



# Nanoscale Education Outreach Evaluation

Formative

By Scott Ewing

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## Acknowledgements

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### **THIS IS A FORMATIVE EVALUATION REPORT**

Formative evaluation studies like this one often:

- **are conducted quickly**, which may mean
  - small sample sizes
  - expedited analyses
  - brief reports
  
- **look at an earlier version** of the exhibit/program, which may mean
  - a focus on problems and solutions, rather than successes
  - a change in form or title of the final exhibit/program



Scott Ewing  
Oregon Museum of Science & Industry  
1945 SE Water Ave  
Portland, OR. 97214  
sewing@omsi.edu  
503-797-4590

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## Background

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### Objectives

- Determine effect of Nanoscale Education Outreach workshop on participants' professional capacity
- Determine effect of participants' involvement on the broader NISE Network

### Methods and Procedures

Data were collected over several months in September and October 2008. NEO participants were contacted via email to schedule a time for an interview. A second recruitment email was sent by workshop organizer Barry Kluger-Bell to increase participation after a low response to the first. After obtaining verbal informed consent, the telephone interviews following the evaluation protocol (Appendix A) tended to last approximately 20 minutes. There have been no issues with the informed consent procedure. All responses were transcribed at the time of the interview but not otherwise recorded. OMSI's Project Evaluator, Scott Ewing, executed all aspects of the evaluation activity.

## Results

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### Overview

Thirty-three (33) out of a total of 87 (38%) participants have been interviewed, exceeding the goal of 30%. Below, emergent themes will be discussed for each area of the interview protocol as well as a broad overview. OMSI was supplied with a framework upon which to examine the data (Appendix B). This framework will guide the areas upon which this report covers.

Most of the participants are current or recently graduated PhD students in scientific disciplines (many directly in the nanosciences). Others were public outreach coordinators at universities with a few other careers as well, such as teachers.

Overall, participants were very enthusiastic about the NEO Workshops and found them to be highly valuable (100% of participants were positive about the workshop). Many spoke of the workshop as being the best workshop they have ever attended.

"I would say this is the best program I've attended that addresses [the learning process] in such an effective way."

"The NEO workshop was the best workshop I ever attended and I really liked it."

"I would definitely emphasize the NEO workshop was one of the best learning experiences I've ever had."

"It was an inspirational workshop and I hope it continues and the right people find their way to it so they'll be just as inspired as I was."

Two attendees either had or expressed an intention to or already had changed their careers after attending.

"I attribute much of [my career choice] and the joy I have in it to NEO. I think it's a great program."

"[My colleague] is planning on changing her career aspirations after attending [NEO] to public outreach."

There were very few complaints. One participant said it wasn't what they expected from reading about it (however they stressed they still enjoyed it and found it valuable). Two other participants felt it was possibly too long (5 days), however they did enjoy it.

"I felt like I was heading out there to learn about inquiry in nanoscience, but I felt like I didn't get any inquiry in nanoscience but inquiry in general. . . I think it was a worthwhile experience however."

"Maybe for the workshops, they're a bit long. Maybe they could do shorter ones."

The NISE Net annual meetings that some participants attended weren't as well received. 24% (8) participants had a criticism of the NISE Net annual meeting. Some felt that the people at the meeting were not well integrated, since they were coming from different backgrounds. They felt the cohorts tended to stick together, while the museum people formed their own groups, researchers in other groups, etc. Some said they felt out of place or questioned their role in the bigger picture.

"Everyone was doing good work, but I didn't see how we [the graduate students] fit in."

"I didn't like the NISE Net annual meeting. It seemed like there were a lot of agendas and people and I didn't know where I'd fit in."

"The feeling at NISE was one of incomplete integration. . . We [the grad students] felt like a small part of something and that part wasn't particularly well integrated."

"The NISE Net conferences tend to get off-topic frequently -- granted they are a diverse group and communication can break down."

"The integration of the [NEO Workshop] into the NISE Network community I felt was somewhat disenfranchised from the community. [We] felt there was a disconnect between the NEO and NISE Network."

However, those who had been to several annual meetings felt they had improved year to year. This isn't to say the annual meetings were without merit. Attendees enjoyed making a variety of new contacts and seeing what other parts of the network were producing.

"I think between the first and second year of the NISE conferences there was marked improvement and what was supposed to be done was accomplished."

