**LIGO E-Lab Workshop Report**

**Edited for Public Viewing**

**June 10, 2013**

*Ginny Beal, QuarkNet Independent Evaluator*

**Dates of Workshop**: June 3 – 4, 2013 **Topic:** LIGO e-lab

**Location**: Black Hills State University, Spearfish, South Dakota

**Observer:** Ginny Beal

**Number of teachers:**

Four High School teachers; four additional teachers were expected, including one middle school teacher but they could not attend due to last minute personal issues.

**Subject areas, grades and levels per teacher:**

Teacher 1: 2nd year teaching Biology in grades 10-11; small high school in Wyoming; first experience with QuarkNet

Teacher 2: 11 years teaching Physics at the 12th grade level: small high school in Wyoming; two years with QuarkNet

Teacher 3: 27 years teaching and currently teaches physics, physical science, geology and astronomy at a small high school in South Dakota; participated in QuarkNet for four years

Teacher 4: 20 years teaching high school Physics at a small high school in South Dakota; involved with QuarkNet and other high energy physics programs for two years

**Mentor or Lead Teacher (organizer):**

Center Mentor is a Professor, Department of Physics, Black Hills State University

**Facilitator(s):**

Dale Ingram**,** Education and Outreach Coordinator, LIGO Hanford Observatory

**Also Attending:**

**Q**uarkNet staff members Kris Whelan (two days), Bob Peterson (one day) and QuarkNet independent evaluator Ginny Beal (two days)

**“Big Ideas” and Learning Objectives**

**Overarching Goals**

Teachers will:

* understand the context that LIGO provides for the e-lab;
* develop personal expertise in using the e-labs;
* develop expertise in managing student use of the e-lab.

**Workshop Objectives**

Participants will:

* understand the basics of LIGO detector operation and explain the need for LIGO's seismic monitoring program;
* learn to use the LIGO e-Lab by completing a full seismic investigation, including the mounting of a poster in the e-Lab poster archive.
* learn to manage student use of the e-Lab by developing expertise with the teacher tools that the e-Lab provides.
* plan to implement the LIGO e-Lab with students by integrating the e-Lab into the local instructional framework, by anticipating logistics of the e-Lab's use, and by deploying the e-Lab's instructional unit if appropriate.

**Introduction**

The first day of this two-day workshop began with introductions by the facilitator, mentor, teacher participants, QuarkNet staff and observer. The facilitator gave an overview of what to expect over the two days of the workshop.

**Day 1, Major Activities and Duration:**

8:35 – 9:05AM – Introductions by facilitator, mentor, teachers, QuarkNet staff and observer.

9:05 – 9:10 AM – Dale states the goals for the two-day workshop:

Day 1: Explore the e-lab, develop activities and make a poster to summarize what is learned in the first day.

Day 2: Put on “teacher’s hat” and develop a vision and a plan of how to use what is learned here with students.

Dale also explains that with the LIGO e-lab there is often an “Implementation Gap,” meaning that when you come to a workshop and learn new materials and skills, and then you go to use it in the classroom, it’s been a while and you don’t remember. So in this workshop we want to close the Implementation Gap. He draws the participants’ attend to the workshop goals on the web site, and mentions that the best outcome of the workshop may be making posters because it moves the participants along and gives ways to use the e-lab with students.

Dale says that the agenda had no times listed so there would be time to be flexible and ask questions.

9:10 – 9:30 AM – Participants watch the movie, “Einstein’s Messengers,” a documentary about LIGO.

9:30 – 9:55 AM – Dale emphasizes significant information from the movie and explains upgrades that are being implemented at LIGO to increase sensitivity. This stimulates questions from teacher participants about topics related to LIGO detectors, including the effects on detectors of being on the moon vs. Earth, of cryogenic environments, of different frequencies and more.

9:55 – 10:15 AM – Dale demonstrates an interferometer and explains how the teachers can build their own and where to find directions. Teachers experiment with the interferometer and ask questions. A good discussion related to seismic and other interferences follows.

10:15 – 10:25 AM – Dale talks about ways to get students interested in LIGO, such as having them play around with the interferometer . He also uses a slinky as a model to demonstrate frequencies. The teachers have a lot of questions and comments. Dale also points out how they can find the movie and other resources for their classrooms.

10:25 – 10:35 AM – Break

10:35 – 11:00 - Dale talks about the teachers using an introduction to LIGO before jumping into the e-lab. He explains that the philosophy of bringing students into the e-lab is to have less talk and less telling them how to do things and more letting them do it, and that is how the teachers will proceed in this workshop. The participants are given the URL for the LIGO e-lab site so they can explore on their own, and they take a pre-test. (The teachers find problems with the test and Dale makes a note to have them fixed – he does this throughout the workshop when glitches are found).

11:00 – 11:55 AM – The teachers continue to explore the e-lab web site with Dale explaining features as the teachers ask questions freely. He encourages them to work through the web site individually or together. Dale closes by pointing out that it’s important to know what kind of teacher you are. For example he says, “when I have a chance NOT to say things to high school students I don’t, because they don’t want to listen. Then when I find them freezing (with the plotting activity), I ask them to plot their birthday (to ease the tension).”

