Let's Do Chemistry Train-the-Trainer Workshop

Welcome Module Transcript

[00:00-00:36]
Welcome to Let's Do Chemistry Train-the-Trainer Workshop! My name is Allison, and I'm a researcher with the Let's Do Chemistry project. In this first module, we will introduce the project, giving you the background of how we got to where we are now. We will provide an overview of the research that this workshop is sharing, including our research methods, and we will share an overview of the workshop, going over what you should expect from the workshop and what we expect from you as a participant.

[00:37-00:43]
Let's start by getting to know the project behind this workshop.

[00:44-01:08]
In 2016 The National Academies of Science published a report and a guide about effective chemistry communication. That report noted that chemistry is one of the least represented disciplines in science museums. A few of our colleagues from this project were actually authors on that report and decided to do something about the lack of chemistry!

[01:09-01:50]
Just a year earlier in 2015, the Royal Society for Chemistry released a report that said that people weren't necessarily afraid of chemistry, instead they found chemistry to be uninteresting, not relevant to real life, and inaccessible and hard to understand. You can see in the two graphs here that a majority of people actually felt sort of neutral about the subject. Those two reports sparked a collaboration between the NISE Network and the American Chemical Society, which was funded by the National Science Foundation to address the lack of chemistry in museums.

[01:51-02:43]
Based on findings from the reports we just shared, as well other literature about public perceptions of chemistry, the project team at Museum of Science, Boston, Arizona State University, and Science Museum of Minnesota determined creating educational products (or activity kits) that were focused on changing the public's attitudes towards chemistry would be the best way to respond to the recommendations laid out by the National Academies. In particular the team chose to focus on strategically impacting people's feeling of interest, relevance, and self-efficacy, in regards to chemistry. We will be referring to these a lot throughout the workshop and so we are going to get familiar with how we were defining these attitudes!

[02:44-03:23]
Interest is the feeling of having your attention, concern, or curiosity particularly engaged by something, which involves both feeling and thinking. People can be interested for just the moment that they do the activity, or their interest could be long lasting, and incentivize them to do follow-up behaviors such as listening to podcasts or signing up for camps. In our

research, we weren't just asking whether a particular activity was interesting, but rather whether the activity they tried made chemistry feel more interesting.

[03:24-03:52]
Relevance is the connection a person makes between a topic and their lives and experiences or even broader societal issues. This is a fundamental part of learning experiences, finding relevance helps someone become more engaged with what they are learning about. In our research, we weren't just asking whether a particular activity was relevant, but rather whether the activity they tried made chemistry feel more relevant.

[03:53-04:25]
Self-efficacy is a person's confidence, or expectancy for success in a particular area, including their ability to understand, talk about, or participate in the topic. Belief in ones' abilities has been show to impact academic outcomes or interest in a subject. In our research, we weren't just asking whether they were able to do a particular activity, but if doing the activity made them feel more confident in chemistry.

[04:26-05:35]
Through the Let's Do Chemistry project, we wanted to be able to both create activities that could achieve our goals and generate knowledge that could be used beyond our project by others. Therefore, we decided to use a design-based research process. This process was developed in formal education or school settings as a way to carry out formative research to iteratively test and refine educational products in the context that they will be used, as well as a way to refine a theoretical framework based upon prior research about how to design these products. Using this process we tested a set of activities and then shared findings with the development team along the way to help them refine the activities, which contributed to the creation of the Explore Science: Let's Do Chemistry kit. This testing also included collecting data to answer our research questions, which helped us refine a framework for the field. The findings from this research are what we are sharing throughout this workshop.

[05:36-06:12]
As one of the outputs of the DBR process we created a suite of hands-on chemistry activities. These were packaged in a kit of physical and digital materials shared with 250 museums, science centers, and other chemistry partners across the county. On the right you can see Tag Children's Museum of St. Augustine unboxing and displaying their new kit. All of the digital resources, including activity guides, training guides, professional development, and other supporting materials, are still available for free from the NISE Net website.

