Center-Level Portfolio: University of New Mexico

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 New Mexico Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year
University of New Mexico	2019	2020	2022
	Both. First was of local interest especially since I was teaching Astronomy. Second I hope to apply activities to introduce particle concepts in my curriculum AND to share with and invigorate colleagues that this support is available. Being here is the first time I had heard of or understood what this support was. I certainly have benefited knowing this support exists. Our teaching and learning fellows were wonderfully supportive and practical. WILL USE, since this is my first experience with them... Penny Histogram, Spectroscopy (which I have used for years but emphasized identifying chemicals, not particle differences). Definitely I plan to share the Portfolio. My school had only one teacher teaching AP Physics (bilingual) last year. She had only taught physics 2-3 years prior. I may be joining her in coming years w AP. We need and welcome challenging/relevant instructional materials on so many different content areas! We have also had a number of less than enthusiastic teachers assigned basic physics who may hopefully be inspired by this material. The Portfolio is especially welcome since it has the teacher instructions! More than my expectations. I came with a great deal of trepidation since I am not currently teaching a "physics" class, and have not taken my multiple years of physics classes for decades. However, I have discovered that I am leaving with classroom materials which I plan to share with colleagues and apply some to my current content as well. Thank you for accepting and encouraging those of us who hope to grow professionally and to grow our students' understanding, but who feel very unqualified to attend.		
	This summer's data camp will end up being very impactful to my students next year. I'm teaching a science elective to gifted 7th and 8th graders next year. I can see how I can bring in new particle physics concepts, and extend previously studied chemistry/nuclear science concepts with the material I learned/learned about next year. The students are usually eager and willing to engage with novel and challenging material, and this week has given me many ideas for this. N/A - just learned about them this summer. I would recommend these because of their unique content and variety. I like that they are leveled and that you can filter them. While I have not explored many of them, I would note that some of them do not have enough detailed teacher guidance so that a novice teacher could pick them out and immediately start working with them. Some of them would need a good bit of teacher PD for effective use/understanding. Ratings may have been higher if I had been assigned to a working group that included teachers who had the intent of teaching physics or physical science next year. If teachers aren't invested in teaching physics, I don't think they take the implementation plan seriously. I don't think my university has a QuarkNet that is well established or large. I don't think many physics teachers were offered the opportunity to attend data camp or have even heard about QuarkNet. Although I (a middle school teacher) am extremely glad for the opportunity to attend, I can imagine selection criteria that would include teachers new to physics teaching in preference over someone like myself (a long serving middle school teacher).	In my middle school "Super Science" elective class, I did use several of the introductory particle physics lessons from summer 2019. Mostly introduction to the standard model. Examples: QuarkNet Workbench, Shuffling the Particle Deck, Rolling with Rutherford. Very grateful for the experience. I teach smart kids, and they appreciate getting a glimpse of particle physics and atypical science content (a middle school teacher).	

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 New Mexico Center**

Center	Program Year (Year of Full Survey)	Program Year	Program Year	Program Year
University of New Mexico	2021	2022	2023	2024
	I always enjoy seeing how people teach, what they prepare in advance, what questions they ask! I will use the method of collecting data and making a table with post its--I'm sure it will come up, I like how intuitive it is and visual too. Because its interesting and somewhat hands on (recommend DAP).			
	I loved the one that I attended and would be very interested in attending more of your programs. (First year) I do not know what the Data Activities Portfolio is, but I would be interested in finding out. At the professional development that I attended I gained great ideas for teaching physics content in the classroom and increased my own particle physics pedagogy. All of the materials provided were high quality and useful. It was a great professional development! I connected with teachers and other educators from across the state.	Use of more/real data in the lessons (including histograms and analysis), some of the data activities with students, stay in contact with other science teachers to share ideas/ experiments, arrange a presentation with real scientists or a virtual lab tour. Examples: Dice, Histograms, and Probability Histograms the basics Histograms: Uncertainty Step-Up Careers in Physics. The QuarkNet professional developments that I have attended have been fabulous! I am very thankful for these opportunities to increase my own content knowledge and apply great concepts to the classroom.		Examples: Mass of a penny, histogram basics, dice histogram probability. Each activity has all the information that you need, including teaching information, student information, and materials. Each activity takes a different aspect of particle physics and breaks it down for the students.
	(First workshop) The marble/Probability activity. I would need more time to consider ways to make the workshop material applicable to classroom teaching. The AFRL activities probably had more application to the STEM classroom.			
	Ideas can be applied to almost any setting/classes, etc. Example: marbles. I had forgotten what the workshop was called...sorry. I plan to use them at various times, marbles are expensive now and hard to find. Keep an open mind on ways to teach all subjects; all is related to sciences. Exposure for teacher and students to learn more outside the PARCC geared exams; open the minds of teacher/students.			
	All have been helpful as I am able to learn new things. For example- with particle physics, I was able to apply the cloud chambers to atmospheric CCN for younger students. None – too advanced. I don't teach HS, but would refer this resource to pre-service teachers.	I teach 6th graders, so cognitively, these topics are difficult to work with for this level of student. However, I will use the "rolling with Rutherford" and card sorting activity as inquiry activities. Examples: Mass of US pennies, Shuffling the Particle Deck, Histograms, Making Tracks, Rolling with Rutherford, Mean Life Decay: pt 1. I hope to include the changing model as an illustration/example.		