11:55 AM – 1:10 PM – Lunch in BHSU Cafeteria

1:10 – 1:30 PM – Dale begins the afternoon asking the teachers to work between now and about 3 pm to build an investigations and then develop a research question, a testable research question that provides a framework for the project. He reminds them to pay attention to resources, specifically the “library” link. He emphasizes that they will push this process through to create a poster. One teacher notices a phenomenon with the data that he’s uncertain about. Dale points out that this is a good start for a research questions and asks what strategies the teacher can put in place to figure it out.

1:30 – 3:15 PM – Teachers work in groups of two, and individually on the project. Dale assists as needed.

3:15 – 4:14 PM - Dale checks with teachers to gauge their progress and to see if they are ready to make posters. They all indicate more time is needed and continue to work until end of day.

**Day 2, Major Activities and Duration:**

8:40 – 9:50 AM – Reflections: Dale begins the day asking the teachers to talk about the previous day, what was interesting and what worked well or not. This leads to a rich discussion among the group members, which is summarized here.

Teachers discussed:

* difficulties they had working through the project map, developing research questions and finding data and organizing it so that would be meaningful;
* how the project is sophisticated for students;
* being annoyed at not seeing expected results;
* the frustration in terms of the time it takes, and how kids get upset when things don’t work;
* concerns about using e-lab activities for introducing content, especially because the NGSS have so much content.
* the project map having too much text and students will get lost or stuck using it.

The facilitator suggested the following:

* If you were being paid to look at data and make something of it, how would you organize your own work? This question lead to the teacher exploring his data and asking questions that resulted in the facilitator providing additional background material that was useful to the teacher’s (and everyone’s) investigation, and helped him develop a research question.
* If the teacher (or student) is annoyed and stops – what should he do next? What advice do we give? If he went to LIGO, was introduced to the staff, spent two days and got annoyed what will they say? Most participants responded, “Join the Club!” Dale pointed out that scientists go through this every day – they look for errors in the system. So if a kid does this, you tell them this is science – and science is not like what you see in the text.
* If teachers say they can’t use the e-lab to teach content, I tell them this is a tool for inquiry related standards. It can’t be created nearly as open-ended in the classroom as we do here. So how do we make a “sandbox” and leave them skills to be discovered. The teachers suggest ideas for giving them skills and then opening things up for exploration and defining the amount of time to spend on the project, perhaps as an idependent study. Bob Peterson suggests looking at posters and mirror what others have done.
* Use the handout, Essential Features of Classroom Inquiry and Their Variations, from Inquiry and the National Standards and see how to save time. This is very useful for teaching inquiry. You were all doing this yesterday, worked as learners, posed questions, connecting to other knowledge you have, collaborating,
* There will be two teachers at LIGO this summer. What if I assign to them to create lessons to find out in what ways does “getting started” (on the project map) not adequately prepare students for using data? The teachers respond that this would be helpful information to have.

9:50 – 10:10 AM –Break; when we come back we’ll decide what will be done the rest of the day.

10:10 – 11:30 AM – Teachers work on project with Dale’s help and collaboration.

11:30 AM – 12:45 PM – Lunch in BHSU cafeteria

12:45 – 1:00 PM - Kris Whelan, QuarkNet staff teacher gives an overview of Drupal and shows teachers how to set up a profile.

1:00 - 1:30 PM - Teachers work on posters.

1:30 – 1:40 PM - The two teachers who are new to QuarkNet present their posters. (Only one of these was submitted to the e-Lab archive). The two experienced teachers’ work was not complete enough to make posters.

1:40 – 2:00 PM - Dale shows the teachers the LIGO e-lab teacher home page and reminds them to not let students log on as teachers; discusses the “Essential Features” text file; discusses how to have students use the log book; shows other helpful links on the teacher site related to assessment with a rubric and scoring guide; reminds how to show updates at LIGO.

2:00 – 3:05 PM – Dale works with teachers individually and collaboratively, helping them understand the project.

3:05 – 3:25 PM =- Dale gives anecdotes about working with students, answers teachers’ questions and wraps up.

3:25 – 3:30 PM – evaluation and then depart.

**Comments/Reflections**

**1. Characterize the interactions between participants and the facilitator.**

Interactions between the participants and facilitator were collegial and friendly. The teachers who were new to Quarknet were quieter at the beginning but appeared to become comfortable with the facilitator and the project very quickly. The teachers with more QuarkNet experience, one more than the other, were somewhat vocal from the beginning. It may have been helpful if all participants had worked together from the start, or if a teacher with QuarkNet experience had worked one-on-one with a teacher new to QuarkNet.

**2. In what ways did the workshop reflect “effective” or best practices?**

Dale was very conscientious about keeping the workshop open-ended and inquiry-based. He gave the teachers an adequate amount of background to get them started and then allowed them to explore and investigate the materials as, ideally, students would. He was also available and accessible to the participants. It was acceptable for teachers to work independently and together. During discussions and especially during the “Reflections,” he continually probed, to have the teachers explore what they knew, and how they would find out things they needed to know in order to proceed. He masterfully modeled what they could do with students to keep them exploring, rather than getting “stuck” or “freezing” which could lead to frustration. He encouraged them to question what they were doing and their thought patterns, so they would more likely be thinking critically and opening up to alternative ideas and solutions.