"I came away with more of an appreciation and context and network that was very meaningful. I can't say that I learned a fact but I learned more of a feel and appreciation."

"What first impressed me was this concerted effort from the scientific and educational communities to take this pro-active approach to this particular subject."

"In terms of nanoscale specifically it was good to get a couple other people, a room full of people doing that and bounce ideas back and forth."

It seems the goals of the NISE Net annual meeting aren't being communicated clearly to the NEO Workshop participants. An effort could be made to help the participants better understand their role, as well more opportunities for the participants to get to know each other, outside of their existing groups.

## **Individual Professional Capacity**

Participants' responses were analyzed with respect to the individual capacity of the professionals and whether the NISE Network had positively contributed to their capacity.

### ***Communication Skills***

The workshop was highly successful at giving participants the skills and confidence they need to communicate with scientists and non-scientists alike. Of the 33 participants, 32 (97%) mentioned that they felt their skills to communicate had improved as a result of the NEO Workshop.

"The most important lesson was that you could narrow down your research, no matter how complicated, to something people could understand. . . Someone who doesn't know anything about it can get an idea of what's going on currently in the research area."

"[The NEO workshop] helped me to effectively communicate scientific research to a diverse audience."

"In graduate school, the only audience we learn to engage is really narrowly focused on people who do similar research as us, so it helps in talking with a broader public."

"Trying to think about inquiry-based lessons makes me think about the large concepts involved in an idea and the best way to present that to people who are not knowledgeable about the field."

### ***Educational Research or Theory***

90% of the participants (30) mentioned something about learning or gaining an increased awareness of various aspects of educational research or theory. The most commonly recalled educational theory by the participants was inquiry-based learning. Participants were enthusiastic about the approach and found it to be appealing and engaging. Many subsequently used inquiry in their outreach activities.

"I got an idea what different stages of aged people think about how you work and how to make them understand, raised their awareness."

"Personally I don't have much background in inquiry-based learning so it was very interesting going through this process and seeing how it matches with the way science is done."

"We covered a lot, for example, different ways of learning and how to do interactive activities."

"I had never really done anything more than teaching at the collegiate level. . . Trying to bring technology based topics to an audience that doesn't have a pedagogical background to deal with the information was fun."

### ***Inquiry-Based Learning***

85% of the participants (28) spoke specifically about inquiry or about the ability to modify an existing activity to be inquiry-based. A few of the participants described inquiry but had forgotten the terminology. As mentioned, participants were enthusiastic about the educational approach and felt comfortable and confident in creating their own inquiry-based activities or demos.

"[NEO workshop] helped me modify some of the teacher's lesson plans to make them more inquiry based."

"[We] turned some existing demos into inquiry-based activities. This was something I felt very positive about. My time was well spent and my institution has benefited from that involvement."

"We focused on developing activities that were appropriate and addressed the topic of nanoscience using inquiry."

"I learned how to incorporate inquiry into real activities for teachers and students."

The two most common specific skills the participants mentioned were how to create an inquiry-based activity (either from scratch or to modify an existing activity to be inquiry-based) and how to communicate complex topics simply and clearly. Explaining simply and clearly has been helpful for participants both in explaining topics to a general audience, but also in their work careers to other scientists.

"It's given me the confidence to know that my expertise as a PhD and post-doc is valuable not only in the lab but as someone who can educate the public."

"I mentioned [NEO] on my resume when applying for jobs. People think the experience of understanding how to talk about science to the general public is a really useful skill both in industry and academia."

"I learned how to interact with audiences as well as people involved in the field. As a grad student I had to fine tune communication between education experts and grad students etc. so people with a great variety of expertise and learning to cross talk across those disciplines."

"Before I couldn't talk professional with someone from a different background (like biology), but now I can interact more widely with people from different backgrounds. I know how to ask the right questions and explain myself."

### ***Diversity***

The topic of diversity was not as widely praised as other aspects of the NEO Workshop. 48% of the participants (16) felt that the NEO Workshop helped them to reach and address diversity and diverse audiences in their work. Most of those participants described this diversity as a diversity of knowledge levels, not socio-economic or racial diversity. Often, participants had to qualify their answers to be sure it was clear that they were talking about knowledge-based diversity and not racial, socio-economic, or other types of diversity.

"People come from different backgrounds and fields. Before I couldn't talk professionally with someone from a different background like biology. Now I can interact more widely with people from different backgrounds. I know how to ask the right questions and explain myself."

