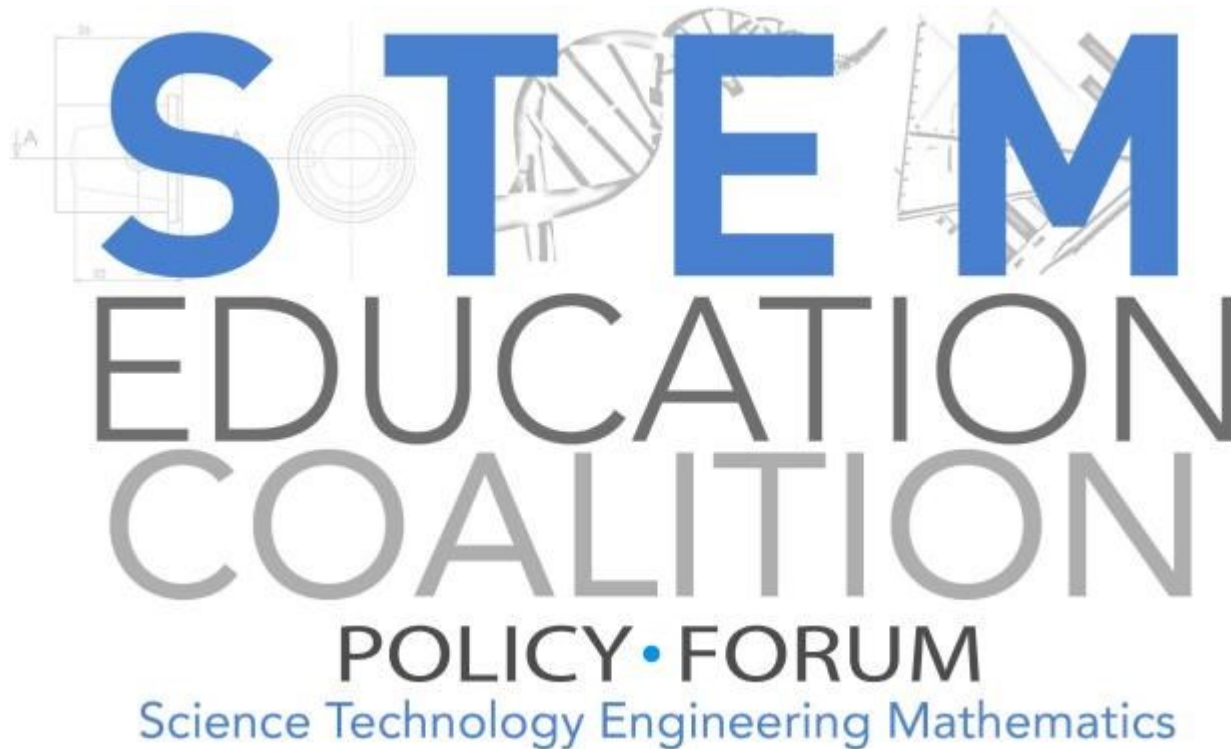


**Informal STEM Education 101:
What We Know and Don't: The State of the Art on Research on
Outcomes in Informal STEM Education**



