

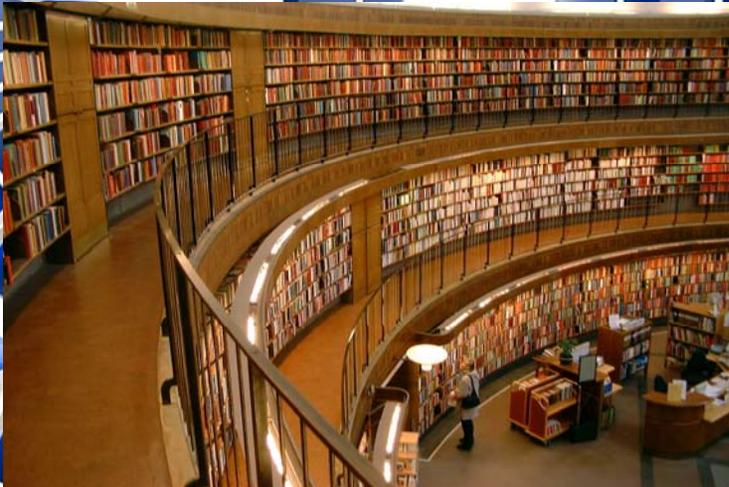
Evaluating STEM Programs in Public Institutions in Communities: Focusing on Equity

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Libraries in Networked Publics

The public sphere is changing, and libraries have, too.

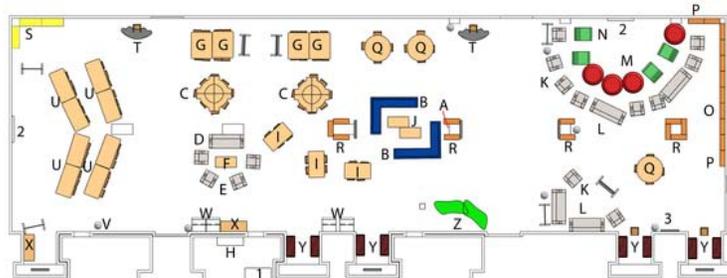


Two Dimensions of Equity

- Opportunities to pursue interest-related learning across multiple settings
- Opportunities to participate in building knowledge about program implementation and effectiveness

YOUmedia Chicago

Youth-powered 21st century learning

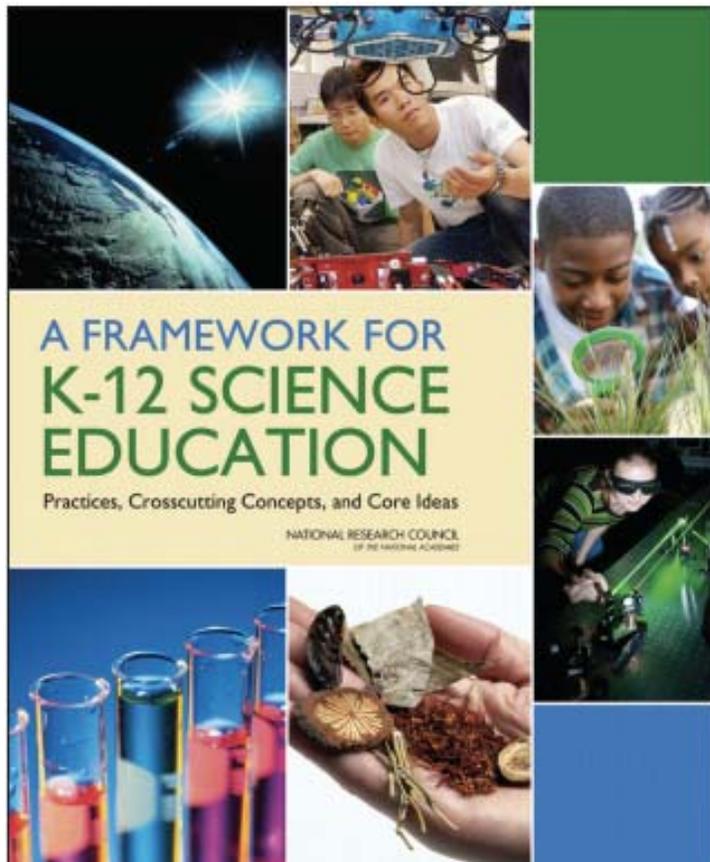


*Please note the colors are not accurate of the actual furniture



Penny Bander-Sebring, Eric R. Brown, Kate M. Jullan, Stacy B. Ehrlich, Susan E. Sports, Erin Bradley, and Lisa Meyer

Engagement in Disciplinary Practices



Obtaining, Evaluating, and Communicating Information
Science requires the ability to derive meaning from scientific texts (such as papers, the Internet, symposia, and lectures), to evaluate the scientific validity of the information thus acquired, and to integrate that information.



Students learn science best by engaging in the practices of science and engineering as they make sense of phenomena using conceptual ideas—both in and out of school. It helps them identify with science.