"The biggest thing I learned [about diverse audiences] was to aim for the 12 year old and make that a good benchmark to address any audience. . . And modulating a bit up or down from there."

"[The NEO workshop] helped me communicate scientific ideas to people who have not as much scientific background as I have. Knowledge-level diversity."

"Being a minority it has really opened my eyes to different ways we can reach minority communities."

45% of the participants (15) felt the NEO Workshop did not have an impact on them in regards to diversity. Most of those believed they already knew about it and the workshop didn't help. A few didn't recall the NEO Workshop addressed the topic. It is possible when asked about diversity, participants who could not recall learning anything were thinking of a different type of diversity.

"I don't think it has mainly because people who come to my university or my lab are already predisposed to be interested in this topic."

"[I] feel that I do a good job at reaching a diverse audience already."

"I don't think it has, which is not a fault of the program particularly. I just can't think of a way that it has helped me in that way."

"Not applicable. They kept us very narrowly focused."

Two of the participants (6%) had criticism of the diversity training in the NEO Workshop.

"What I remember pretty clearly was they had a half-hearted attempt at diversity and the fellow was uncomfortable. . . It was pretty sad, frankly, and could've been done better . . . The only thing I picked up at the workshop was getting someone who's comfortable to talk about the subject to talk about it."

"I think the NEO workshop could have been improved by addressing [diversity] directly instead of indirectly. I heard it was good subsequently."



Considering the high praise the workshop received in all other regards, it is a bit surprising that such a relatively small percentage of participants (48%) felt that the NEO workshop helped them to reach and address diversity. This section of the syllabus could potentially be revised.

### ***Real Products***

Nearly all of the participants had public outreach experience of varying degrees prior to participation in the NEO Workshop. Participants seem to fall in to three broad categories when it comes to their current outreach activities.

- 1) Involved in outreach and using NISE Net resources regularly (either Nano Kits, lesson plans created at the workshop, lesson plans create in association with contacts made at the workshop, or other networking opportunities)
- 2) Involved in outreach but independent from NISE Net
- 3) Not currently doing outreach

Determining if participants had subsequently created real products or programs as a direct result of participation in the NEO Workshop was not straight-forward – there were no questions asked to directly answer that. Inferring from participants answers to other questions, it is believed that 94% (31) of the participants had created a real product after attending, such as delivering a demonstration they created or delivering an existing demonstration (NISE Nano Kits) in a new venue.

"I was involved in getting high schools involved with nanotechnology after [NEO]. Before, the thought never crossed my mind."

"Four of us developed a set of activities that I used in a class that I taught a couple months after that."

"A few of the people at the school where I was and I approached a high school to teach some students."

"I use that framework for our outreach activities here and how to incorporate inquiry into those things."

As for what audience benefited from these new products or offerings, see Table 1.

<b>Table 1: Audience</b>	<b>Data</b>
K-12 (visiting schools, school groups visiting)	67% (22)
Informal audiences (science centers, the public)	61% (20)
Teachers (teacher workshops)	30% (10)
Minorities (disadvantaged youth, inner city students)	18% (6)
Women	12% (4)
Elderly	3% (1)
Disabled	3% (1)
Community College students	3% (1)

Other/not described	12% (4)
K-12 (visiting schools, school groups visiting)	67% (22)

"Our center does outreach with undergraduate, school teaching, programs with the local science center. We also do work with some local schools (elementary and middle)."

"I've used the kit on 4 occasions in 3 institutions."

"I have done outreach for middle and high school teachers about nanoscience. Learning how to get the teachers interested and to learn was very helpful."

"I design and implement summer curriculum for teachers for summer professional development."

Participants were active and enthusiastic for the most part about doing outreach and continuing outreach after the workshop. A few participants were too busy or not in a position to participate in outreach opportunities.

### Capacity of the Institution

Overall, participants felt their institution had benefited from participation in the NISE Network primarily due to the individual's involvement. Some mentioned new connections made at the workshop and subsequently connecting of their respective institutes. Others mentioned how the NISE demos were very helpful for their outreach programs at their institutes (many seemed to have a mandatory outreach program that was helped by NISE Net). Some participants mentioned their institution was used as a resource for the NISE Net (by supplying experts). Others mentioned the participation of their institute in Nano Days. Some participants weren't aware of any institutional level connection to NISE Net besides themselves.