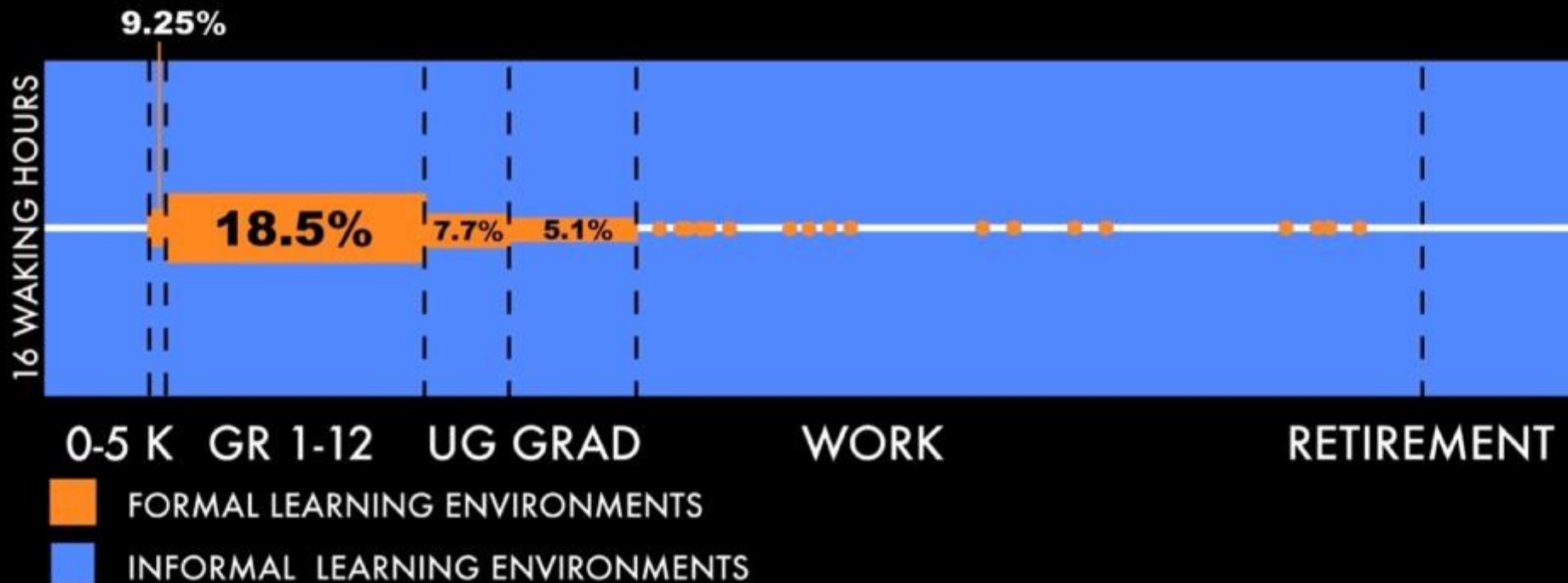
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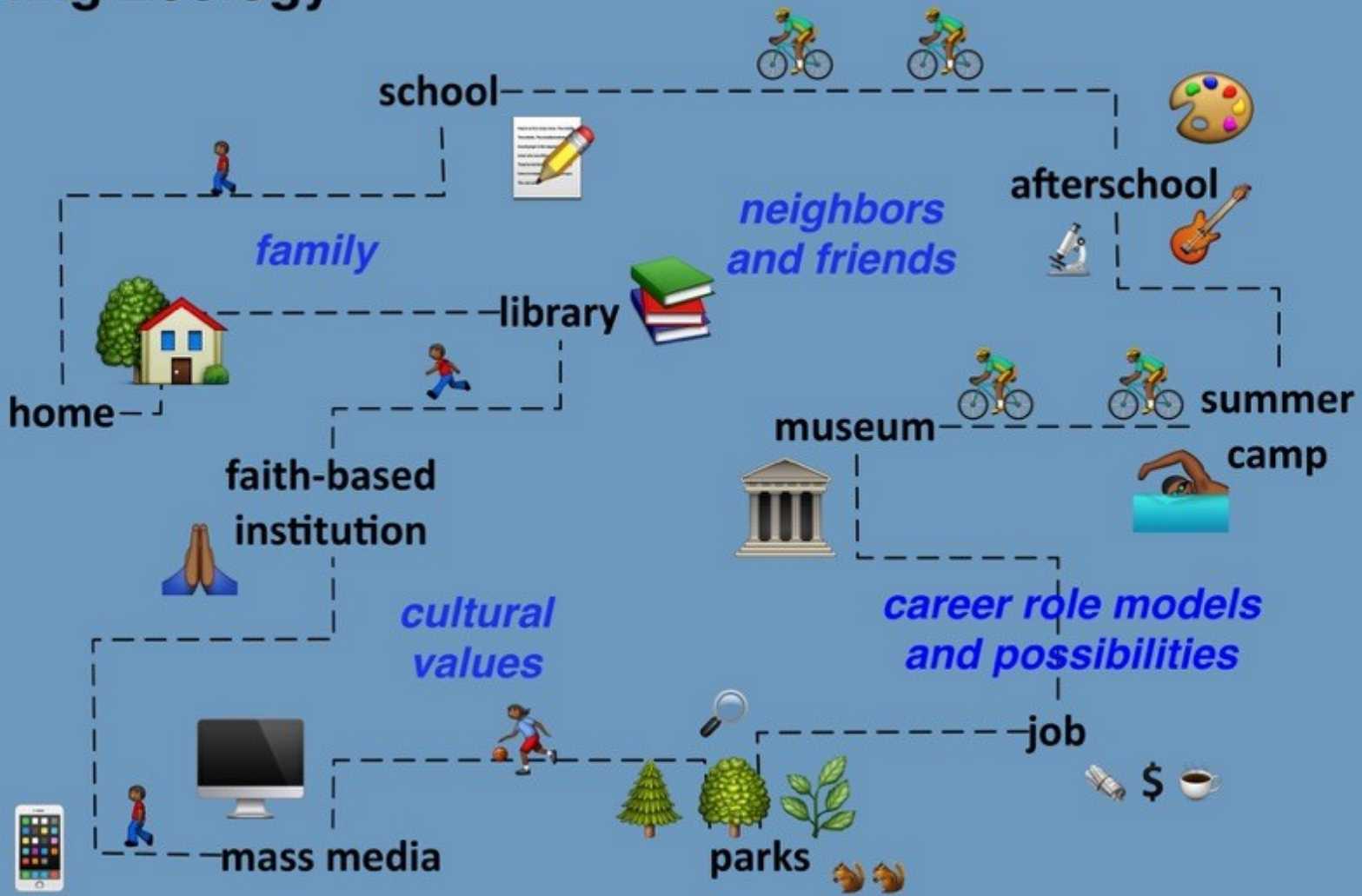
STEM LEARNING AND OST

@BronwynBevan,
University Of Washington

LIFELONG AND LIFEWIDE LEARNING



Learning Ecology



WHAT IS OUT-OF-SCHOOL TIME STEM LEARNING?

Everyday Learning	Self-Directed Learning	Structured, Supervised Learning
Home/Family Community School Yard Social Media On-the-Job	On-Line Radio, TV, Film Museums Books/Libraries Hobbies, Clubs	Afterschool Programs Weekend Classes Summer Camps Internships Clubs

WHAT IS OUT-OF-SCHOOL TIME STEM LEARNING?