The Sci-Dentity Program



June Ahn

create,
tell your story
and read stories
written by
others



inspire,
get inspired
or share what
inspires you



connect,
customize your
profile and keep
in touch with
your friends



Mega Subramaniam



Allison Druin



Ken Fleischmann

Mathematizing Children's Literature



Allison Hintz

Fair sharing in *the Doorbell Rang*



Counting in *the Hungry Caterpillar*

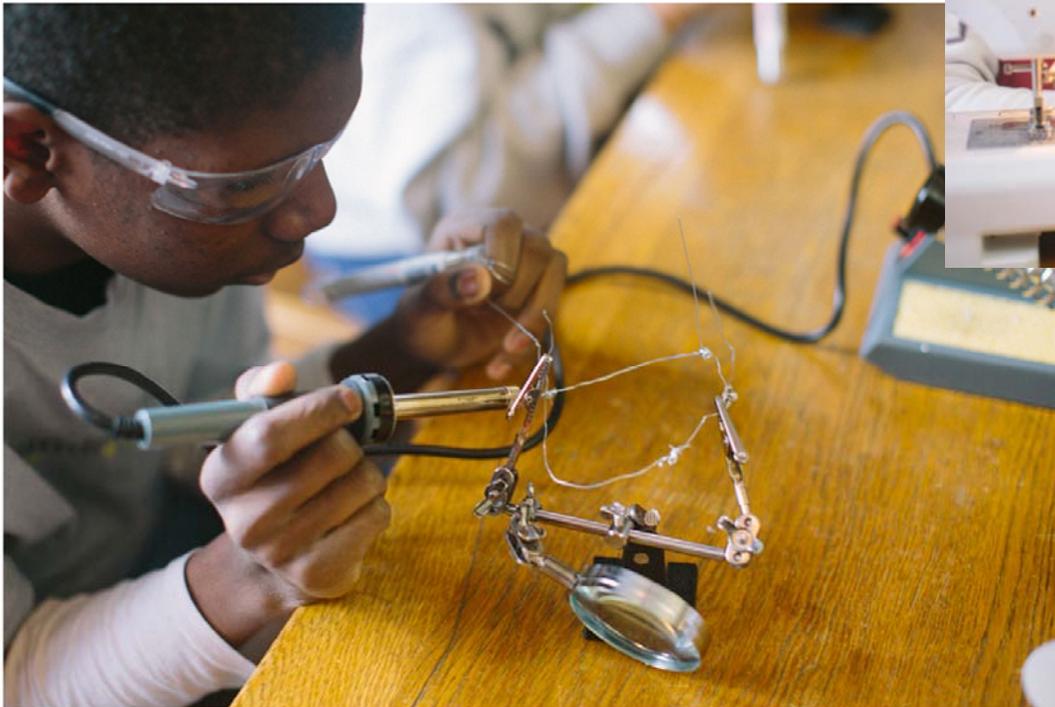


Arrays in the *Madeline* series

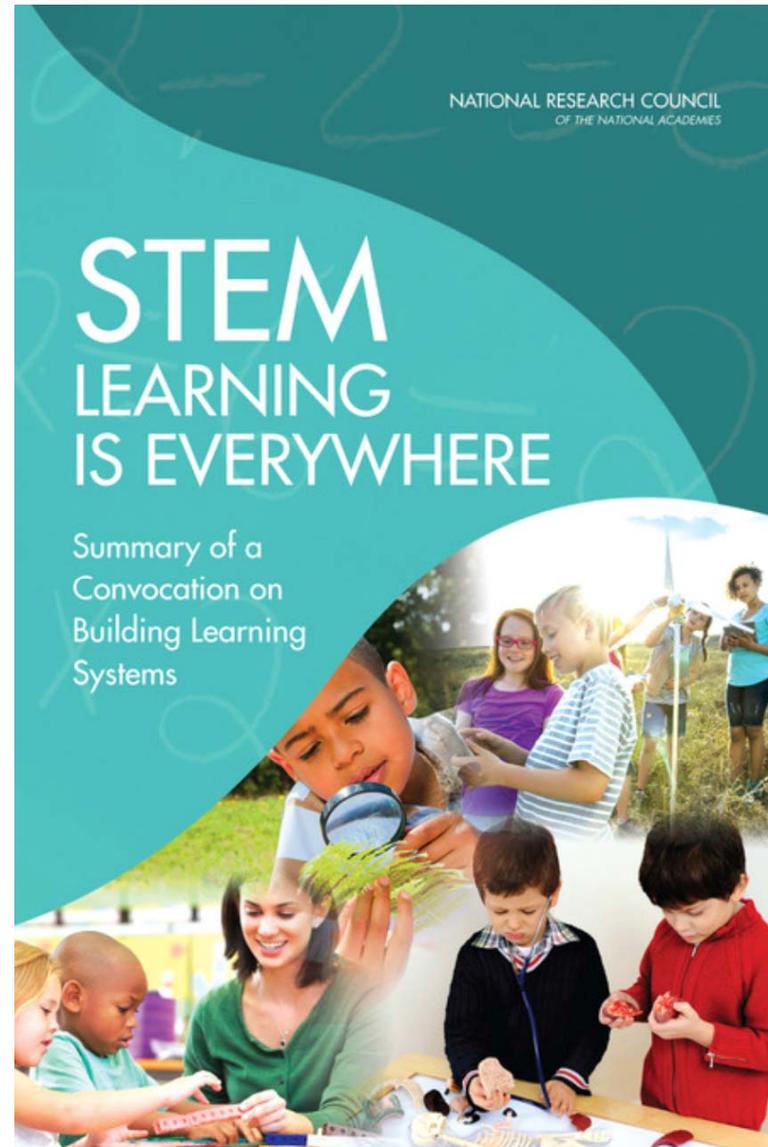
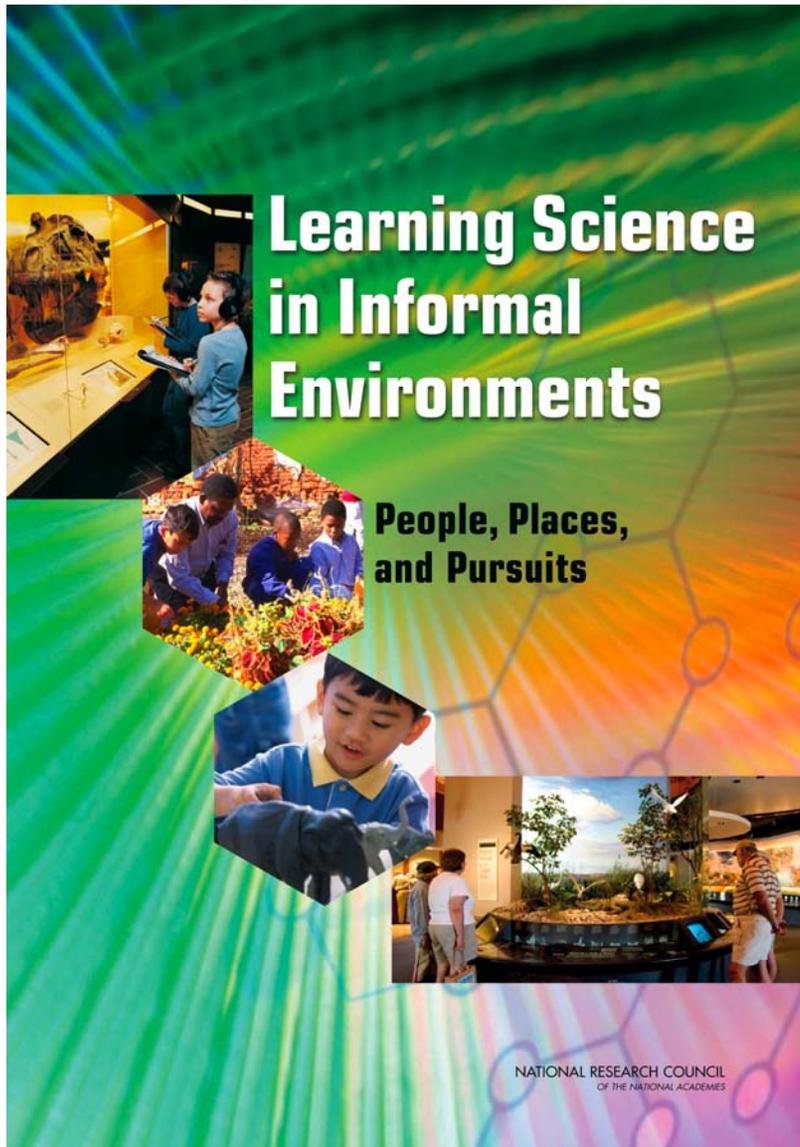


