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## Stem for Success Evaluation and Assessment Resources for Researchers

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# Stem for Success Evaluation and Assessment Resources for Researchers

A collection of resources for academic research in federally sponsored programs

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**Abstract:** The article presents a collection of federal and nonfederal resources intending to assist the researcher in the understanding of evaluation of broader impacts and participation in STEM. It starts answering the question to Part I Where do I start? by defining evaluation, internal vs external evaluators, basic literature on evaluation, and continues by sharing a list of the professional associations. Part II expanding the search deepens the conversation into field-specific areas and journals. Part III moves the discussion into evaluation for principal investigators (PIs). Part IV Finding an external evaluator provides some answers about where to find evaluators. Part V discusses the new horizons for evaluation 2022. Finally, a one-page summary of the NSF REU evaluation resources is presented.

**Keywords:** Evaluation, Broader Impacts and participation, Research, Innovation, Resources

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# Introduction

Since the federal government introduced “evidence-based” in educational research in 1970<sup>1</sup>, a growing need to assess the impact and actual results of sponsored research studies and programs has resulted in the integration of “evaluation and assessment”<sup>2</sup> into the “broader impacts and participation”<sup>3</sup> section on grants.

This document aims to present a review of evaluation resources and present them in an accessible form to researchers to make efficient use of their time in preparing for grants.

## Part I: Where do I start?

### What is evaluation?

Evaluation is a set of approaches and techniques used to make judgments about the effectiveness or quality of a program or treatment; to improve its effectiveness; and to inform decisions about its design, development, and implementation<sup>4</sup>.

### How is evaluation different from research?

The primary purpose of an 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<sup>5</sup>

### What are your needs?

Every project has different levels of engagement and/or complex levels of interaction and report. Not all grants require a full evaluation and assessment report but all grants need some level of evaluation of the impact.

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<sup>1</sup> Johanningmeier, E. V., & Richardson, T. R. (2007). *Educational Research, the National Agenda, and Educational Reform: A History*.

<sup>2</sup> Mertens, D. M. (2021). *Research and Evaluation in Education and Psychology. Integrating Diversity With Quantitative, Qualitative, and Mixed Methods* (5.<sup>a</sup> ed.). SAGE Publications, Inc.

<sup>3</sup> Podkul, T., Silverstein, G., Goodyear, L., & Toldson, I. (2019). *Broadening Participation in STEM*. NSF INCLUDES Coordination Hub.

<sup>4</sup> National Research Council. (2009). *Surrounded by Science: Learning Science in Informal Environments*. The National Academies Press. <https://doi.org/10.17226/12614>

<sup>5</sup> CAISE. (2021). *What is Evaluation?* Informal Science. <https://www.informalscience.org/evaluation>

## Do I need an internal or an external evaluator?

The partnership, commitment, and collaboration that you will require between the research team and the evaluator will lead to a successful evaluation plan. The more time you can allocate to discuss your needs with the evaluator the better the instruments and design of the plan will be, the evaluator will influence the project, plan, and activities necessary to achieve the results derived from the implementation and assessment of the evaluation plan. The four fundamental questions<sup>6</sup> to answer are:

1. What type of evaluation do you need?
  - a. Front-end evaluation
  - b. Formative evaluation
  - c. Summative evaluation
2. Do you need an internal or external evaluator?
  - a. Internal evaluator, pros: “Familiar with the culture at NJIT” and cons: “may be invested in the outcome of the evaluation”
  - b. External evaluator, pros: “no vested interest in the project outcomes” and cons: “they are typically more expensive”
3. Do the requirements of the project lend themselves to an independent contractor or an evaluation firm?
  - a. Independent contractor, pros: “Lower cost” and cons: “not enough resources needed for complex studies”
  - b. External firm, pros: “robust resources for complex studies” and cons: “higher total cost of the project”
4. Will your project be better served by a local or out-of-area evaluator?