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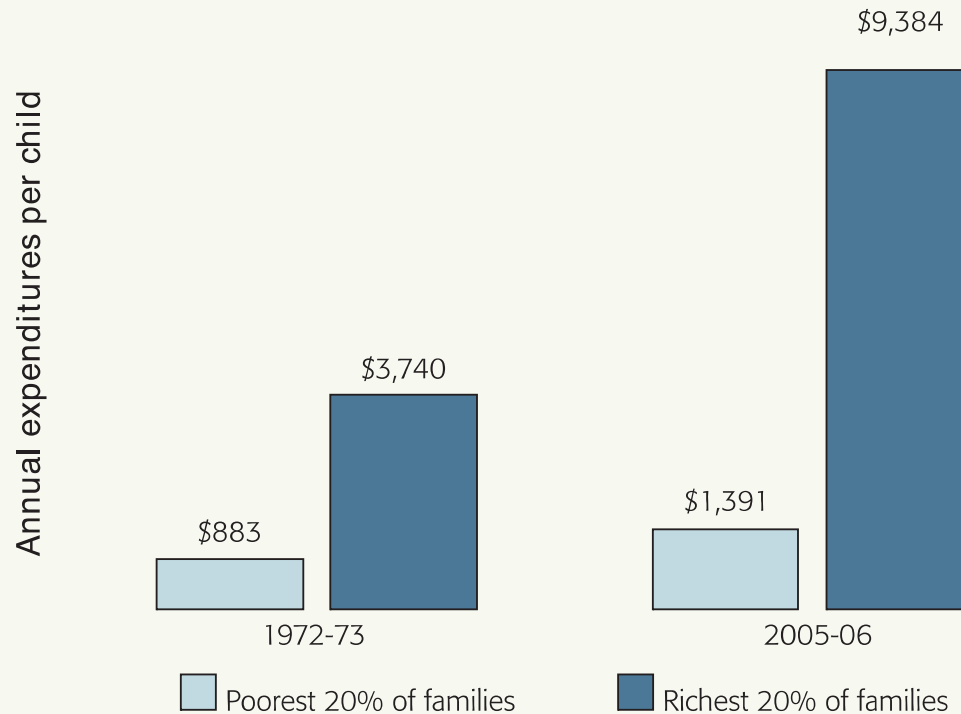
SOCIAL AND INTEREST-DRIVEN

WHAT IS OUT-OF-SCHOOL TIME STEM LEARNING?

Everyday Learning	Self-Directed Learning	Structured, Supervised Learning
Home/Family Community School Yard Social Media On-the-Job	On-Line Radio, TV, Film Museums Books Hobbies, Clubs	Afterschool Programs Weekend Classes Summer Camps Internships
50M PK-12 Youth	50M PK-12 Youth	20M? Youth 10M=6M 4-H, 4M B&G Clubs 10M=9M the Y, 1.6M 21CCLC 10M?=Museums, Libraries, Nature Centers, Community Programs
Social Policies	Cultural Policies	Educational Policies

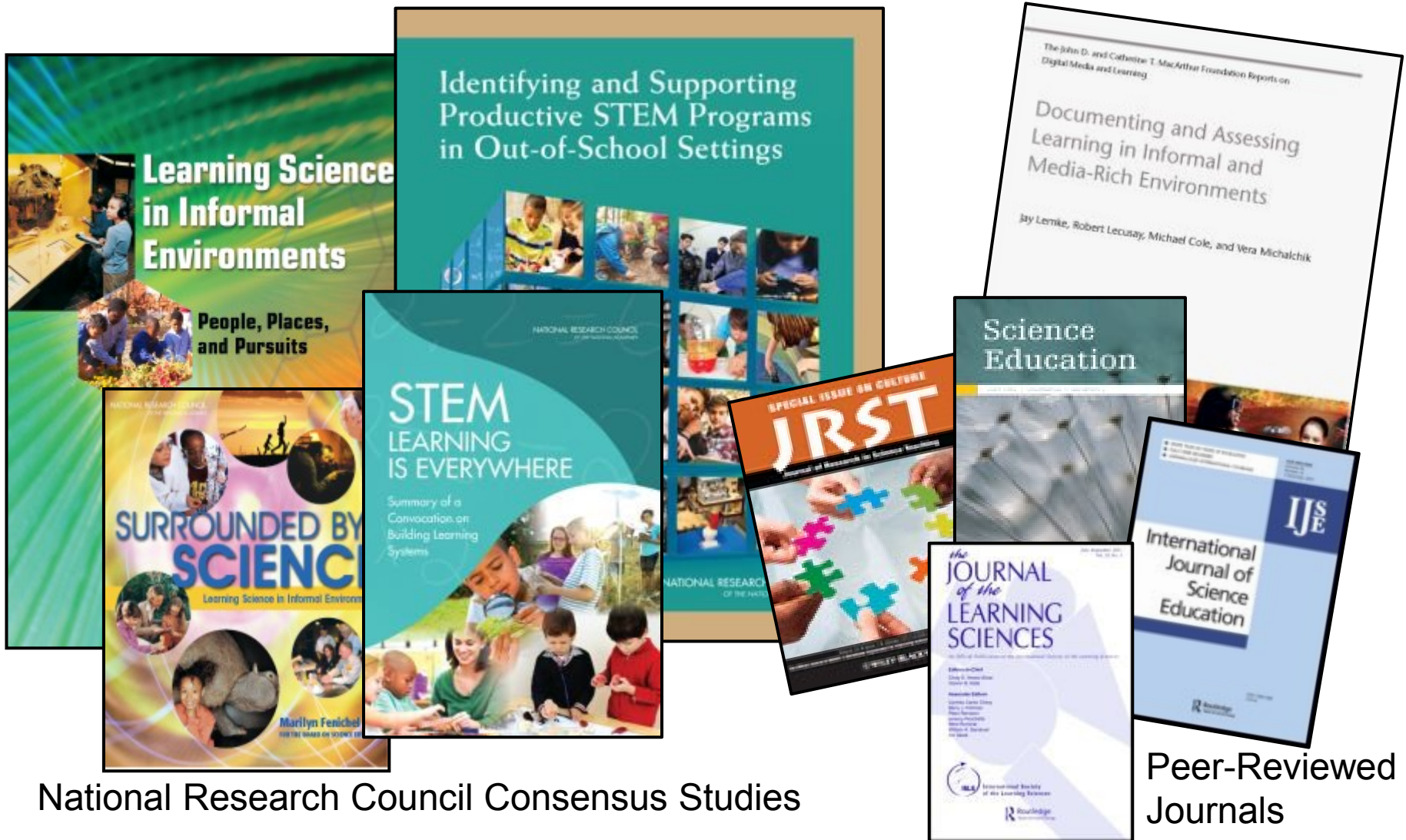
FIG. 4.