[06:13-06:53]
The other output we mentioned was a framework to support creating or modifying hands-on activities to achieve the same interest, relevance, and self-efficacy outcomes supported by the kits. We encapsulated the frameworks and what we learned about the strategies in a Research-to-Practice Guide, pictured here and freely available on the NISE Network website for download. This guide shares more details about the project, activities, and

research findings. And through this workshop, you'll be learning about the framework in a new way – focused on learning how to apply what we found to your own outreach work!

[06:54-07:33]
Hi, everyone. My name is Marta Beyer, and I'm a member of the Research team and so now that we've talked a little bit about where the project came from and what was created, we'll shift our focus to talk about the research connected with the project. Each module in this workshop will contain a video walking through the research findings in more detail, where we will highlight the main findings, focusing on what we learned through visitor interviews and video recordings. We will also share ideas around applying the research to your practice! But before we get to that, we want to share a little bit about our research methods and participants.

[07:34-08:20]
The questions guiding our research included how does activity design (content and format) affect visitor attitudes about chemistry? And how does facilitation affect visitor attitudes about chemistry? As we discussed when talking about the background of the project, the attitudes we were specifically focused on were interest, relevance, and self-efficacy. Going into the project the team had collected some ideas about what might be successful in each of these areas, based off of previous NISE Network research and other peer-reviewed literature. These ideas were collected into an initial theoretical framework, and this research aimed to learn more about each of these areas in order to refine our framework.

[08:21-09:42]
During the initial phase of the project, we focused on collecting data to help the team make refinements to the activities as well as answering our research questions. As we mentioned earlier, this was part of a design-based research project, which means that the activities were tested within the context they will be used. In our case, that was with science museum visitors! We tested 15 activities with visitors at two sites: the Museum of Science, Boston and the Science Museum of Minnesota. Additionally, testing and development was an iterative process, so each activity was tested at least twice, incorporating visitor feedback for each new iteration, using primarily qualitative data. As part of this process, we gathered 274 paired interviews and observations from visitor groups. Theses interviews were collected to understand participants' feelings about whether the activity impacted their interest, relevance, and self-efficacy around chemistry and what about the activity contributed to this change. During the 2nd iteration of testing, videos were collected from 44 of these groups so that we could have a rich, qualitative understanding of visitors' experiences with the activities and look more closely at how the activities were being facilitated.

[09:43-10:30]
Since context is so important for design-based research, we feel that it is helpful to also know who participated in our research. During the interview, we identified a focus subject, who was the person that answered all of the close-ended questions. Open-ended feedback was collected from the focus subject as well as other group members. Our activities were designed for visitors aged 8 and older. So, groups were eligible to participate if they

included a child at least 8 years old or had adults who were willing to participate. We saw that almost all of our participants identified as white, with some identifying as Asian, Hispanic or Latino, Multiracial, or Black or African American.

[10:31-11:55]
We also asked participants about gender, age, and prior experience with chemistry. More than half of our participants identified as female. We saw that participants were split pretty evenly between adults and children. Since we also asked about chemistry experience in school, what you're seeing here is 42% of our sample were participants under 14 years old and so had not had an opportunity to take a chemistry class in school. The rest of the sample was 14 years or older, most of whom had at least taken high school chemistry. Some of the adults had also taken chemistry classes in college, majored/minored in chemistry, or had chemistry jobs. While we anticipate that our research is applicable to chemistry outreach in general, we recognize that there may be differences in your specific context or audience. Our participants were split fairly evenly between adults and children, but were largely white, had more women and girls, and had a range of chemistry experiences. As you think about applying this research, consider what you know about your audience and think about how that affects how you apply the frameworks. You can also test your activities to gather more specific feedback that might inform your choices. We will be including resources for doing your own evaluation during the Build Your Training module.

[11:56-13:09]
We created a framework of strategies to consider when designing activities, based on the research completed during this project. It specifically focuses on what we learned about the content and format strategies that led to increased interest, relevance, and self-efficacy. Just as a broad overview, and to help you understand what we mean when we say content and format strategies. Content strategies, in the left column, are the topics, information, or concepts that visitors discuss, think about, or hear about during an activity. This could include talking about applications or uses of chemistry or making connections to everyday life. Format strategies, in the center column, refer to what participants are doing or how they interact with the activity, such as allowing visitors to be hands-on and interact directly with the activity or allowing them to observe phenomena related to the activity. All of the strategies that we are sharing to increase interest, relevance, or self-efficacy are included in the framework because they were supported by our data. We will be sharing the elements of this framework in more detail through videos accompanying the first two modules of this workshop.