Elham Kazemi

Millvale (PA) Community Library Makeshop



Mobile Makeshop session at Millvale Community Library / Photo: Ben Filio



Available at: www.nap.edu

How People Learn Across Encounters

Although it is important to understand the impact of informal environments, *a more important question may be how science learning occurs across the range of formal and informal environments.* The science learning literatures and fields are segmented in ways that are at odds with how people routinely traverse settings and can engage in learning activities across those settings. We need to better understand the extended learning processes and interactions associated with STEM literacy and workforce-related learning pathways.

Recommendations

- Build a map and bridge the gaps
- Connect young people to STEM learning opportunities
- Build an infrastructure that will last
- Provide professional development
- Support innovative evaluation approaches
- Research how STEM learning ecosystems work

Longitudinal Study of Connected Learning

<http://connectedlearning.tv>

The image shows the cover of a report titled 'CONNECTED LEARNING'. The title is written vertically in large, bold, blue and pink letters. To the right of the title, there is a subtitle: 'an agenda for RESEARCH AND DESIGN'. Below this, it says 'A research synthesis report of the Connected Learning Research Network'. The authors listed are: 'Written by: Mizuko Ito, Kris Gutiérrez, Sonia Livingstone, Bill Penuel, Jean Rhodes, Katie Salen, Juliet Schor, Julian Sefton-Green, S. Craig Watkins'. It also mentions 'With contributions from: Shaondell Black, Neta Kliger-Vilenchik, Dilan Mahendran, C.J. Pascoe, Sangita Shresthova'. At the bottom right, it says 'The Digital Media and Learning Research Hub Reports on Connected Learning'. The background of the cover features a network diagram with various icons in hexagonal shapes, including a laptop, people, a globe, and a gear.

CONNECTED LEARNING

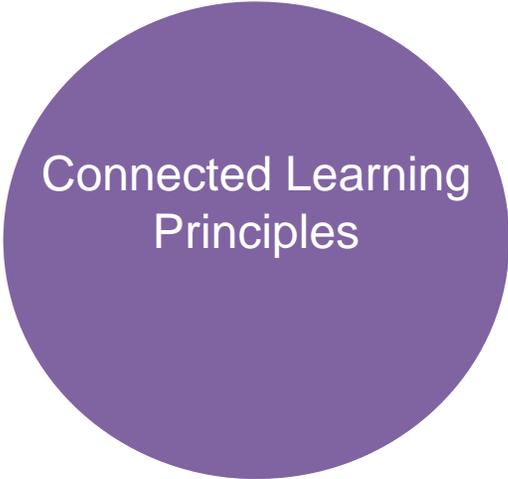
an agenda for
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The Digital Media and Learning
Research Hub Reports on
Connected Learning