Family enrichment expenditures on children



Author's calculations are based on data from the Consumer Expenditure Surveys. Expenditure patterns vary across families and include child care. Books, fees for sports activities and equipment, and summer camp enrollment fees are examples of common "child enrichment" expenditures. Amounts are in 2012 dollars. Reprinted with permission from **Whither Opportunity?** © 2011 Russell Sage Foundation.

RESEARCH JOURNALS AND SYNTHESSES



National Research Council Consensus Studies

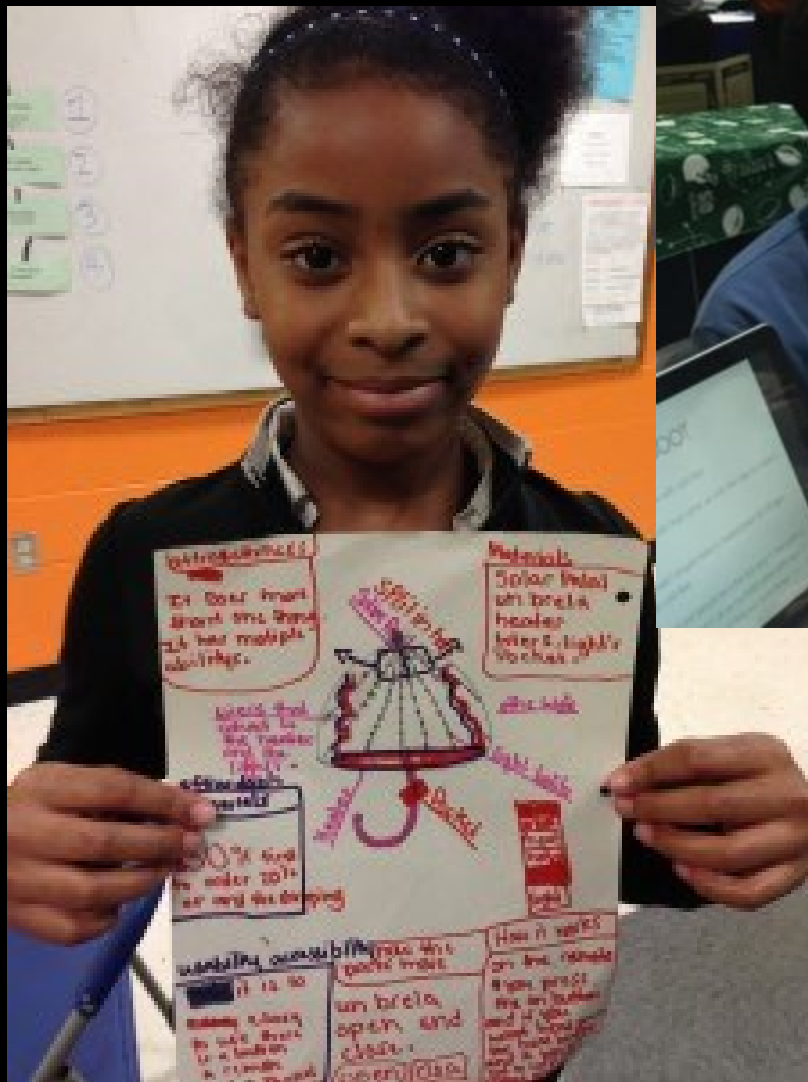
Peer-Reviewed Journals

STEM LEARNING: WHAT RESEARCH SAYS

- **Learning develops across settings and over time**
(National Research Council, 2002)
- **STEM learning is best accomplished through firsthand engagement in STEM practices**
(National Research Council, 2012a)
- **21st c skills promote deeper learning**
(National Research Council, 2012b)

HIGH QUALITY STEM LEARNING IN AFTERSCHOOL (NRC, 2015)

- Provides **first-hand experiences** with phenomena, concepts, and practices that are both intellectually and socio-emotionally engaging.
- **Recognizes and leverages/builds on** young people's interests, prior experiences, and cultural resources (which vary across communities).
- **Actively makes connections** to STEM ideas and experiences in school, at home, and in future learning and work opportunities (which vary across communities).

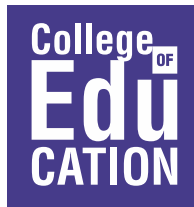


GET City (Boys & Girls Club)
Calabrese Barton & Tan, 2010

IMPLICATIONS OF RESEARCH

- **OST sector is a powerful resource waiting to be tapped, serving 10-15M youth/year, and primed to expand STEM education.**
- **Robust STEM learning ecologies contain multiple, varied, and locally adapted programs** that can address all students' interest and needs as they change, evolve, and fluctuate over time.
- **To broaden participation in STEM**, communities need to actively ensure that students from low income communities have access to responsive, engaging OST STEM. And there is a need to actively **broker/connect** youth to additional ongoing learning opportunities.