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 New Mexico Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year
University of New Mexico	2022	2023	2024
	Data Camp - giving me an introduction to particle physics and some resources. Rolling with Rutherford Has some good statistical practice activities. Since I just got involved with QuarkNet, it hasn't yet impacted my teaching or student knowledge. It would be helpful if there was a QuarkNet curriculum map to tell us a sequence of the available activities that would be most useful for learning content. Not sure how active the local QuarkNet community is. Since I just got involved with QuarkNet, it hasn't yet impacted my teaching or student knowledge.		
	The weeklong data workshop has been incredibly helpful. I was able to gain a ton of information and experience to bring back to the classroom. I have used the Rolling with Rutherford activity in my chemistry class. It was a fun and insightful activity to do with my students and I can see doing it more. I would recommend all of the activities I have tried to physics teachers with a decent too strong understanding of particle physics. I personally felt uncomfortable with some of the activities before attending this data camp.		
	Both were equally helpful for my teaching. (First year) *Planned:* Histogram creation and bin sizing Use of spreadsheets for analyzing data sets. I will be recommending this to other teachers because it represents the SOTA of statistical analysis and data presentation. I am a retired nuclear engineer teaching physics now. Even with that background, I have learned so much new nuclear physics material and the status of present particle physics research. In addition, I have learned best practices on how to teach particle physics at high school level. This workshop was fantastic. Instructors are excellent, material is well organized, and I can use everything to help me teach physics.	Will use the data plotting routines to demonstrate the influence of different physical and environmental parameters on muon detection.	I have the Cosmic Ray Detector in my classroom at La Cueva High School and use it when we discuss cosmic radiation originating the various sources in the distant universe. I will use this specific class to teach students on real data analysis using spreadsheets. I have already developed lessons using and programming a spreadsheet (google sheets). Google 'sheets' spreadsheet incorporating the data analysis functions built into the program. This is my third QuarkNet class and each class has a different topic emphasis which I have been able to implement in some manner into my physics lessons. In doing so, the students have got a realistic visualization of what particle (quantum) physics is all about.
	Both will be helpful. Both will provide activities for selected topics. The ATLAS data workshop will provide most activities, but the Cosmic Ray workshop will also contribute activities as well as provide a research opportunity for students using the detector. Examples: Particle shuffle, Rolling Rutherford, Step Up, and Z-boson activities. I already use a guide-inquiry science curriculum. What I learned in the workshop suggested additional activities that bring in Cosmic Ray and Atlas ideas. I am answering this based on what I plan to do based on this workshop.		

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 New Mexico Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
University of New Mexico	2022	2023	2024	2025
	Both are useful in different ways. It's hard to say because I haven't had to implement yet. I think that ATLAS Data might be more accessible, but I'm not sure. I plan on using the penny mass activity and Rolling with Rutherford. I'll let you know in the future which one ends up being used more and how. It's helpful to have already curated activities especially for particle physics which is something that many teachers don't have much experience with it. A little more written out guidance would have been helpful for those of us who struggle with auditory instructions. It was pretty good as is (workshop). I'm not sure I would change much. I'll let you know in a future survey.	I was able to use the CRMD in my Exploring Physics elective and had a few students use the CRMD for their science fair projects.		
	The Cosmic ray and particle physics content covered in the workshop. Example: Rolling with Rutherford for model design and experimental set up. The few activities I viewed included a statistical portion which adds to their instructive use. Being new to the content, I am not able to see how much of this content will be useful to my current topics. The workshop leaders were expert in teaching and in content knowledge, they were inspirational in their presentations and teaching styles.		Shuffling the particle deck. The resources are very useful and well made. They also seem to be grade level appropriate. The data is real and easily accessible	I will use the activities for data collection, experimental procedures, and data analysis activities and incorporate the ideas into my class content in labs and demonstrations. Examples: Rolling with Rutherford, Cosmic watch experimental set up, cloud chamber demonstration. I have not used these in class yet, but plan to use modified versions of these activities in my AP physics class. QuarkNet is very valuable in providing teachers with resources and ideas to improve their current content. Also, the info is current and at the forefront of science in the big picture. QuarkNet provides an easy way to step into particle physics in the regular high school science class room.