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<sup>6</sup> Bonney, R., Hellenga, R., Luke, J., Marcussen, M., Palmquist, S., Phillips, T., Russell, L., Trail, S., & Yalowitz, S. (2011). *Principal Investigator’s Guide: Managing Evaluation in Informal STEM Education Projects*. Center for Advancement of Informal Science Education.  
[https://www.informalscience.org/sites/default/files/caisevsapi\\_guide.pdf](https://www.informalscience.org/sites/default/files/caisevsapi_guide.pdf)

## Comparison of internal vs external evaluators (adapted from Conley-Tyler 2005<sup>7</sup>, Kellogg 2004<sup>8</sup>, and Patton 2008<sup>9</sup>)

	Internal Evaluator	External Evaluator
Expertise	Internal evaluators work in the environment in which the project operates and may have firsthand knowledge of the project, content, and organizational policies and practices.	External evaluators may possess special skills or exposure to a wide range of methods and practices that would be useful to incorporate.
Perceived bias	There may be a perception of bias if the internal evaluator is "too close" to the subject matter.	Perceived impartiality is a strong argument for the use of external evaluators.
Availability	Staff evaluators are readily available for project meetings or spontaneous data-collection activities.	Local evaluators can be readily available or can use telecommunications when needed.
Cost	Internal evaluators on salary can have an advantage over external evaluator fees. However, it can be expensive to maintain an idle staffer in between projects.	External evaluation fees can be high compared to salary but can be cost-effective when the evaluation is needed only part-time or for a limited duration.
Organizational investment	Over time, an internal evaluator can build an organization's capacity to support evaluation. However, this might not be a priority for an organization that will conduct evaluation on an infrequent basis.	External evaluators can acquaint staff with the value and methods of evaluation and can train staff in data-collection techniques. This can build a culture of evaluation within an institution.

<sup>7</sup> Conley-Tyler, M. (2005). A Fundamental Choice: Internal or External Evaluation? *Evaluation Journal of Australasia*, 4(1-2), 3-11. <https://doi.org/10.1177/1035719X05004001-202>

<sup>8</sup> Kellogg Foundation. (2004). *W.K. Kellogg Foundation Evaluation Handbook*. W.K. Kellogg Foundation.

<sup>9</sup> Patton, M. Q. (2008). *Utilization-Focused Evaluation* (4.<sup>a</sup> ed.). SAGE Publications, Inc. <https://us.sagepub.com/en-us/nam/utilization-focused-evaluation/book229324>

## Where can I find the guiding principles and national standards?

The starting point is the American Evaluation Association:

- [AEA Guiding Principles](#) (AEA, 2021c)/ (PDF 4 pages)
- [AEA Public Statement on Cultural Competence In Evaluation](#) (AEA, 2011) / PDF 10 pages

## What are the works that belong to a basic library?

The following is a collection of the best resources for quick reference:

- [CDC Framework for Program Evaluation](#) (Centers for Disease Control and Prevention, 2021) / 1 page
- [Perspectives on Broader Impacts](#) (NSF, 2015) / PDF 16 pages
- [User-Friendly Handbook for Mixed Methods Evaluations \(1997\)](#) (Frechtling & Westat, 1997) / PDF 4 pages
- [Western Michigan University Evaluation Checklists](#) (WMU, 2014b) / Website

## Where can I find the professional associations on Evaluation?

This is a short list of association websites:

- [American Educational Research Association \(AERA\)](#) (AERA, 2021) / Website
- [American Evaluation Association \(AEA\)](#) (AEA, 2021b) / Website
  - [AEA Cluster, Multi-site and Multi-level Evaluation TIG](#) (AEA Connect, 2021a) / Website
  - [AEA Data Visualization and Reporting TIG](#) (AEA Connect, 2021b) / Website
  - [AEA STEM Education and Training TIG](#) (AEA Connect, 2021c) / Website
  - [AEA365](#) (AEA, 2021a, p. 365)(AEA, 2021) / Blog
- [Southeast Evaluation Association \(SEA\)](#) (SEA, 2021) / Website
- [National Council on Measurement in Education](#) (NCME, 2021) / Website

## Additional resources of further readings to start

### Principles and standards

- [Joint Committee Standards for Educational Evaluation](#) (JCSEE, 2021) / website

### Evaluation Planning Books and Resources

- [Framework for Evaluating Impacts of Broadening Participation Projects](#) (Fitzgerald Bramwell et al., 2009) / 89 pages

- [The Step-by-Step Guide to Evaluation: How to Become Savvy Evaluation Consumers](#) (W.K. Kellogg Foundation, 2017) / 264 pages
- [The User-Friendly Handbook for Project Evaluation \(2010\)](#) (Westat et al., 2010) / PDF 159 pages

## Understanding Evaluation

- [A Program Director's Guide to Evaluating STEM Education Programs: Lessons Learned from Local, State and National Initiatives](#) (ITEST & EDC, 2013) / 44 pages
- [Creating Strong Broader Impacts for NSF Proposals: Role of Evaluation & Broader Participation](#) (James Lipuma, 2017) / Video 1:47 hours
- [Informal Science: What is Evaluation](#) (CAISE, 2021b) / Website 1 page
- [Writing an Evaluation Plan](#) (Office of Sponsored Projects, 2017) / Website 2 pages.