UNIVERSITY *of* WASHINGTON



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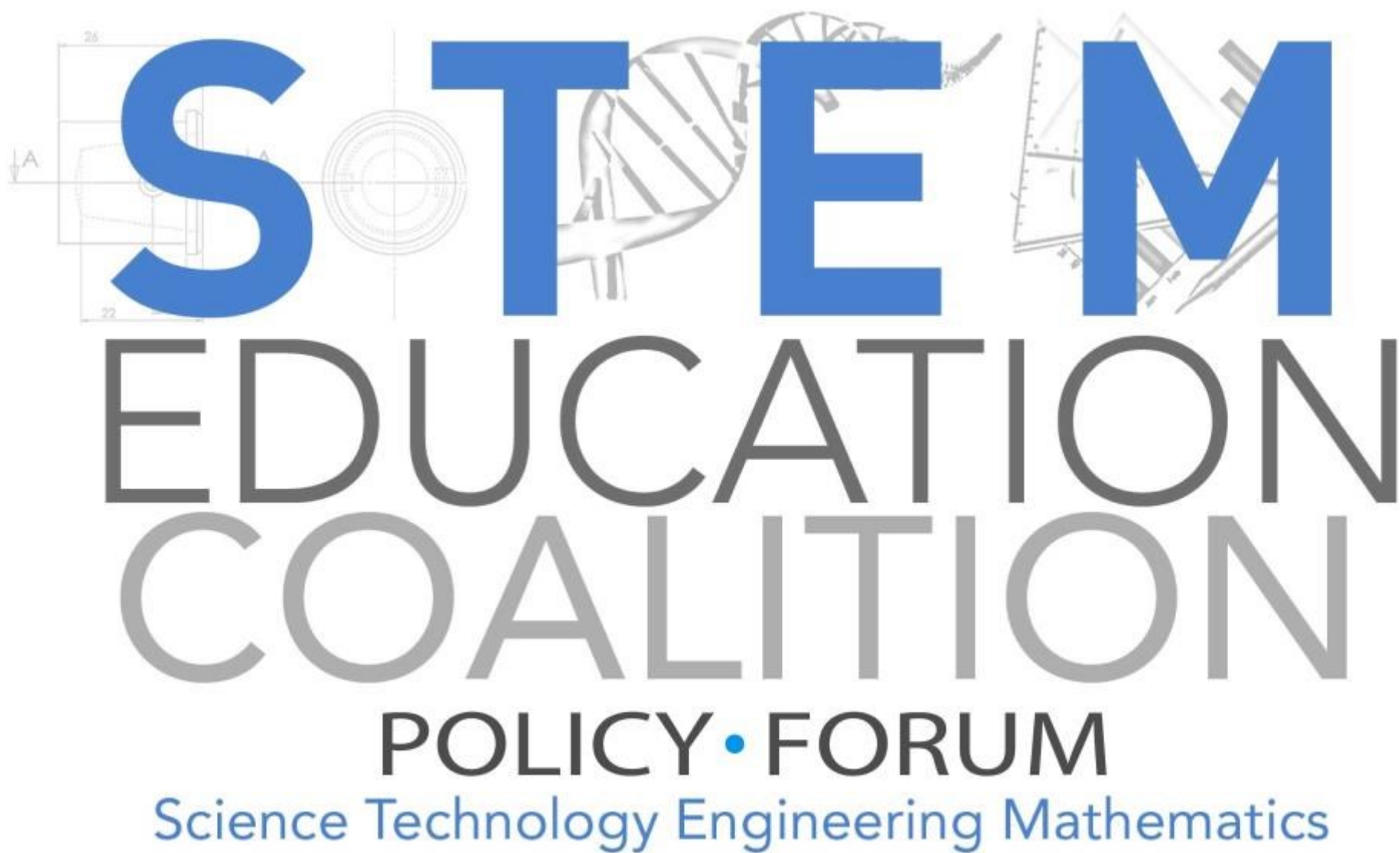
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Informal STEM Education 101: Connecting Research & Practice in Informal STEM Education

