

Defining and Measuring STEM Identity, Interest, and Engagement



center for advancement of
informal science education

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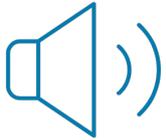


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About CAISE

The Center for Advancement of
Informal Science Education

InformalScience.org is a collection of project, research, and evaluation resources designed to support the informal STEM education community in a variety of learning environments.

[Learn more >](#)

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GO

InformalScience.org

- 8,000+ research and evaluation resources
- Task forces, meetings, convenings, etc.
- [Year in Informal STEM Education](#)
- Proposal development supports ([NSF AISL](#))
- [Monthly newsletter](#)

Broadening Perspectives on Broadening Participation in STEM

A TOOLKIT FROM CAISE'S BROADENING PARTICIPATION TASK FORCE

Use these resources to plan and lead reflective discussions that can make your education or science communication work more inclusive.

[EXPLORE THE TOOLKIT](#)

What is STEM Identity, Interest, & Engagement?

A VIDEO INTERVIEW SERIES

We asked 35 STEM scholars including education researchers, science communication scholars, social psychologists, and learning scientists how they define, explore, and measure these STEM constructs.

[EXPLORE THE RESOURCES](#)

2018 Year in Informal STEM Education

DESIGNED TO TRACK AND CHARACTERIZE FIELD GROWTH, IMPORTANT PUBLICATIONS, AND CURRENT TOPICS.

Includes the categories of citizen science, cyberlearning, living collections, making, media, public libraries, public events, science centers/museums, science communication, and youth/afterschool.

[BROWSE THE CATEGORIES](#)

Today's Speakers



Amy Grack Nelson

Science Museum of
Minnesota



Kelly Riedinger

Oregon State
University



Mac Cannady

Lawrence Hall of
Science



Kevin Crowley

University of
Pittsburgh

Today's Agenda

Background on CAISE's Work	2 minutes
Introduction to Identity, Interest, & Engagement	10 minutes
The Evaluation & Measurement Task Force	3 minutes
Approaches & Tools	20 minutes
Audience Questions	10 minutes
Additional Resources	2 minutes



CAISE History

- [Principal Investigator's Guide to Managing Evaluation in Informal STEM Education Projects](#) (2011)
- 2013 [Evaluation Capacity Building Convening](#)
- ["Design Evaluation" pages](#) (2015)

The CAISE Evaluation & Measurement Task Force

Task Force Members

Amy Grack Nelson

Science Museum of Minnesota

Mac Cannady

Lawrence Hall of Science

Tina Phillips

Cornell Lab of Ornithology

John Besley

Michigan State University

Kelly Riedinger

Oregon State University

[Read a recap of our August 2018 convening on evaluation and measurement.](#)

LEADERSHIP & STAFF

Kevin Crowley

University of Pittsburgh

Martin Storksdieck

Oregon State University

Jamie Bell

CAISE

Michelle Choi

University of Washington

Melissa Ballard

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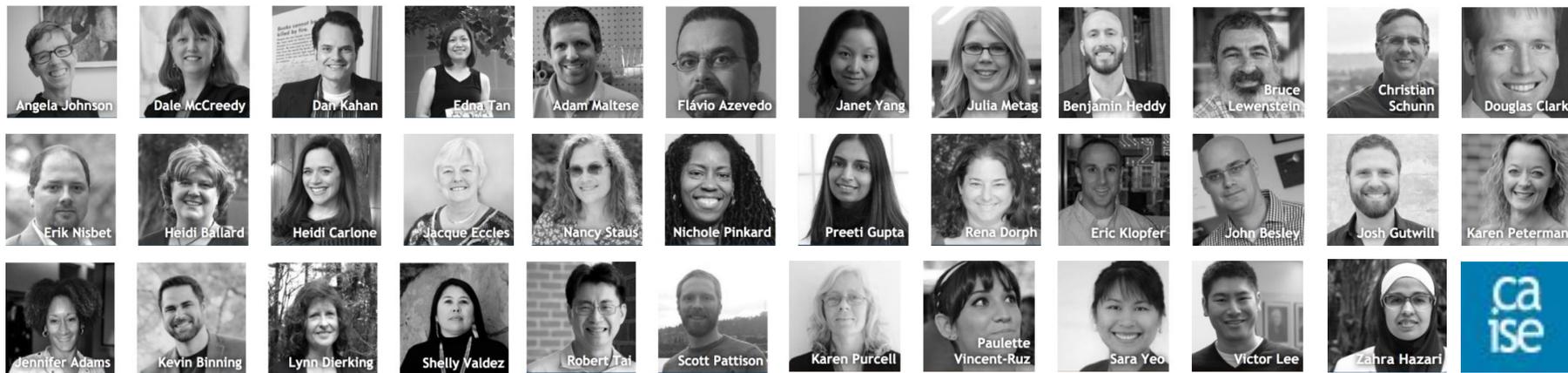
The Charge