### *Responsibility and Leadership*

From the framework, the data were analyzed with respect to the individual's subsequent involvement in their institution's efforts to incorporate nanoscience and if they had taken on more leadership or responsibility. Again, this question was not directly asked in the protocol so the results are inferred from other answers.

It seems that 67% (22) of the participants had taken some action or steps at their institutions that indicated an increase in their efforts to incorporate nanoscience. Not all of the participants were in a position to have that effect on their institutions.

"We're trying to put [the new activities] in our outreach program."

"I was at the end of my PhD when I attended NEO. . . . Because I left a few months later I'm not sure they continued to participate."

"I've been the liaison between my university and NISE. Most of the other people involved in outreach here were not aware of NISE."

"I went to Taiwan in 2006 for 1 month to collaborate with teachers throughout the country and saw what they were doing with nano education."

"I don't have any particular expertise as I'm not really an educator or administrator."

"My work with in-service teachers providing them with sound and effective inquiry based activities that deal with nano technology and nano science."

For the most part, participants were willing and interested to be involved in the effort but realistically some of them simply aren't in a position to be a leader or take on additional responsibilities.

### ***Engage Working Scientists***

Next, the framework had us look at the level to which participants fostered relations or engaged working scientists in their work. As most of the participants were themselves working scientists/scientific experts, we look at the degree to which they themselves (or others at their institution) engaged in outreach.

Based on this understanding of the framework, 79% (26) of the participants engaged at the local level with themselves as experts or by connecting other resources at their institution.

"I do work with kids, giving them information about nanotechnology and how it brings various disciplines together. Middle school and high school."

"I was the outreach point person for the materials research center at the university. Part of that I would organize people to do presentations at schools or on the street. We did weekly science groups at some local inner-city schools."

"The center for material research has a 'ask the science expert' section where I help with creating answers and putting them up on the web and in the paper."

"I was involved in a fellowship to go to a Junior High to help with the life science and physical science classes with 7th and 8th graders."

Participants made an effort to get involved in outreach opportunities locally; though it is likely they would have been engaged in outreach regardless of the NEO Workshop (many of them came to the NEO Workshop since they were already engaged in outreach). However, they believe the quality of their outreach improved thanks to their participation. Having these experts/scientists being engaged in quality outreach in their local communities meets the goals of the NISE Net.

### ***Institutional Capacity to Deliver Nanoscience Education***

Generally speaking, participants believed that their institutions' involvement with the NISE Net was beneficial (where applicable – a few participants were not at institutions). 91% (30) of the participants fall into this category. At larger institutions some participants felt that, though valuable and having an impact, it was limited to their department or working group.

"They put up a program to invite high schools and visit the schools and come up with a program for kids to use to play around and learn about nanoscience."

"We collaborated with 2 museums and each one gets a NISE kit and faculty from our centers went to the museums to do these kits. We've used them multiple times."

"The Nano outreach department didn't know about NISE so they learned more about it through me. This strengthened the relationships between institutions through my department."

"It helps our institution be aware of other outreach opportunities and professors get help with their grants to get outreach components."

NISE Net resources and the NEO Workshop were widely viewed as having a positive effect on the outreach activities. The networking and connections made between intuitions and, more importantly, the people, was considered very valuable to the participants. However, as one participant noted, most of the graduate students aren't real representatives of their institutions. They are often only at their university for a few years, then move on to their next pursuit. Though they find the connections valuable, those connections move with the people unless there is a formal outreach body within the institution.

## **Other**

Other questions were covered in the interview that were not part of the framework. These will be briefly commented upon here.

### ***Contacts***

Of those involved in outreach, most use the contacts they met at the NEO workshop in some fashion (to share ideas, use as resources for information, etc). Many also mentioned they had become friends with the people they had met at the workshop and stayed in contact with them socially, not just professionally.

When asked about contributing to or continuing with the NISE Network in the future, many expressed a desire to contribute, though several were unsure of how they could. Most seemed to think their contribution would be as a resource or act as an expert in their field. Another way that participants felt they could contribute was in their ability to help in the development of activities or demos.