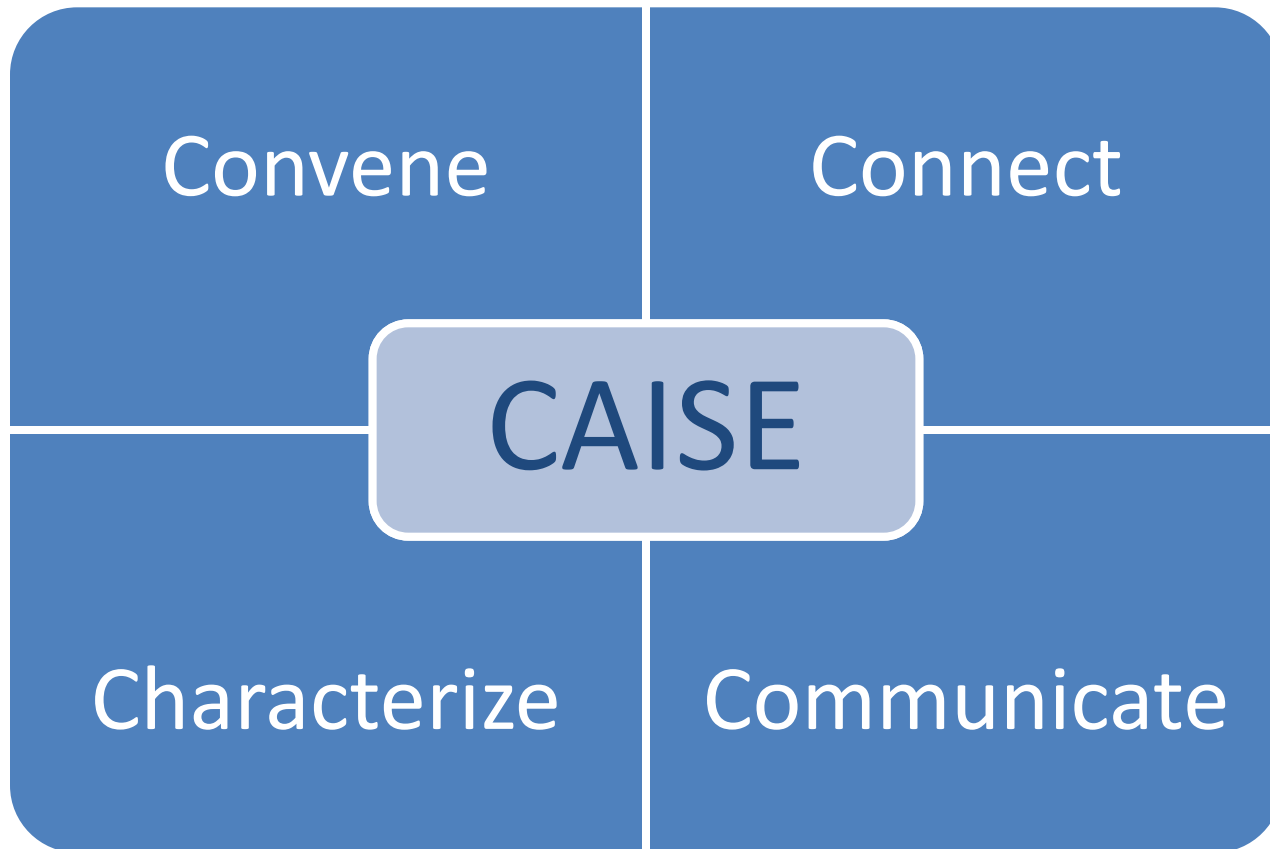
James Bell

Project Director

Center for Advancement of Informal Science Education
(CAISE)



This material is based upon work supported by the National Science Foundation (Award Nos. DRL-0638981 / DRL-1212803). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.



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InformalScience.org is a central portal to project, research and evaluation resources designed to support and connect the informal STEM education community in museums, media, out-of-school and a growing variety of learning environments.



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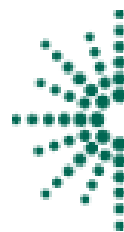
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Scientists can collaborate with the ISE community and use informal STEM learning strategies to engage the public with the content, process and broader impacts of their research.

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WHAT IS INFORMAL SCIENCE?

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STAR LIBRARY EDUCATION NETWORK: A HANDS-ON LEARNING PROGRAM FOR LIBRARIES AND THEIR COMMUNITIES

Date: Wednesday, September 15, 2010 to Saturday, August 31, 2013

Resource Type: Project Descriptions

Environment Type: Public Programs, Library Programs, Professional Development, Conferences, and Networks, Professional Development and Workshops, Resource Centers and Networks, Exhibitions, Library Exhibits

Audience: Elementary School Children (6-10) | Middle School Children (11-13) | Families | Museum/ISE Professionals

Discipline: Engineering | Geoscience and geography | Technology

Organization:Space Science Institute

Description or Abstract: The STAR Library Education Network: a hands-on learning program for libraries and their communities, (STAR_Net for short) is led by the National Center for Interactive Learning (NCIL) at the Space Science Institute (PI: Paul Dusenbery). STAR stands for Science-Technology, Activities and Resources. Team members include NCIL staff, the American Library Association (ALA), Lunar and Planetary Institute (LPI), and the National Girls Collaborative Project (NGCP). STAR_Net is developing two comprehensive, informal education programs: Discover Earth and Discover Tech. The project also includes a comprehensive evaluation plan and a research component that explores how public libraries can serve as a STEM learning center in rural, underserved communities. STAR_Net is supported through a grant from the National Science Foundation. The STAR_Net project includes two traveling library exhibits: Discover Earth: A Century of Change and Discover Tech: Engineers Make a World of Difference. The Discover Earth exhibition features interactive, multimedia displays that allow exhibit visitors to interact with digital information in a dynamic way, encouraging new perspectives on our planet. Discover Tech introduces the many extraordinary ways that engineers solve problems to help people and societies around the world. Similar to a science center experience, visitors and families will be able to explore and tinker with their own engineering solutions. A number of STEM activities and resources will be developed by project staff and by other organizations to help librarians and community partners offer a wide variety of programs for their patrons. Besides the traveling exhibits and programs, STAR_Net also includes library staff training (online and in-person) and a Community of Practice (CoP) for librarians (including non-host librarians) to interact and partner with STEM professionals and organizations. NCI's Kate Haley Goldman and staff from Evaluation and Research Associates are conducting the project's evaluation.

Project Website: <http://community.starnetlibraries.org/>






Funder(s): NSF

Funding Program: ISE/AISL


Award Number: 1010844


Funding Amount: 2495325


PROJECT PRODUCTS

-  Poster - STAR Library Education Network (STAR_Net)
-  Public Libraries as Places for STEM Learning: An Exploratory Interview Study with Eight Librarians
-  STAR_Net Summative Evaluation Report
-  Spotlight: Star_Net
-  STAR_Network Presentation

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Team Members



Paul Dusenbery
Principal Investigator



Stephanie Shipp
Co-Principal Investigator



Lisa Curtis
Co-Principal Investigator

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If you would like to edit a resource, please use [this form](#) to submit your request.