- Identify common constructs of interest across ISE and science communication, identify how those are being defined, measured and used in evaluation, identify leaders who are exploring those actively.
- Develop resources to support informed evaluation and measurement thinking and work in both ISE and science communication around: identity, interest, and engagement.



What is STEM Identity, Interest, and Engagement?

An interview series with 35 scholars



Ways to Engage

Construct web pages:

- Overview document
- Clickable collage of interviews

Interview web pages:

- Short biography
- Summary quote
- Video clip
- Interview highlights
- Full conversation transcript with links to research & resources

WHAT IS STEM ENGAGEMENT?
We interviewed 12 researchers to learn how they're thinking about it.

The Role of Engagement in STEM Learning and Science Communication
Reflections on Interviews from the Field

ENGAGEMENT | PAULETTE VINCENT-RUZ
Paulette Vincent-Ruz is a Student Researcher in Learning Sciences and Policy at the University of Pittsburgh. To learn more about her perspective on engagement, we talked with Paulette and Chris Schunn, Professor of Psychology, Learning Sciences and Policy, and Intelligent Systems at the University of Pittsburgh, to hear how they define and evaluate engagement in their work.

"It's really important to know whether the setting or the activity that they're experiencing is actually affecting the way they perceive themselves (as scientists or not), or the way they perceive themselves as accomplishing certain activities or not. I think that's the value of studying engagement."

www.informalscience.org/em-task-force

Foundational Concepts

Amy Grack Nelson

Outcomes of ISE Experiences

NSF Impact Categories

1. Awareness, knowledge or understanding
2. **Engagement** or **interest**
3. Attitude
4. Behavior
5. Skills
6. Other outcomes

[Framework for Evaluating Impacts of Informal Science Education Projects](#) (2008)

Six Strands of Informal Science Learning

1. Sparking & developing **interest** & excitement
2. Understanding science knowledge
3. **Engaging** in scientific reasoning
4. Reflecting on science
5. Engaging in scientific practice
6. **Identifying** with the scientific enterprise

[Learning Science in Informal Environments](#) (2009)

Interest

...

What is interest?

We define interest as somebody's desire to **re-engage with a topic**; to want to do more of it, to **learn more** about something, to **do more** of an activity.

- [Adam Maltese](#)

Interest is a complex construct. It **starts with an emotion**, but as it develops it begins to bring in things like **knowledge, values, and self-awareness**.

All of those things are fed by new interest experiences, and then they re-motivate further interest experiences.

- [Scott Pattison](#)

Interest is also thought of as...

Preference

Fascination

Value

Choice

What can interest look like?

- What you feel (**emotional**)
- What you think (**cognitive**)
- What you do (**behavioral**)



Four-Phase Model of Interest Development

Phase 1: Triggered situational interest



Phase 2: Maintained situational interest



Phase 3: Emerging individual interest



Phase 4: Well developed individual interest

Engagement

...

What is engagement?

Spending time in an exhibit with ***attention focused*** on the learning materials provided.

- [Josh Gutwill](#)

How are they ***feeling***?
How are they ***thinking***? What are they ***doing*** during that experience? And is it focused on the activity itself?

- [Karen Peterman](#)

Voluntary, sustained participation in whatever kind of activity we've designed.

- [Eric Klopfer](#)

Three dimensions of engagement

Affective

Behavioral

Cognitive

Additional aspects of engagement

- Temporal aspects of engagement
- Repeat engagement
- Individual vs. social engagement



Identity

...

What is identity?

I think of identity as sort of a sense of someone having a ***sense of who they are, what they can achieve, what's possible.***

It's something that can evolve and transform over time with certain influences.

- [Dale McCreedy](#)

Identity has to do with ***how people recognize themselves,*** fundamentally, but that is mitigated by ***how they are recognized by others*** as well as their own interests.