[13:10-14:13]
In addition to the design strategies framework, we created a separate facilitation framework for this project. We based our framework on discussions with our educators along with relevant literature about facilitation. Ultimately, we adapted a framework from the Exploratorium that described facilitation of maker activities, using the video data we collected. We identified three main areas of facilitation used by educators when interacting with visitors using one of the Let's Do Chemistry activities. Each of these areas has a variety of techniques used by our facilitators. The three main areas are invite participation,

support exploration, and deepen understanding. Through our research we saw that facilitation techniques were complicated and intertwined, as we will discuss in the facilitation module for this series. In general, we saw that many techniques contributed to a positive interactive experience between a facilitator and participant, which overall supported increased interest, relevance, and self-efficacy.

[14:14-14:31]
Now that you've had an introduction to the project and our research framework, let's talk about what we will be doing over the next few weeks in our workshop. My name is Emily, and I'm a Museum of Science educator for the Let's Do Chemistry project and I'll be leading you through this next section.

[14:32-15:15]
We learned so much through our ChemAttitudes project, and it might seem overwhelming at the moment to think about learning all of that information during this workshop. So, let's keep in mind three major goals and expectations. We expect that during this workshop you will learn how to adapt a hands-on chemistry activity to support the IRS framework by completing the given activity exercises, learn how to train others in supporting increased IRS for hands-on activity participants, participate in all aspects of the workshop to the best of your ability by completing pre-online session preparatory work, attending the five online sessions and completing post-online session written exercises (otherwise known as worksheets).

[15:16-15:55]
We have broken down the workshop into five sections, or modules, to help build your confidence throughout the process and make the information more digestible. This first module introduces you to the project, the framework, and our goals for this workshop. This is what you are going through now. The second module will focus on the design structure and format for hands-on activities. The third module will focus on the design of activities to include chemistry content. The fourth module will focus on facilitation of these hands-on activities. The fifth module will focus on designing a training to share what you've learned to colleagues and/or volunteers who facilitate activities.

[15:56-16:58]
All of the Modules have individual work you should do offline to maximize the time we have during the online sessions to ask questions, discuss, and workshop your ideas for your hands-on activity together. This individual work includes prep work, and a written exercise. Before each module's online session, you will watch the pre-recorded presentation for the module (what you are watching now!) and read through the module document. The prerecorded video will give you the background information you need for the online session, and will cover the relevant research findings and how those findings can be applied to your practice. We also have a Module document, which you should review prior to the online session. This includes the key points from the videos that will be useful for your work as well as the written exercise that you will complete after the online session. The written exercise, or worksheet, at the end of your module document should be

completed after the online session for that module, and submitted before the next week's online session via a google form that we will share with you.

[16:59-17:29]
Each module will also have an online session where workshop team members and participants will come together in Zoom to review a summary of the research findings that pertain to the module, split into small groups to discuss any changes you might make to your hands-on activity to increase interest, relevance, or self-efficacy based on what you have learned during the module, and then come back together as a group to continue discussions and review the next week's topic.

[17:30-17:45]
Before our first online session, you should review your assigned activity, start gathering your activity materials, and review the welcome module document included online or in your packet. That's all I have to share for now. If you have any questions - please don't hesitate to reach out!

[17:46-17:56]
Before I go though, I'd like to have some of our pilot workshop participants send us off with some of their stories of being involved with this project.

[17:57-20:33]
Hi, my name is Dyani Melgarejo, I use she/her and they/their for pronouns, and I was a participant in the spring 2020 Let's Do Chemistry workshop. So, when I was first asked to do this workshop, I wasn't quite sure what to expect, but what I found was a very rich community of like-minded individuals who were from all different aspects of their professions. There were chemical engineers, there were educators, and there were even undergraduates like myself, all coming together for the common purpose of teaching chemistry to their communities.