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Youth Access & Equity in ISL

- How can researchers and practitioners work collaboratively with youth to create more equitable ISE environments and settings?
- Audience: Youth from Underrepresented Groups, Researchers, Practitioners

STAR Library Network

- In what ways do libraries serve as an environment for STEM learning?
- Audience: Youth, especially rural regions

Synergies

- How do a variety of informal STEM experiences influence urban youth over time?
- Audience: Urban youth

Activation Lab

- What interests, skills, and knowledge do children need to succeed and persist in future STEM experiences?
- Audience: Youth

California Tinkering Afterschool Network

- What does STEM-rich, equity-oriented tinkering look like in out-of-school settings, and what kinds of professional learning is needed to support it?
- Audience: Youth, Practitioners



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Informal STEM Education networks and organizations have developed resources and expertise to help the STEM research community design and evaluate outreach, engagement and broader impacts activities.

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RESEARCH AGENDAS

Across the field of Informal STEM education, agendas are emerging to guide research, support innovative interventions, and to understand, share, and scale successful practice. These agendas are often roadmaps to identify and prioritize possible research directions and questions, and reflect the field's ongoing evolution to connect research and practice. Agendas are typically developed through intensive and inclusive processes involving reviewing current literature, convening experts, summarizing current findings, identifying gaps in evidence, and iteratively vetting the agenda with the broader field.

Current Research Agendas

21st Century Natural History Learning

Institutions that support natural history learning are mobilizing internationally to explore how they can support learning for the "21st Century naturalist". In the US, the Smithsonian led the development of a learning research agenda with input from educators, scientists, evaluators, and learning researchers. The Natural History Museum London and Kings College London have also launched a series of meetings to develop a research agenda for the UK. The UK and US agenda converged on highly similar themes to guide the field into the 21st century.

Priority Areas for Research and Practice

- Understanding and facilitating stronger two-way communication between experts and the public. (Identified in both the US + UK processes)
- Understanding the affordances and value of collections and authentic objects for learning. (US + UK)
- Domains of knowledge that are core to natural history learning, evolution, biodiversity, sustainability, and science process skill such as observation, comparison, modeling, visualization, etc. (US + UK)
- Developing and deploying innovative facilitation and mediation of natural history learning that leverage social practices, collections, social media, digital technology and more. (US + UK)
- Helping to create a broader field of natural history learning by exploring connections between learning, organizational change, and the broader learning ecologies in which our institutions exist. (US only)
- Understanding the needs, resources, and interests of the wide variety of audiences who come to natural history settings. (UK only)

Related documents:

- [Summary of the US Agenda Process: A Research Agenda for Learning in Natural History Settings](#)

Zoos and Aquaria

This evolving framework provides an opportunity for all AZA-accredited institutions and independent researchers to become involved in social science research and to work collaboratively in order to enhance the impact of zoos and aquariums and the conservation field as a whole. It also provides a structure for individual institution and multi-institutional studies to be interpreted in the larger picture of what is known about zoos and aquariums, their visitors, and their community relationships.

The overarching questions below are designed to facilitate the synthesis of information that is useful for and accessible to researchers, educators, marketers, administrators, and other stakeholders:

- What Role do Zoos and Aquariums Play in Lifelong Learning Experiences?

- Zoos & Aquaria
- Natural History Settings
- Children's Museums



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KNOWLEDGE BASE

The Knowledge Base (formerly the ISE Evidence Wiki) is a collaboratively generated resource designed to streamline access to and share evidence about the impacts of informal STEM learning on a range of audiences in a variety of settings. Articles in the Knowledge Base are intended to be evidence-supported claims that can be referenced when developing proposals or "making the case" for a strategy or approach to funders and stakeholders, as well as to see what is known and emerging in the field.

Are you interesting in contributing to the Knowledge Base? Contact caise@informalscience.org in order to edit existing articles or to create new ones.

Search our knowledge base. Select from one of three categories below.

SUBJECTS

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RESET

Adults | Programs, Online & Mobile Technology

Adult Informal Science Education Programs

There are a variety of informal science education programs that target adult learners. These programs exist along a continuum from casual drop-in programs (e.g., 1-2 hour workshops or lectures on...

ISE 101, Ecosystems of STEM Learning

Affective experiences are an important part of informal science education

Fun, excitement, pleasure, enjoyment, delight, laughter, wonder, joy are all emotional states that many informal science educators desire learners to associate with science learning. Yet in formal...

Broadcast Media & Film

Broadcast Television and STEM Learning

Broadcast television offers a variety of ways to present STEM-content and informal science education programming to public audiences. The educational program "Watch Mr. Wizard" (NBC 1951-1965)...

Children (6-12) | Broadcast Media & Film, Games & Cyberlearning, Online & Mobile Technology |

Ecosystems of STEM Learning

Children learn more across multiple types of media and ISE experiences

Numerous research studies have demonstrated that educational media can produce significant STEM learning among children. Viewing of educational television has been found to contribute to children's...

- 53 articles and growing



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EVALUATION

Evaluation is a set of approaches and methods used to assess the quality of a program or treatment; to monitor its development, and implementation (or effectiveness) and to provide evidence to demonstrate what works.

When evaluating informal STEM education, several types of evaluation are often considered: Front-end, formative, remedial, and summative. *Front-end evaluation* occurs during the project planning process. It often takes the form of audience research as it gathers data about the knowledge, interests, and experiences of the intended audience. *Formative evaluation* guides project improvement during the development process by gathering data about a project's strengths and weaknesses that can be used to make improvements. *Remedial evaluation* is carried out when a finished exhibition or program first opens to see how all the individual components work together as a whole. The purpose is to see if any small changes need to be made before beginning summative evaluation, which focuses on a project's overall effectiveness and impact. *Summative evaluation* is particularly important in making decisions about continuing, replicating, or terminating a project.