- [Zahra Hazari](#)

It's the stories people tell about ***how they see themselves, how they feel others see them,*** and ***what kind of person they want to become.***

- [Heidi Ballard](#)

Identity is individually and socially constructed

How you see yourself (**internal**)

How you are seen by others (**external**)

Types of STEM identity

I am/they are a science person.

I am/they are a scientist.

I am/they are someone who does or can do science.

Intersectionality

- STEM identity intersects with an individual's other identities.

STEM identities can be marginalized

- By social structures such as race, class, gender, and ability
- By dominant cultural norms, structures, practices, and expectations



Identities as situation and context dependent

I cannot completely address the question who an individual is becoming in a setting, unless I also address the question, “***Who are youth obligated to be in the setting?***”

I’m always looking at individual’s performances ***in relation to what the setting demands, celebrates, and marginalizes.***

- [Heidi Carlone](#)

We’ve seen youth perform themselves differently when the community of practice in which they are entering and to engage in STEM in has been different...

We think a lot of identity and identity work is ***a negotiation with people in whatever space or figured world that we’re in.***

- [Edna Tan](#)

Approaches & Tools

Reflections from Task Force Members

Engagement

Mac Cannady & Amy Grack Nelson

Looking at “arousal” with psychophysiological measures

“In the work that I’m doing, I’m making an appeal to sit up and pay attention and take notice of your feelings.

When you have that heightened attention, you’re noticing more, and you’re ready to respond more to what’s going on.

We can get signals about heightened arousal using some of the new wearable technologies that are available.”

- **Victor Lee**, Associate Professor, Graduate School of Education, Stanford University



[Victor's Interview](#)

Using tools in different contexts

“I had a chance to think about all the different ways we’ve tried to use the Engagement Survey... What was lovely about doing that is I could see how well it holds up with different audiences and in different learning contexts...

When we used it at science festivals, we learned that you need to use it in relation to a particular booth and not to gather reactions to the entire experience overall. I think it’s possible to measure engagement in a overall experience like that, but the Engagement Survey is just not the right tool for doing that.”

-**Karen Peterman**, President, Karen Peterman Consulting



[Karen's Interview](#)

Collecting data with social media

“Engagement for me often takes the form of engagement with friends on **social media**—things like viewing, liking, sharing, and retweeting.

I want to understand how and why people develop the opinions that they hold about scientific topics, so understanding how they engage with and consume information is a part of why I include that concept in my work.”

- **Sara Yeo**, Assistant Professor, Communication, University of Utah



[Sara's Interview](#)

Tool: [Social Media Research Toolkit](#)

Identity

Jamie Bell & Kelly Riedinger

Identity's relationship to culture and community

Heidi Carlone studies identity in concert with culture.

- Assumes that “people are formed in practice” and “can author themselves in creative and imaginative ways,” within the constraints of societal structures
- Identity has much explanatory potential and involves a tension between structure and agency

Shelly Valdez looks at identity from a communal perspective where self is deeply connected to culture.

- Sees language use/development as an indicator of identity development (bridging “ways of knowing” with science)



[Heidi's Interview](#)



[Shelly's Interview](#)

Political identities and trust

"Identity influences how we process information about controversial science issues. It influences all type of cognitive process of selective exposure.

What information we expose ourselves to, how we comprehend it, do we recall it or not, do we either reject or accept it."

- **Erik Nisbet**, Associate Professor of Communications, Ohio State University



[Erik's Interview](#)

Subject-specific identity

“For the high school physics teachers that we work with we basically put together an instrument and it includes items that capture the constructive interest, and performance competence belief.

Belief in their ability to perform the task the teachers are asking them to do and belief in their ability to understand physics as well as recognition.”

- **Zahra Hazari**, Associate Professor of Science Education, Florida International University



[Zahra's Interview](#)

Interest

Kevin Crowley & Kelly Riedinger

An institutional commitment to research & practice

Researchers and practitioners are now sitting side-by-side and doing all their work in collaboration.

It's not the researchers going over to the practitioners and saying, "I really want to use you as guinea pigs or study what you're doing because I'm really interested in this."

And it's not the practitioners saying, "Can you give us some research to inform what we're doing here? Or can you come give a talk or lead a seminar?"

