Defining and Measuring STEM Identity, Interest, and Engagement
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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.

Search the Collection

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Broadening Perspectives on Broadening Participation in STEM

What is STEM Identity, Interest, & Engagement?

A TOOLKIT FROM CASES’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.

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 TOOLKIT

2018 Year in Informal STEM Education

DEIGNED 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.

EXPLORE THE RESOURCES

BROWSE THE CATEGORIES

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
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

- 2013 Evaluation Capacity Building Convening
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

LEADERSHIP & STAFF

Kevin Crowley  
University of Pittsburgh

Martin Storksdieck  
Oregon State University

Jamie Bell  
CAISE

Michelle Choi  
University of Washington

Melissa Ballard  
CAISE

Read a recap of our August 2018 convening on evaluation and measurement.
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

www.informalscience.org/em-task-force
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

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

**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

Hidi & Renninger, 2010
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
“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
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
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

**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)
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
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
“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
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
CAISE’s round up of evaluation tools & instruments

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.
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