implementation plans that have been developed, discussed (and subsequently posted) by participating teachers during workshops conducted during the summer of 2023 through 2025 have been bundled and presented in a supplemental document to this portfolio.