Three Sources of Data



Connected Learning
Principles

A survey for measuring youth experiences of interest-related activities according to principles of connected learning



Program
Experiences

A survey of youth's experiences in programs designed to promote connected learning



Connected Learning
Outcomes

A survey for measuring potential outcomes of connected learning

Construct-Centered Approach

- Begins with a clear definition of the focal constructs:
 - *Principles of Connected Learning*
- Identifies things people say or do to reveal these constructs, along with tasks to elicit these things:
 - *Asking youth to characterize their experiences of an interest-related pursuit*
- Develops and tests items to develop validity evidence for scales
 - Using construct mapping approach to characterize levels of depth of approach and measure variability in responses

Defining the Principles

Interest Powered

Youth pursue their interests in a way that pervades their lives, and their pursuit deepens their knowledge and expands their horizons.

Production Centered

Youth ask for and iterate based on feedback on their designs, consistently applying a critical stance toward their own and others' designs. They circulate designs to a broad audience whose thinking and action they seek to influence.

Shared Purpose

Youth participate in activities with a common purpose, equitable participation, and opportunities to lead and contribute.

Openly Networked

Youth have access all the time to needed digital tools and support for their use; pathways of participation across places to deepen interest are transparent and accessible.

Peer Supported

Other people broker access to new opportunities and resources to deepen and pursue interests.

Academically Oriented

Youth pursue their interests in a way that pervades their lives, and their pursuit deepens their knowledge and expands their horizons.

Construct Map

Level	Description
4	Other people broker access to new opportunities and resources to deepen and pursue interests.
3	Other people provide strong support through teaching and helping within the activity.
2	Other people provide modest support through teaching and helping within the activity.
1	Other people provide limited or no peer support for participation in the activity.

- Levels should clearly differentiate experiences in terms of quality
- Deeper levels are hypothesized to be linked to better outcomes

Puzzling Through How To Elicit Connected Learning Experience

- The second step in designing measures is naming things people might say or do to reveal these constructs, along with tasks
- Typical approaches
 - Give people a test (more appropriate for knowledge and skill development, not so appropriate in informal settings)
 - Ask about experiences in a single setting (not appropriate, given the construct)
- Our approach: Focus on the individual *pursuit* and elicit experiences related to that pursuit

Beginning with a Pursuit

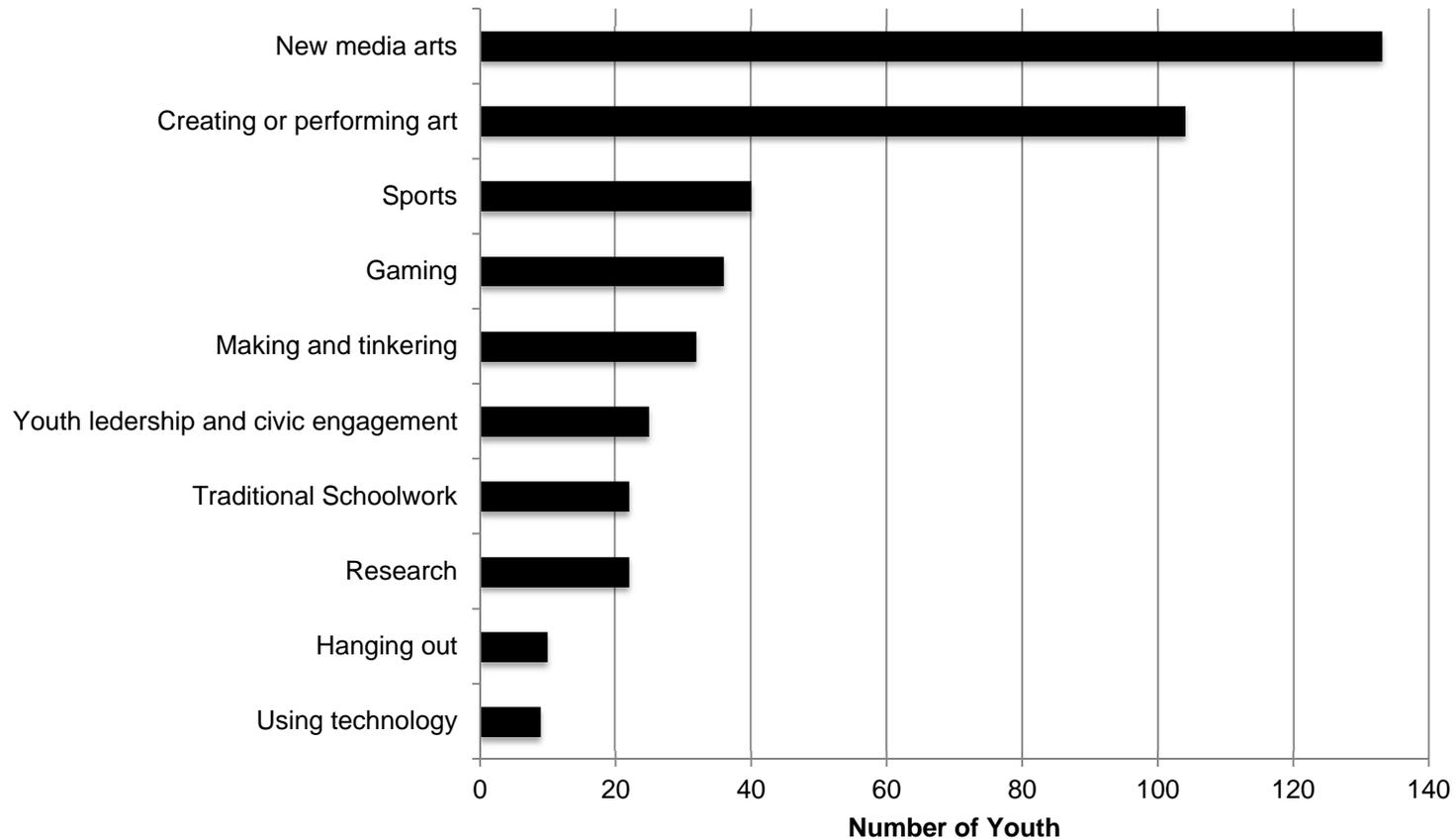
- Think of an Activity:
 - What is something you did for at least three years during your second decade of life (age 10-20) that:
 - You enjoyed doing?
 - You got better at the more you did it? *and*
 - You looked for opportunities to do more of it, whenever you could?
- Talk to a Neighbor:
 - What was the activity?
 - When did you start and stop doing the activity (if you stopped)?
 - Who did the activity with you or encouraged you to do it (if anyone)?
 - Where did you take part in the activity?