Both are sitting down and asking about these problems together, trying to work through solutions and also being really creative about what that means in terms of learning experiences, the kinds of ideas they're built on, and what they offer to the people who participate in them.



[Rena's Interview](#)

activationlab.org

Research findings spur youth partnerships

“We showed [the educator] our data and said, “This is what we’re seeing kids are interested in,” and we had already gone out in the community and found some potential afterschool partners that we could suggest.

For example, a huge majority of kids love coding, programming, and video games, and Pixel Arts Game Education is another afterschool club we were able to help bring in so kids are able to develop and support that interest.”

- **Nancy Staus**, Senior Research Associate, Oregon State University



[Nancy's Interview](#)

Audience Q & A

1. Finding the right measurement tool
2. How professional evaluators might use these resources
3. Capturing longitudinal outcomes
4. STEM / science vs. discipline-specific measures
5. The relationships between constructs

EVALUATION TOOLS AND INSTRUMENTS

Most evaluations require the use of a data collection tool—a survey or other data collection instrument. Evaluators either need to adopt or adapt tools “off the shelf” or create new ones. Either method can pose challenges: Tools that have been developed for one evaluation may not prove suitable for another, at least not without careful modification. At the same time, creating new tools requires expertise in measurement and instrument design.

How do you know if an off-the-shelf instrument is appropriate for your needs?

Good question! When considering the use of an instrument, keep in mind the following:

- 1. What is the instrument measuring?** Review how the instrument developers define what it is they are measuring. Does it match exactly what you want to measure? Also look for validity evidence that the instrument measures what it proposes to measure. Validity evidence can be from expert reviews, think-aloud interviews, factor analysis, and other validation techniques.
- 2. What audience was the instrument created for and tested with?** Instruments are created for a particular audience. If your audience matches the one that an instrument was designed for, great. If not, you'll need to do some testing to see if the instrument works for your audience before you use it for an evaluation. For instance, a survey created for adults may or may not be appropriate for children. You won't know until you test it.
- 3. What context or setting is the instrument meant for?** An instrument meant for one setting may not work well in a different one. For instance, a survey developed to measure an experience kids have in a school classroom may not be valid for evaluating an experience they have within a museum. Again, testing is required if an instrument is to be used in a new setting.
- 4. Do I have the expertise to be able to judge the appropriateness and quality of the instrument?** Experience with evaluation and instrument design are necessary to successfully choose and use an “off-the-shelf” instrument. If you don't have this experience, be sure to call on someone who does.

Evaluation tools and instruments

The following websites provide tools and instruments that can be used for evaluating the wide range of outcomes addressed by informal STEM education projects, or that can serve as starting points for modification.

- [Activation Lab \(ActLab\)](#): ActLab is a national effort to learn and demonstrate how to activate children in ways that ignite persistent engagement in science, technology, engineering, art, and mathematics learning and innovation. Visit the website to find a variety of instruments developed and tested by ActLab to measure constructs such as science learning activation, engagement, and scientific sensemaking.

[What is Evaluation?](#)[Working with an Evaluator](#)[Developing an Evaluation Plan](#)[Evaluation Tools and Instruments](#)[Evaluation Reporting and Dissemination](#)[Learn More About Evaluation](#)

CAISE's round up of evaluation tools & instruments

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DECEMBER 2018

Broadening Perspectives on Broadening Participation in STEM

By Bronwyn Bevan, Angela Calabrese Barton, and Cecilia Garibay



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How Can Our Efforts in Public Engagement with Science Be Made More Inclusive? A Summary for Stakeholders

caise.org/summary-for-stakeholders

Equity and inclusivity are essential to broadening participation in STEM. This summary for stakeholders provides a key to building inclusive and equitable public engagement and science communication programs that broaden participation in STEM.

Below are the indicators that you should look for in all that you do to ensure that you are being as inclusive as possible in your public engagement and science communication efforts.

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Conversation Guide

Effectively broadening participation starts by examining our own practices. This shifts the burden for change from individuals historically excluded from STEM to those who design and lead public engagement with STEM programs. Many organizations and programs have begun to reflect critically on how their work reproduces or disrupts patterns of participation in STEM. The CAISE Broadening Participation in STEM task force identified five key, overarching challenges leaders must work toward addressing:

1. Recognizing the importance of reflecting on and possibly reforming your efforts to broaden participation through adopting a more critical stance about what can lead to lasting change.
2. Clarifying what "broadening participation" means to your program or organization.
3. Recognizing whether and how your program or organization reproduces dominant cultural norms of STEM to adopt more inclusive approaches.
4. Identifying whether and how your program or organization is truly prioritizing efforts to broaden participation, and what it means if you are not.
5. Understanding how your efforts to broaden participation strategically enrich and contribute to your local systems of STEM learning and engagement opportunities.