How is evaluation different from research?

The primary purpose of evaluation is to assess or improve the merit, worth, value, or effectiveness of a program or project and to advance the field (in this case, informal STEM education) by deriving lessons for funders, policymakers, or practitioners. Evaluation studies are typically conducted for clients and in collaboration with various stakeholders who are invested in improving or assessing a particular event, program, or activity. In contrast, educational research is typically designed to study a characteristic of learning grounded in an academic discipline such as psychology or sociology, or to study a particular theoretical framework. Research traditionally is geared toward knowledge generation for the larger field.

Want to learn more about evaluation?

You've come to the right place! This site includes a wide range of resources that will help individuals learning about evaluation as well as those with many years of evaluation experience under their belts. To start, check out [Chapters 1 and 2 of the Principal Investigator's Guide to Managing Evaluation in Informal STEM Education Projects](#) for a more detailed introduction to evaluation and stories from practitioners about the interplay between evaluation and project implementation. We've also gathered a [collection of some great guides and handbooks](#) that provide overviews of evaluation as well as detailed guidance for carrying out an evaluation. Other links on this page will take you to information on [choosing and working with an evaluator](#), [developing an evaluation plan](#), [locating evaluation tools and instruments](#), [reporting and disseminating evaluation findings](#), and [understanding where the informal STEM evaluation field is headed](#). See what we have learned from evaluation and research in these summaries.

[Working With an Evaluator](#)[Developing an Evaluation Plan](#)[Evaluation Tools and Instruments](#)[Evaluation Reporting and Dissemination](#)[Learn More About Evaluation](#)[Browse Evaluation](#)

...nts about the effectiveness or
...form decisions about its design,
...or an informal STEM project,
...ggest how it might be improved, and

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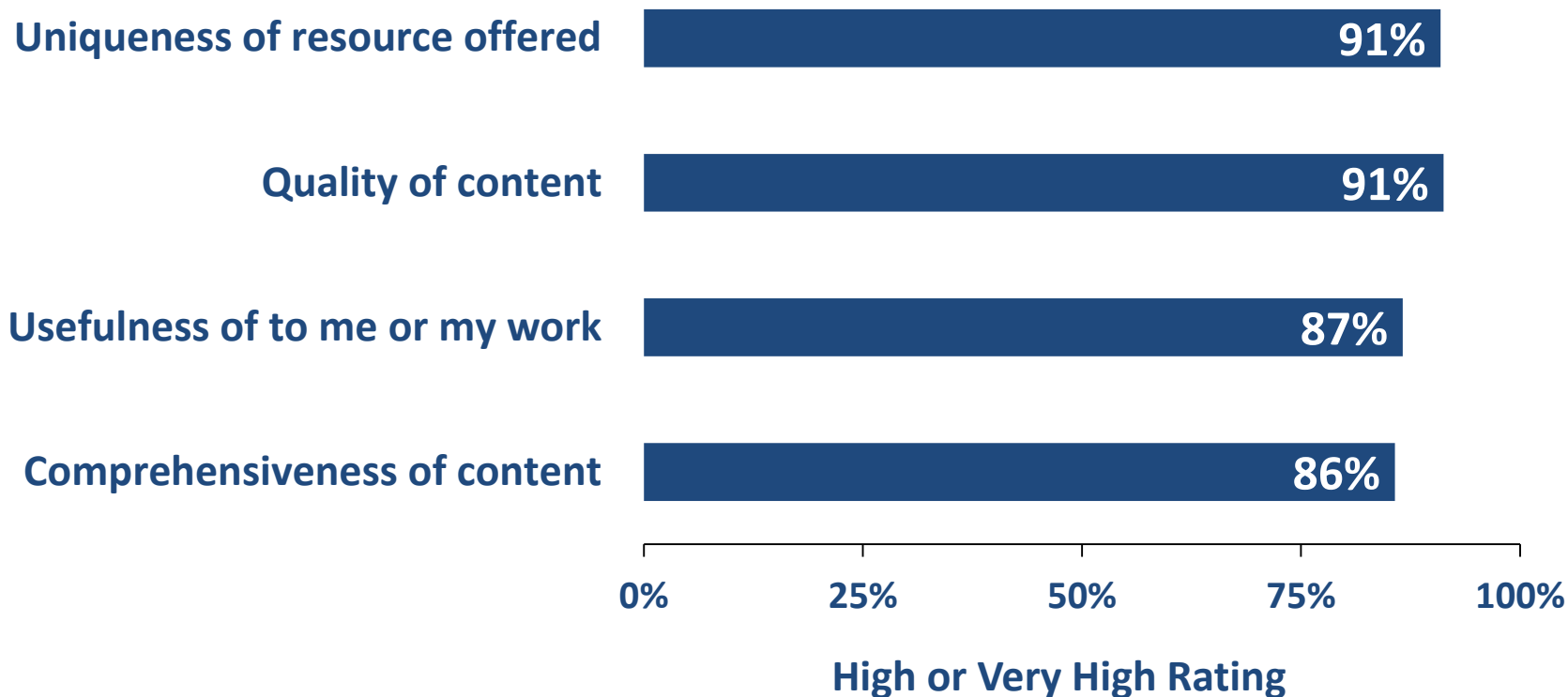


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