Let's hear about your experiences.

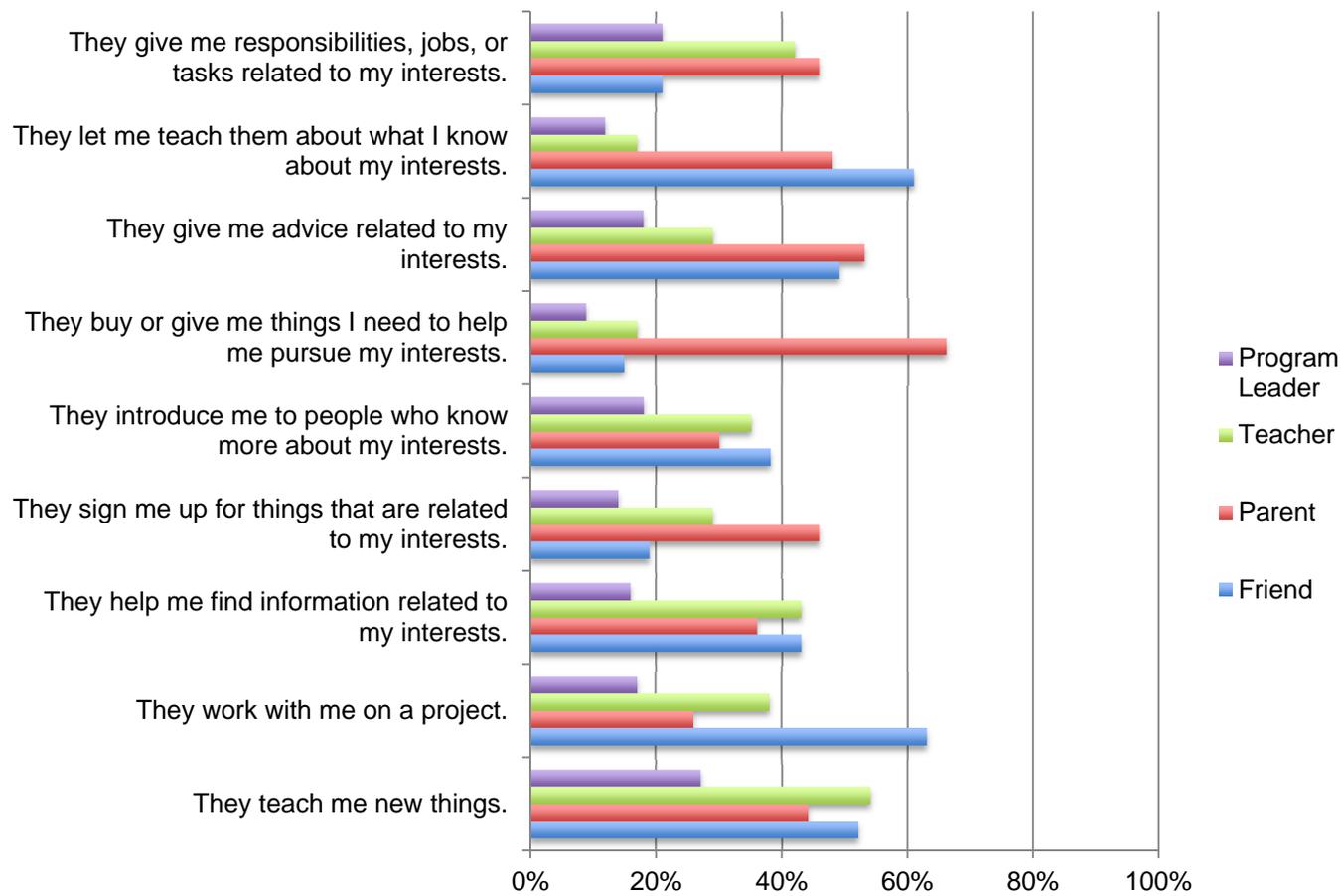
Our task revealed pursuits that spanned multiple settings.

Number of Settings Youth Pursue Interest-Related Activity	Number of Youth (N=266) (Percent)
1	77 (28.7%)
2	97 (36.2%)
3	58 (21.6%)
4	26 (9.7%)
5	7 (2.6%)
6	1 (0.4%)

Our approach enabled us to capture a variety of pursuits.