The challenges require that leaders and staff closely examine what they do, why, how, and with whom. To support this self-examination, over time, there are a multitude of reflection questions within the Broadening Perspectives on Broadening Participation in STEM report, the practice briefs, and on the next page. As a staff leader or trainer, make sure carefully consider which questions to ask and when.

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How Can We Help Scientists Adopt Equity Approaches to Science Communication?

By Pamela Loh, Danielle Stott, Sarah Hyman, Deborah Barakat, and James Bull, and Tony Skovt

What is the Issue?
Science communication that connects STEM-based professionals with various publics are often designed and implemented with a range of multiple audiences in mind. Having specific, articulated behavioral goals and communication objectives can facilitate strategies for identifying impactful opportunities to advance their strategic goals and objectives. A growing body of research suggests that adjusting communication approaches can influence the effectiveness of engagement efforts. These findings suggest that scientists and communication staff should apply the same rigor used in their research design to understand how their communication objectives align with the engagement strategy. Leaders of professional learning and training in science communication as well as leaders of informal STEM education.

Why It Matters to You

- **Scientists and STEM professionals** can benefit from understanding their engagement strategies.
- **Science communicators** can benefit from understanding the ways that scientists and STEM professionals can benefit from their engagement strategies.
- **Professional developers** can benefit from understanding the ways that scientists and STEM professionals can benefit from their engagement strategies.

Things to Consider
As you develop a STEM education program that is inclusive and equitable, consider the following: How do you ensure that your program is inclusive and equitable? How do you ensure that your program is inclusive and equitable? How do you ensure that your program is inclusive and equitable?

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How Can Institutions Model Inclusion in the Workplace?

By David Davis, David Davis, and David Davis

What is the Issue?
Inclusive workplaces are science communication and science education programs that are designed to be inclusive and equitable. Inclusive workplaces are science communication and science education programs that are designed to be inclusive and equitable. Inclusive workplaces are science communication and science education programs that are designed to be inclusive and equitable.

Why It Matters to You

- **STEM educators and science communicators** can better support youth when they effectively engage parents in relevant aspects of the work.
- **Professional development leaders and science communication trainers** can help their audiences recognize the need to work in partnership with organizations that cultivate parent engagement and support.
- **Funders** can encourage programs to identify and fund their impacts could be strengthened through parent engagement.

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How Can We Re-Think Assumptions About Parent Engagement?

By Dawn McCleady, Meekia Batzer, and Rhonda Updegraff

What is the Issue?
Parents, broadly defined as the significant adults in a child's life, have the potential to greatly impact children's participation in STEM. They have insights into their children's interests, activities, and dispositions that can help science communication practitioners make STEM more relevant to children's lives. However, assumptions that prevent collaborative learning experiences for children and adults are rare. Dispositions, traditions, or attitudes often do not engage these influential adults as effectively as they might, nor are they always open to the perspectives, needs, and expertise that caregivers bring to the activities in which their children participate.

Things to Consider
Active parent engagement and support of children's learning manifests in different ways, not all of which require parental presence. There are many known challenges with regard to parental engagement in informal STEM learning and science communication opportunities. While some parents eagerly engage, many may be less comfortable for a range of reasons, such as their own prior negative experiences with STEM, literacy or language challenges, unfamiliarity with the setting, or work/life or religious obligations that cause hesitation. It is critical that STEM educators and science communicators consider how varied perspectives, values, belief systems, and power dynamics play out in science communication learning experiences. It is crucial to consider whether parents are part of the intended audience and, if so, how they can participate. Parents are often relegated to the role of bystanders. Whether or not today, they may come to the experience meaning that it is meant for the child only.

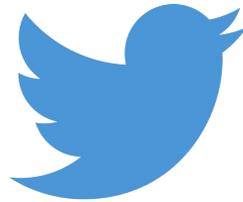
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www.informalscience.org/broadening-perspectives

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