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 New Mexico Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year	Subsequent Program Year	Subsequent Program Year
University of New Mexico	2022	2023	2024	2025
				Using QuarkNet experiences to teach the different types of subatomic particles in Chemistry as well as types of radiation. Examples; Mass of US pennies for use to teach density = mass / volume Cloud chamber to teach different types of radiation Shuffling the Particle Deck to teach different types of subatomic particles
	This is my first exposure to most of the information - so maybe both? I think I will use Mass of US Penny, Step-Up program, Rolling with Rutherford (first exposure to QuarkNet) I would recommend it - The lessons are well thought out.	I plan on using the Half-Life dice game to learn about particle decay.	Here is the link to my implementation plan https://docs.google.com/presentation/d/1Ykk9lWROy-QVi2mMVPsXuwZKitnqcmClJaLDU5Kws5Q/edit?usp=sharing I have a CRMD that I will be using in the classroom this year and have used Shuffling the Deck activity. Examples: Shuffling the Deck and Quark Workbench. I have been a QuarkNet teacher for 2+ years and am just now beginning to feel comfortable with incorporating this into my curriculum.	I teach 8th-grade physical science and have begun incorporating information regarding the particles that make up protons and neutrons, as well as the standard model. This year, I will include information about conservation laws, special relativity, dark matter/energy, and how CERN is seeking answers. Example: Shuffling the deck.
	Not yet applicable. Helpful to content knowledge. Great resources. This was a great workshop! While I do not teach physics, I feel like I have a lot I can take back to my chemistry class and implement to not only help my chemistry students' understanding but also to better prepare them for physics.			
	have only attended this one. Has been very helpful so far! lots of great ideas to start introducing my students to coding. I have not tried any yet, but look forward to doing so. I have not yet explored the Data Activities Portfolio instructional materials			

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 New Mexico Center**

Center	Program Year (Year of Full Survey)	Subsequent Program Year
University of New Mexico	2023	2024
	Dice activities, penny activities, Rutherford activity. Good learning activities for the students.	
	(First year) I have learned about a lot of these activities at this workshop this week and am planning to use several of them in my classroom this year. I would recommend the materials because they are very thorough, contain all the necessary materials, and have great skills built into them. They not only help students get an introduction to particle physics, but also work on building skills like data analysis and experimental design. The workshop I attended this week in particular has advanced my knowledge and experience with QuarkNet significantly. I feel much more confident incorporating these concepts and activities into my classroom. This workshop has helped me build connections with local teachers and collaborate on use of cosmic ray muon detectors and data analysis. We conducted a real experiment together that gives me great ideas about how to engage my students in experimental design and data analysis.	Step up careers in physics at the beginning of the year when we talk about what physics is and what physicists do; possibly integrate google colab activities using other interface like replit or binder (district will not allow colab); plans for using cosmic ray detector. Examples: I am currently planning to use activities on histograms, the z boson, and shuffling the particle deck (among others)
	The workshop I attended this week in particular has advanced my knowledge and experience with QuarkNet significantly. I feel much more confident incorporating these concepts and activities into my classroom.	
	Program Year (Year of Full Survey)	
	2024	
	This is my first experience with QuarkNet. I appreciate the passion with which people are sharing their expertise. I am thankful for the opportunity to participate. I look forward to applying what I have learned in this workshop in my classroom.	
	Program Year (Year of Full Survey)	
	2025	
	This was my first time to participate.	
	All! I get so much out of every QuarkNet experience and apply this to my classroom. Examples: mass of a penny dice, histogram, and probability. They provide hands on activities for students. They are easy to follow and yet academically rigorous. This is one of the best professional development programs that I have been involved with! Thank you for these amazing resources!	

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.

In a supplemental document to this portfolio, an example of student work from a classroom implementation, an implementation plan created by a teacher, and posters created by participating teachers during a 2025 workshop are presented.