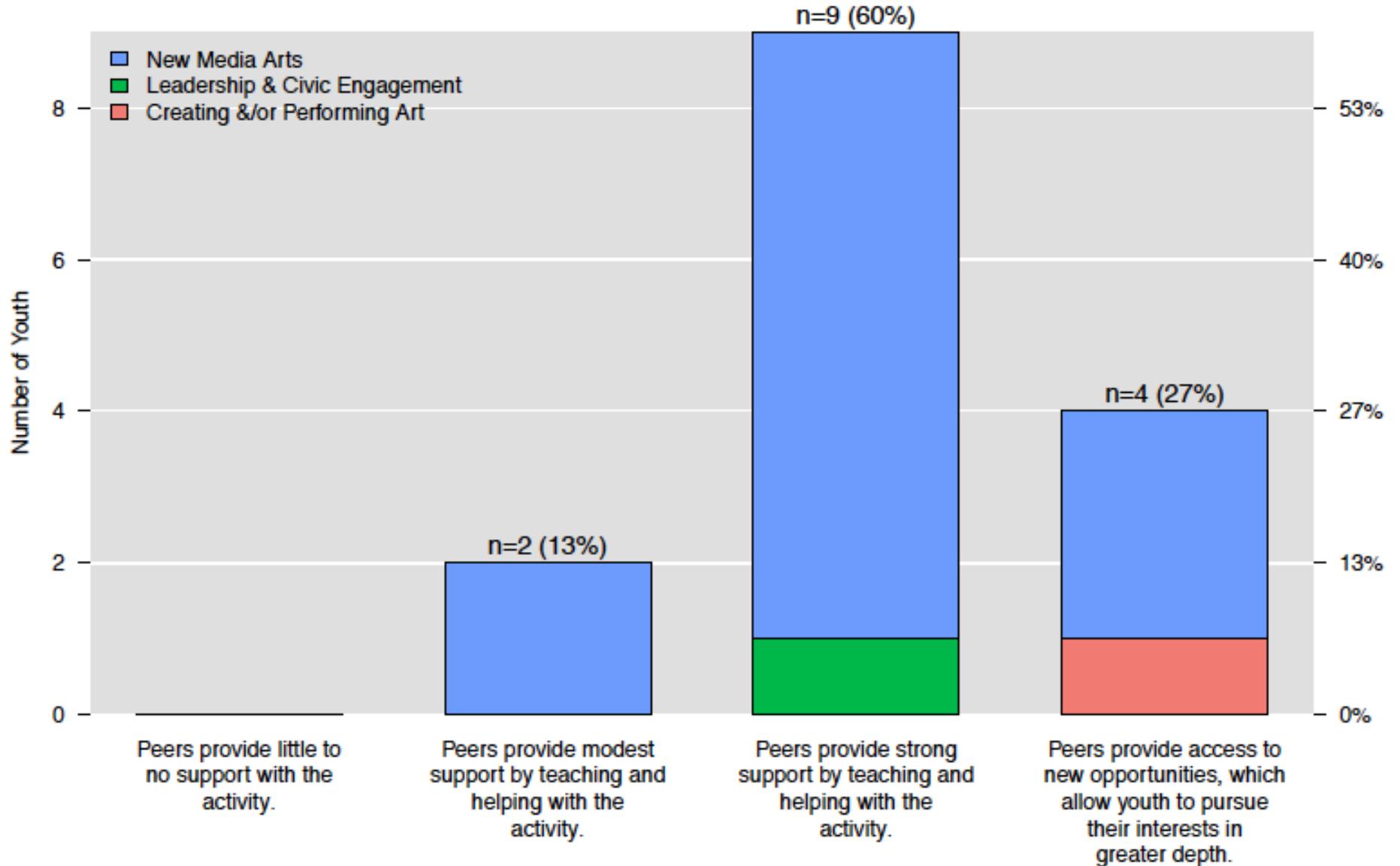


We get a sense of how and when learning is supported by a diverse range of adults and peers.



Peer Supported.

Youth provide encouragement, help, and feedback to each other as part of their participation in the activity.



The Next Steps

- We tested items in the field.
- We analyzed item responses to see whether they matched our expectations, based on our construct map.
- We revised items and repeated the process.
- We used the data to explore dimensions of equity in experience.

Program Experiences



Program
Experiences

A survey of youth's experiences in
programs designed to promote
connected learning

Guidance for Defining Constructs

Common Core State Standards	Framework for K-12 Science Education
<p>Make sense of problems and persevere in solving them.</p> <p>Reason abstractly and quantitatively.</p> <p>Construct viable arguments and critique the reasoning of others.</p> <p>Model with mathematics.</p> <p>Use appropriate tools strategically.</p> <p>Attend to precision.</p> <p>Look for and make use of structure.</p> <p>Look for and express regularity in repeated reasoning.</p>	<p>Asking questions and defining problems</p> <p>Developing and using models</p> <p>Planning and carrying out investigations</p> <p>Analyzing and interpreting data</p> <p>Using mathematics and computational thinking</p> <p>Constructing explanations and designing solutions</p> <p>Engaging in argument from evidence</p> <p>Obtaining, evaluating, and communicating information</p>

Guidance for Defining Constructs

- Rich ethnographies of young people learning across settings and over time.