**3. In what ways did the workshop reflect ineffective practices?**

This was a small group of knowledgeable, motivated and enthusiastic teachers and it was obvious that the material was interesting, exciting and fun for them. Within the constraints of time, the practices were mostly effective.

However, there could have been more emphasis on how to deal with the concerns of the teachers, such as addressing the New Generation Science Standards, especially content areas; and how to address different learning styles or students who are not interested in the material or research-based projects.

It was unclear what previous knowledge the teachers had about LIGO and Dale did not actively assess participants’ initial understanding. Effective practices include knowing what students (in this case, teachers) understand and encouraging them to pair with someone who knows more.

**4. What are your suggestions for improvement?**

It might have been helpful to have all the participants work together from the start, or if an experienced teacher worked one-on-one with a newer teacher, so they could have benefitted from the others’ experience. They were told they could work together, however they tended to partner with the person with whom they were most familiar.

Participants were told how to go through the project map and use the resources. Their attention could have been drawn more specifically to resources that would help them save time in the process, especially because the workshop is only two days. (Note: Dale recognized this himself, after the first day)

Only one of the four teachers completed a poster and submitted it to the e-Lab poster archive. Posters are an important (vital) feature of the workshop, and they are also beneficial for teachers who wish to see what others have done. Again, time constraints were a factor here, but all participants should be encouraged to complete this aspect of the project, even after the workshop is over.

More emphasis could be placed on implementation of e-Lab and materials in the classroom. Ideas were explored, but the teachers did not leave with a clear plan for how they will use it with their students.

No post-test was given. The post-test is a good indicator of what the participants have learned at the workshop, and could be informative to the facilitator.

**5. Closing Thoughts**

Overall, the facilitator met most of the goals of the workshop. The time constraints prevented in-depth investigation of all aspects of the project. The teachers became familiar with operations and research at LIGO, how seismic activity can affect the data, how to develop research questions and create posters. They also explored ways to introduce the e-Lab and associated materials into their classroom.

**6. Workshop Participant Satisfaction Data**

Following are data collected using a QuarkNet workshop participant survey.

The table shows that means were between (1) “Strongly Agree” and (2) “Agree,” out of a possible (4) “Strongly Disagree.”

Below this table are comments and answers to questions from the surveys.

**Table:** Survey Items with Means and Standard Deviations for Each Item

|  |  |
| --- | --- |
| **Item** | **Mean/SD** |
| a. The workshop was well organized. | 1.5/0.6 |
| b. The facilitator clearly stated the objectives of the workshop. | 1.5/0.6 |
| c. The objectives of the workshop were met. | 1.5/0.6 |
| d. The instructor(s) facilitated the workshop effectively. | 1.3/0.5 |
| e. The schedule allowed sufficient time to meet the objectives. | 1.8/1.0 |
| f. The workshop provided time to consider ways to use what I learned in the classroom. | 1.3/0.5 |
| g. The workshop provided opportunities to ask questions and/or discuss ideas. | 1.0/0.0 |
| h. The workshop helped me feel more comfortable with the topic(s). | 1.3/0.5 |
| i. My understanding of the material increased. | 1.3/0.5 |
| j. Questions were answered/addressed at my level of understanding. | 1.3/0.5 |
| k. I experienced inquiry-based teaching techniques. | 1.3/0.5 |

**Comments**

Teachers were asked to give comments if they rated an item “3” or “4.” Two gave comments, one not related to the rating.

1. Time was well-used but a 3rd day could have been used to complete the reflection and analysis.
2. Super job

**Questions**

Teachers were asked to answer the following questions. Their responses are below the questions.

**4. What were the 2-4 most important things you learned from this workshop?**

1. online available tools and info for inquiry learning; exposure to online databases available for data to be utilized in investigations

2. LIGO is more about how the earth is moving than about gravity waves. I understand this is necessary; I am getting older when the datasets don't include events I remember!

3. I increased my understanding of LIGO, its function, and how its data is used. I also got many ideas on how to use that data in my own classroom and at differing levels.

4. Being able to navigate through LIGO e-lab, how to use it to get students to do their own research, but guided.

**5. List specific strengths and weaknesses you would like the facilitator and/or QuarkNet to know about.**

1. Dale did a good job leaving the activity open ended allowing us to seek out our own questions; important when a teacher is learning how to manage inquiry activities.

2. The strength is that Dale was flexible.

3. I enjoyed the very openness of the class and the ability to work with others or independently. Weakness is the shortness of the class.

4. Very knowledgeable about LIGO, e-lab, science content.

**6. What related topic(s) would you like to know more about?**

1. Is there a poster generating tool or "app" that I could use in my classroom?

2. Local Homestake DUGL

3. Throw it at me!!

4. Building a working seismometer