## Part II Expanding the search

### Where can I find the federal associations and hubs on Evaluation?

- [EvaluATE – NSF: ATE Evaluation Resource Hub](#) (EvaluATE, 2021) / Website
- [Evaluation Affinity Group – INCLUDES National Network](#) (NSF INCLUDES National Network, 2021) / website
- [NSF: STEM Learning and Research Center \(STELAR\)](#) (STELAR, 2021b) / Website
- [Oak Ridge Associated Universities](#) (ORAU, 2021) / Website.

### “Deepening the Search in Field-Specific Areas”: STEM Evaluation Tools & Instruments

- [Activation Lab Tools: Measures and Data Collection Instruments](#) (University of California, 2021) / Website
- [Assessing Women & Men in Engineering \(AWE\) STEM Assessment Tools](#) (Bogue & Marra, 2005) / PDF 8 pages
- [Assessment Tools in Informal Science \(ATIS\)](#) (ATIS, 2020)
- [Developing, Validating, and Implementing Situated Learning Instruments \(DEVISE\)](#) (Bonney et al., 2010)
- [Effective Communication Strategies for Interviews and Focus Groups](#) (WMU, 2014a) / PDF 7 pages
- [Field-tested Learning Assessment Guide \(FLAG\) Tools](#) (SERC, 2021) / Website
- [Instruments](#) Teacher Questionnaires (Horizon Research, Inc., 2021) / Surveys
- [Math Science Partnership Instrument Search](#) Database of Measures of Teachers' Mathematics/Science Content Knowledge (MSP, 2010) / Survey

- [Online Evaluation Resource Library \(OERL\) Instruments](#) (OERL, 2021b) / Instruments
  - OERL: Glossary of Report Components (OERL, 2021a) / Table
- [STEM Learning and Research Center \(STELAR\) Resources, Survey and Instruments](#) (STELAR, 2021a) / Instruments and Surveys
- [Undergraduate Research Experience Surveys](#) (Lopatto, 2004) / Survey
- [Undergraduate Research Experiences Support Science Career Decisions and Active Learning](#) (Lopatto, 2007) / Survey
- [Undergraduate Research Student Self-Assessment \(URSSA\)](#) (University of Colorado Boulder, 2018) / Survey

## What are the journals that belong in a basic library?

A list of journals exploring evaluation:

- [American Journal of Evaluation](#) (AJE, 2021) / Website
- [Evaluation and Program Planning](#) (EPP & ELSEVIER, 2021) / Website
- [Evaluation: The International Journal of Theory, Research and Practice](#) (SAGE, 2021) / Website
- [Journal of MultiDisciplinary Evaluation](#) (JMDE, 2021) / Website
- [New Directions for Evaluation](#) (Wiley Online, 2021) / Website
- [Practical Assessment, Research & Evaluation](#) (PARE & UMA, 2021) / Website
- [The Evaluation Exchange](#) (HFRP, 2021) / Website

## Part III Evaluation for Principal Investigators

### What are the referential works for faculty members?

The following resources will assist faculty in understanding evaluation for Principal Investigators

- [Center for Advancement of Informal Science Education \(CAISE\) PI Guide: Managing Evaluation in Informal STEM Education Projects](#) (Bonney et al., 2011) / 82 pages
- [Evaluation Flash Cards: Embedding Evaluative Thinking in Organizational Culture](#) (Quinn Patton, 2017) / 28 pages
- [Principal Investigator's Guide, Chapter 3: Choosing an Evaluator: Matching Project Needs with Evaluator Skills and Competencies](#) (Marcussen, 2017) / PDF 18 pages

## Part IV Finding an external evaluator

### Where can I find evaluators?



A list of external evaluators, organizations, and consulting groups that have provided external evaluation services to CSLA faculty at NJIT:

- [Informal Science](#) (CAISE, 2021a)
- [Partnerships in Education and Resilience \(PEAR\)](#) (PEAR, 2021)
- [SageFox Consulting Group](#) (Sagefox Group, 2021)

## Part V New horizons 2022

### What are the current horizons on evaluation?

The NSF “Annual Evaluation Plan FY2022”<sup>10</sup> was released on March 2021:

“The Evaluation and Assessment Capability (EAC) Section EAC bolsters NSF efforts to make informed decisions and promote a culture of evidence. Located in the Office of Integrative Activities of the Office of the Director, EAC provides centralized technical support, tools, and resources to conduct evidence-building activities and to build capacity for evidence generation and use across the Agency”

#### Questions?

Please contact Clemencia Cosentino, Chief Evaluation Officer at [eac@nsf.gov](mailto:eac@nsf.gov)

## Part VI A summary (one-pager): REU Evaluation resources from NSF

The following resources, which summarize research on the impact of undergraduate research experiences, could be helpful to investigators as they are designing those experiences and considering approaches to evaluating them:

- “The 2010 User-Friendly Handbook for Project Evaluation” (Westat et al., 2010). This Handbook was developed to provide project directors and principal investigators working with the National Science Foundation (NSF) with a basic guide for evaluating NSF’s educational projects.
- Brownell, Jayne E., and Lynn E. Swaner. “Five High-Impact Practices: Research on Learning, Outcomes, Completion, and Quality; Chapter 4: “Undergraduate Research.” Washington, DC: Association of American Colleges and Universities, 2010” (2010). Reviews published research on the effectiveness and outcomes of undergraduate research.

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<sup>10</sup> NSF. (2021). *Annual Evaluation Plan FY2022*. National Science Foundation. [https://www.nsf.gov/od/oia/eac/PDFs/NSF\\_Annual\\_Evaluation\\_Plan\\_FY22.pdf](https://www.nsf.gov/od/oia/eac/PDFs/NSF_Annual_Evaluation_Plan_FY22.pdf)

- Laursen, Sandra, et al. "Undergraduate Research in the Sciences: Engaging Students in Real Science. San Francisco: Jossey-Bass, 2010" (2010). Examines the benefits of undergraduate research, and provides advice for designing and evaluating the experiences.
- Linn, Marcia C., Erin Palmer, Anne Baranger, Elizabeth Gerard, and Elisa Stone. "Undergraduate Research Experiences: Impacts and Opportunities" (2015) *Science*, Vol. 347, Issue 6222 (6 February 2015); DOI: 10.1126/science.1261757. Comprehensively examines the literature on the impacts of undergraduate research experiences, and identifies the gaps in knowledge and the opportunities for more rigorous research and assessment.
- Lopatto, David. "Science in Solution: The Impact of Undergraduate Research on Student Learning. Tucson, AZ: Research Corporation for Science Advancement" (Lopatto et al., 2010). Findings from the author's pioneering surveys explore the benefits of undergraduate research.
- National Academies of Sciences, Engineering, and Medicine. "Undergraduate Research Experiences for STEM Students: Successes, Challenges, and Opportunities" (National Academies of Sciences, Engineering, and Medicine, 2017). Washington, DC: The National Academies Press, 2017; DOI: 10.17226/24622. An NSF-commissioned study that takes stock of what is known, and not known, about undergraduate research experiences and describes practices and research that faculty can apply to improve the experiences for students.
- Russell, Susan H., Mary P. Hancock, and James McCullough. "Benefits of Undergraduate Research Experiences" (Russell et al., 2007) *Science*, Vol. 316, Issue 5824 (27 April 2007); DOI: 10.1126/science.1140384. Summary of a large-scale, NSF-funded evaluation of undergraduate research opportunities, conducted by SRI International between 2002 and 2006. The study included REU Sites, REU Supplements, and undergraduate research opportunities sponsored by a range of other NSF programs.

Several additional resources offer practical help for designing particular components of REU projects:

- "Online Ethics Center for Engineering and Science" (OEC, 2021). Information, references, and case studies for exploring ethics in engineering and science and designing training on the responsible and ethical conduct of research.
- "Center for the Improvement of Mentored Experiences in Research" (CIMER, 2021). Publications and online resources focusing on effective mentoring of beginning researchers.
- "Evaluation Tools: Undergraduate Research Student Self-Assessment" (URSSA, 2018). The NSF-funded online survey instrument for use in evaluating student outcomes of undergraduate research experiences. Some REU Sites use this tool or a variant of it (see, for example, <https://bioreu.org/resources/assessment-and-evaluation/>) to assess student learning gains. Other REU Sites use other tools or follow a different approach; NSF does not prescribe any one approach to evaluation and assessment for REU Sites.

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