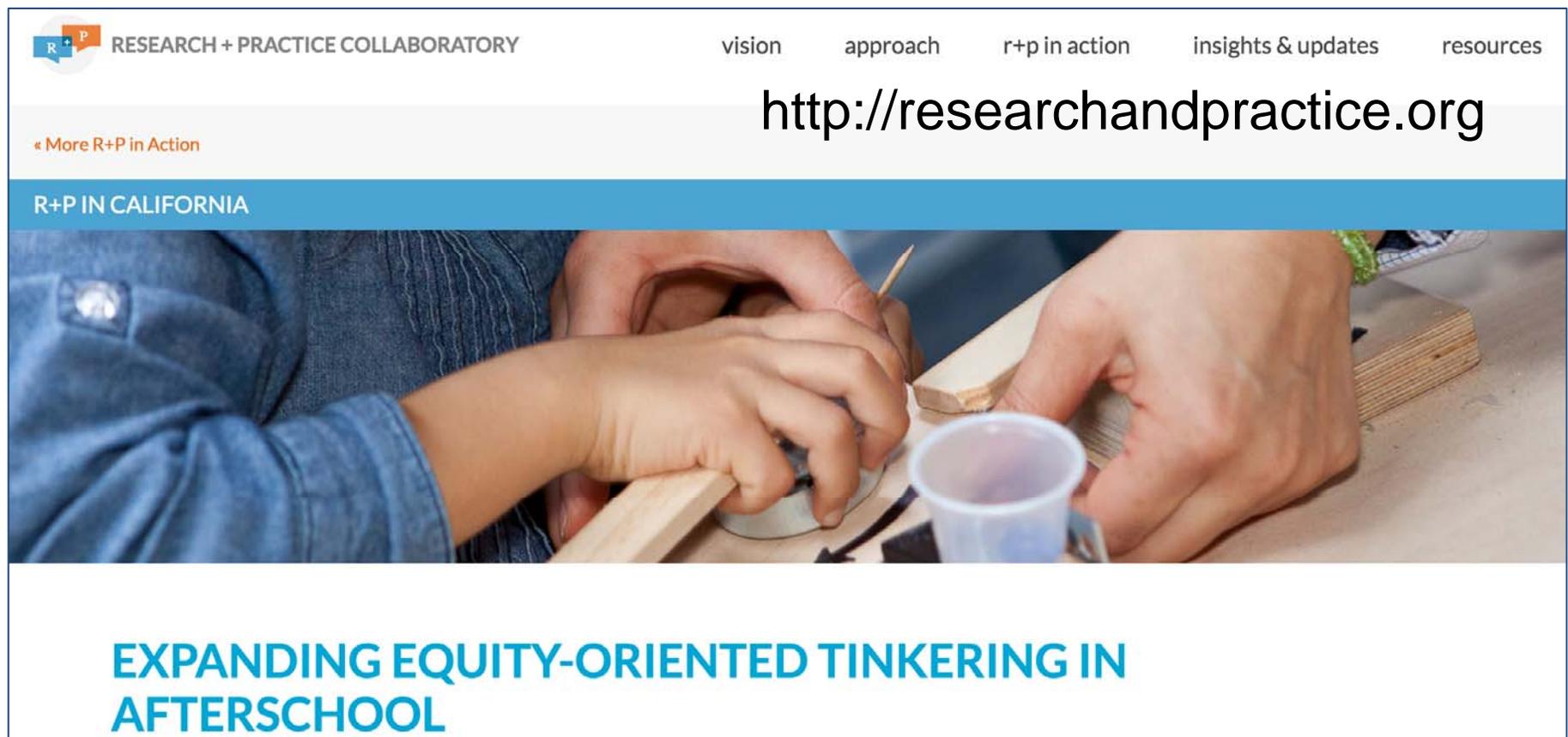
LIFE Center: Youth who construct or are provided with personally meaningful STEM learning experiences and agency for their learning develop a sense of themselves as capable STEM learners.

- Input from parents and program leaders.

<http://life-slc.org/>

Guidance for Developing Constructs

- Frameworks developed collaboratively by researchers and practitioners



RESEARCH + PRACTICE COLLABORATORY

vision approach r+p in action insights & updates resources

<http://researchandpractice.org>

« More R+P in Action

R+P IN CALIFORNIA

EXPANDING EQUITY-ORIENTED TINKERING IN AFTERSCHOOL

The image shows a close-up of two pairs of hands working on a wooden project. One pair of hands is using a pencil to mark a piece of wood, while the other pair is holding a white plastic cup. The background is a light-colored wooden surface.

Key Considerations in Eliciting Youth Experience

- Attend to equity in identifying opportunities
- Look for practices youth may not identify as “STEM-related”
- Programs are only one site where youth experience science, mathematics, and engineering practices
- Focus on unique site contributions:
 - At the setting
 - To roles that adults and peers play in brokering across settings

Thinking About Outcomes



A survey for measuring potential outcomes of connected learning

Thinking in Levels

Individual level

Group level

System or community level

Modeling a Participatory

Approach

Design charrettes with youth and program leaders

Individual Outcomes: Candidate Categories

- Further academic pursuits
- Workplace pathways
- Civic engagement
- Deeper play and fun
- Heightened interest in STEM
- Greater identification with STEM

Use extreme caution when using existing, traditional measures

What would youth say or do?