What the Let's Do Chemistry workshop had us do, was take a demo, a science demo that we already had, and fit it into the Let's Do Chemistry framework based on three tenets: relevance, interest, and self-efficacy of the participants. These methods were based on a lot of research, a lot of studies, to see how we can best reach our target population, how we can increase those three tenets in our participants. We reframed our workshops, we talked with each other, we used different module steps, and we ended up improving our activity, and making it a lot easier and digestible for our participants to actually engage and be interested in chemistry.

When I first started, it actually was a little bit challenging because teaching a demo is pretty intuitive. You know, you stand up in from of your audience, your kids, your adults, your patrons, and you just perform. You are like, "Here is how you put this thing together, here's how it looks, what do you see? What do you notice?" But this workshop had us look critically at the words we were using, and bolster it up to be more interesting, relevant, and improve self-efficacy in the participants. One of my favorite things about the workshop, on top of improving my chemistry demonstration, is networking with other professionals in the fields. I connected with folks from all over the country, from very different walks of life,

but they have similar experiences. I had a really wonderful time, I definitely learned a lot, I'm excited to bring these techniques to my community, and I hope you give it a shot.

[20:34-21:41]
Hi! My name is Kate Anderson, Director of K-12 Education for Beyond Benign a non-profit dedicated to empowering students, educators, and the community to practice sustainability through green chemistry. Just as the ChemAttitudes Framework sets up we too strive to engage students with interest, a sense of relevance and feelings of self-efficacy when it comes to chemistry.

What we are doing is we have partnered up with the Lemelson Foundation to connect both the ChemAttitudes Framework along with the Invention Education Framework to hopefully inspire more chemists as well as more inventors. We see great synergies between the two frameworks and through participating in the pilot it was great to engage with other educators to discuss how and where we see connections for, in terms of related to guiding questions and how to facilitate more curiosity and excitement in our future problem solvers.

[21:42-24:48]
Hi there, I'm Dr. Greg Tucker or Dr. T for short — a lab instructor at Grand Canyon University, intellectual property professional at Skysong Innovations, and more recently an American Chemical Society Outreach Member of the year for 2020 here in Central Arizona. I'm a huge proponent for STEM, like many of you are, especially for the more "forward-movement" of STEAM (Science, Tech, Engineering, ARTS & Math).

I was sitting in the exact same spot where you are, logging in, starring into a screen and wondering how a virtual workshop was going to enhance my outreach efforts. The concept of chemistry and the phenomena and the reactions, now coupled with the loss and gain of electrons to generate electricity is a difficult enough concept to learn already and now to do it within an hour or even less time is very difficult. So my last in-person session (pre-Covid you could say) that our students grasped most of the experiment went over pretty well, but when I tried to explain full circle the application of it and how it is already present in society and how we use electro chemistry. That's where some of them got it, but a lot of them didn't and even some of the adults that were helping out didn't really quite grasp the application. And that's when I knew I wanted to do something more and make the experiment better and I really wanted everyone when they came in doing it and then walking away knowing I got something out of it and I feel more encouraged as a scientist understanding these concepts. So with that said, that's when I joined the National Informal Science Education Network. I completed the program and I'm sitting here now encouraging you that you can do it, too.

The Boston Museum of Science team presented us their outreach model to assist us as facilitators to design a much more efficient protocol to be more effective during our outreach efforts. So during this event, I would use the model called I.R.S., (and no, it's not what you're probably thinking right now) but what it stands for is interest, relevance, and self-efficacy. I make it a point to not only do these hands-on activities, but I want the

students to envision themselves as scientists and so I make it a point to do this either in a lab setting to get that full exposure being on-site and importantly as an African American scientist I really emphasize this when I'm teaching or educating kids of color. So what I was missing was the relevance, and after learning this IRS model, I now implement it in my experiment, which safe to say it's gone over pretty well now. Alright, let's get to it, let's go to the lab.

[24:49-25:00]
Here are the credits for the documents we cited during this presentation. Feel free to pause, take a photo, or come back to this spot in the video if you would like to dive deeper into these resources.

[25:01-25:07]
This project was supported by the National Science Foundation. Thank you for watching!