### ***NISENET.org Website***

Most participants did not use the website very frequently. 64% (21) of the participants used it 10 times or less. Many only used it to register for the workshop or the annual meeting. Others, while mentioning they don't currently use it, would visit it more frequently if they got into more outreach programming. However, those who do use it more regularly (36%) find it to be a valuable resource. The people who do use it find the demo kits to be very helpful. Also it was used as a way to find contacts or get in touch with people previously met.

To improve the site, people suggested improving search capabilities. They felt it was difficult to search. They would be interested in a job posting section as well.

## **Conclusion**

Overall, participants were highly enthusiastic about the workshop, the skills they learned, and the benefit to their institutions resulting from participation. Though the connections made at the workshop are valuable, they can be transient, moving with the individual rather than being formalized at the institutional level. The NISE Net annual meetings need be organized in such a way that the participants are clear about their roles and what they have to offer to the wider group.

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## Appendix A

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### Phone Interview

The information you provide in this interview will not be recorded, nor attributed to you, nor made public. These interviews will be compiled into an aggregate set of data for purposes of evaluating the impact of the NISE workshops. This interview will take about 20 minutes.

**1. Recall the NEO workshop(s) that you have participated in.** (This was the week long workshop at the Exploratorium, one day gatherings before and after the annual meetings, and other NEO events.)

**A. Can you tell me about what you recall some of things you learned from the workshop?**

B. Do you feel that you are **more aware** about practices in nano education and public outreach?

C. Are there some **specific skills** or new capacities you think you learned from the workshop?

**2. Did you follow up with the people you met at the workshop?**

**Are you still in contact with them?** [Are you working together? In what capacity? Related to nano?]

**3. Can you tell me about what kind of work you currently do? What is your current job, position, and/or role at your institution?**

Institution:

Role:

Do you participate in any outreach:

Do you participate in any network-related activities:

**4. In what way has what you learned in the NISE Workshop help you in your current work? Please explain.**

**5. How about in your own professional development and career?** [Has it helped even if the work you do now doesn't relate to any future aspirations you may have in education]

6. Overall, as you think about all the experiences you have had with NISE Network as a whole, do you feel you have **gained knowledge and skills that have better prepared you to engage public audiences in NSET education?** Please elaborate.

**7. How well has NEO helped you reach and address diversity and diverse audiences in your work?**



**8. How do you imagine contributing to or continuing with the NISE Network in the future?**

**Now a few questions about your institution:**

9. a) Can you tell me how your institution has participated in the NISE Network, if at all?

b) Do you believe that your institution has benefited from participation in the NISE Network? Did this strengthen the relationships between institutions? Improved collaboration among people at your own institution? Received good pointers to information to advance institution's agenda?

**10. The following questions refer to the NISE Network website at [www.NISENET.org](http://www.NISENET.org)**

**a. Have you visited or used NISENET.org website?**

\_\_\_\_ Did you know about the site?

\_\_\_\_ Once ?

\_\_\_\_ 1-3 times ?

\_\_\_\_ 3-10 times ?

\_\_\_\_ about once a month ?

\_\_\_\_ about once a week ?

\_\_\_\_\_almost every day?

**b. How do you use (or have used) the resources, kits, and/or information on the NISENET.org site:**

**c. Have you used the NISE resource center?**

**d. Are there other resources or services you would like to see provided on the site?**

**Do you have any additional comments to add?**

## Appendix B

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### Interview Reporting Framework

Has NISE Net positively contributed to the individual professional capacity of its leaders?

- improved skills to communicate with non-scientists (public, school groups, etc.)
- gained awareness educational research and theory
- understanding and gaining experience of inquiry-based learning and ability to design and redesign activities to be more inquiry-based
- greater awareness about diversity and reaching diverse audiences

Has NISE Net developed and provided multiple professional development experiences for participants across the Network that have resulted in real products?

Has NISE Net provided valuable, varied, and multiple opportunities for professional development and networking among leaders in the ISE field and scientists from research institutions?

What are some of the audiences NEO participants have worked with? Has s/he worked with more diverse audiences as a result of training received from NEO workshops?

#### ***Capacity of the Institution***

Are there NEO people who, after participating in several NISE Net activities and experiences, have taken on more responsibility with network leadership and in their home institution's efforts to incorporate nanoscience?

Has NEO workshop and/or participants fostered relationships or engaged working scientists in their work, primarily at the local level?

What are some organizations that NEO people are working with as a result of their NEO experience?

Has NISE Net has contributed to the growth in institutional capacity to deliver informal nanoscience education?