- Focus question: *What are the individual outcomes of connected learning?*
- Problem: Existing measures of youth development were a poor fit to program opportunities
- Approach: Design charrette, a tool of participatory design for developing survey items for outcomes of connected learning

Design Charrette for Outcome Measures

- Partners: HIVE Research Network, CU Boulder, SRI International
- Settings: HIVE New York, Denver network of arts-focused programs



Dixie Ching



Tim Podkul



Rafi Santo



Katie Van Horne



Adam York



Niem

- Joined KAYSC as part of the Climate Change Crew
- Helped lead annual summer camp teaching kids from ages 6 to 13 about energy conservation, environmental justice, social justice, and gardening and eating healthier.
- After graduating HS, came back as an intern with the Climate Change Crew in a leadership/mentor role
- Discovered passion in chemistry and environmental justice at KAYSC
- Wants to pursue degree in Environmental Law
- Degree is not offered at her university

Brokering and Mentorship

Well, there's a lady named Sandra, and she has a big role in helping alumni, I don't know, helping them plan for their future, in a sense. So, I definitely seek some of those staff in the KAYSC. What they can do to help me is just being full of support, that being emotionally and mentally. Just being there for me and just being really honest and just, I don't know, helping me network and connect with people that they know can further, what do you call it, can help me figure out what I want to do, so, definitely that.

Support for college that doesn't offer her desired major

I think that it definitely had to do with some of my teachers at my high school because they had kids who had already went to St. Kate's. So they're like, "It's a great school you should definitely go there." Even then I had, even at the KYC, I had full support and everyone was like, "You should definitely go there." I mean, I had other choices for colleges, but St. Kate's was like my final because I knew that it was right for me and I had full support from everyone else, so.

... after being enrolled in Saint Katherine's and finding out they didn't have my major, which was environmental law, and for that to be achieved, I had to major in environmental, in, what do you call it, political science and public, shoot, public relations and they didn't have that, so I had to take classes at St. Thomas. Right now, currently, that's what I'm pursuing.

Hive NYC Community Meet-Up | January 22nd, 2015 | Connected Learning Outcomes Worksheet

Deeper Fun/Fulfillment/Joy/Satisfaction

Ex: Talked about devoting more free or me time to a maker activity.

Success in Academics/Bonding to School

Ex: Says that classes seem more relevant now.

Advancing Career Goals/Goal Discovery

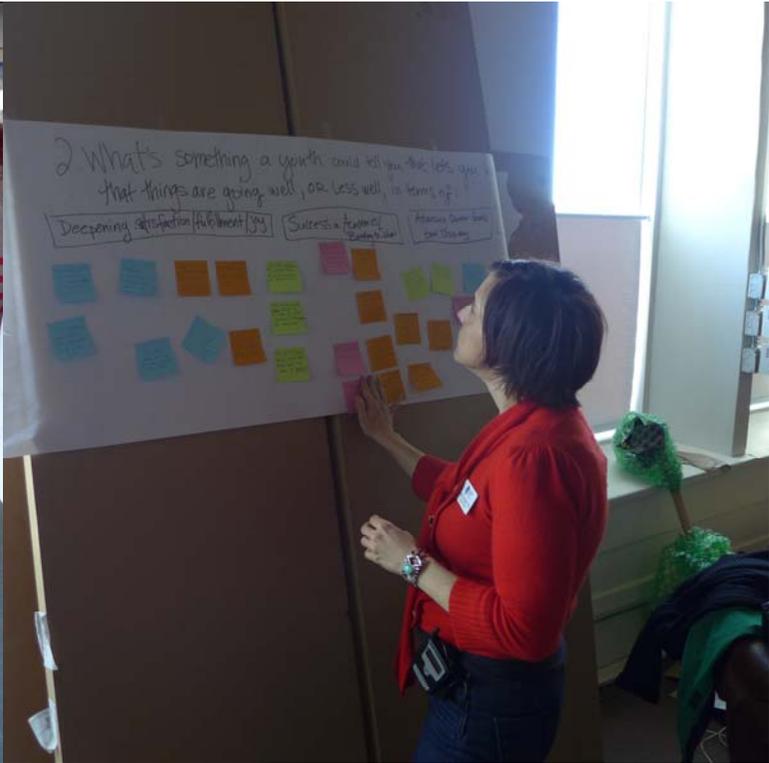
Ex: Followed up with a professional contact.

Deepening Civic Engagement

Ex: Developed a game with a social justice message.

[other outcomes]

<http://tinyurl.com/mgtgkfx>



System Level: Infrastructure

- Infrastructure

- Developing institutional links for expanding pathways of movement across settings
- *Analytic approach: Trace networks of ties that enable diverse youth to “level up” and “level out”*
- *Analytic approach: Comparing search patterns to opportunities (using approaches for analyzing search patterns in UCAR’s digital libraries)*



System Level: Ecosystem Resilience

- Characterizing the opportunities available at the community or city level
- Dimension of *diversity*: How varied are opportunities in particular neighborhoods
- Dimension of *redundancy* of pathways: How many different ways are there to explore and develop an interest

Equity, Evaluation, and Stance

- Good measures can support accurate *diagnosis of inequity*
- Developing such measures requires *participation* of key stakeholders
- Measures need to be employed from a stance of *continuous improvement*, whereby a collective engages in purposeful efforts to use evidence to improve opportunities for all

Resources and Contact

Measures of Connected Learning

<http://researchtools.dmlhub.net/>

Research+Practice Collaboratory

<http://researchandpractice.org>

Email:

william.penuel@colorado.edu

Twitter:

@bpenuel, @learnDBIR, @NCRPP