Reflected and Strategizing about Measuring EPO Impact

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Abstract. This paper is a result of a Special Interest Group workshop held at the Astronomical Society of the Pacific Annual Meeting on July 23, 2013. Members of the NASA Science Mission Directorate Education and Public Outreach (EPO) community and other EPO professionals reflected on program impacts across the spectrum of EPO. Questions considered during the workshop included the following: What have we learned from our work? How have we measured program impacts? How can we collaborate to determine next best steps for collectively measuring impact? How can our individual programs and projects contribute towards a better understanding of the impact we are able to have as a community across a range of federal and non-federal funding sources? This paper is a summary of the discussion.

1. Session Description

Members of the NASA Science Mission Directorate (SMD) Education and Public Outreach (EPO) community recently compiled a comprehensive set of information for all SMD EPO-funded programs and projects. These profiles are publicly available.1 This site showcases a snapshot of the vast, deep, and diverse impacts of these programs—more than 85 in all. Examples of program impact were presented by the SMD Science Education and Public Outreach Forums in a plenary session held on July 23, 2013, at the Astronomical Society of the Pacific Annual Meeting: Ensuring STEM Literacy (Smith et al., this volume). During a follow-on Special Interest Group workshop, EPO

1http://smdepo.org/page/5324
community members along with other EPO professionals discussed common strategies, tools, successes and challenges in measuring impacts. The results of those workshop discussions are outlined below.

2. Workshop Session

2.1. Initial activity

The National Science Foundation identifies five major categories of program impact measurement for informal science education:

1. Awareness, knowledge, or understanding: Measurable demonstration of assessment of, change in, or exercise of awareness, knowledge, understanding of a particular scientific topic, concept, phenomena, theory, or careers central to the project.

2. Engagement or interest: Measurable demonstration of assessment of, change in, or exercise of engagement and/or interest in a particular scientific topic, concept, phenomena, theory, or careers central to the project.

3. Attitude: Measurable demonstration of assessment of, change in, or exercise of attitude toward a particular scientific topic, concept, phenomenon, theory, or career central to the project or one’s capabilities relative to these areas. Although similar to awareness/interest/engagement, attitudes refer to changes in relatively stable, more intractable constructs such as empathy for animals and their habitats, appreciation for the role of scientists in society, or attitudes toward stem cell research.

4. Behavior: Measurable demonstration of assessment of, change in, or exercise of behavior related to a STEM topic. These types of impacts are particularly relevant to projects that are environmental in nature or have some kind of a health science focus since action is a desired outcome.

5. Skills: Measurable demonstration of the development and/or reinforcement of skills, either entirely new ones or the reinforcement, even practice, of developing skills. These tend to be procedural aspects of knowing, as opposed to the more declarative aspects of knowledge impacts. Although they can sometimes manifest as engagement, typically observed skills include a level of depth and skill such as engaging in scientific inquiry skills (observing, classifying, exploring, questioning, predicting, or experimenting), as well as developing/practicing very specific skills related to the use of scientific instruments and devices (e.g., using microscopes or telescopes successfully).

For the first workshop activity, we applied the NSF evaluation framework to the full spectrum of SMD-funded education and public outreach programming. Participants identified all of the audiences that their EPO programs are targeted to reach as well as the NSF impact categories to which each EPO program aligned. The table below outlines the results of this activity.

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2http://informalscience.org/images/research/Eval_Framework.pdf
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Table 1. Distribution of Participants’ Programs by Audience and Impact Category (these results are illustrative of the SMD EPO programs represented by the participants in attendance at this particular workshop).

<table>
<thead>
<tr>
<th></th>
<th>PreK</th>
<th>Elementary School</th>
<th>Middle School</th>
<th>High School</th>
<th>Higher Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness, Knowledge, Understanding</td>
<td>6</td>
<td>16</td>
<td>16</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>Engagement, Interest</td>
<td>3</td>
<td>13</td>
<td>15</td>
<td>15</td>
<td>7</td>
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<tr>
<td>Attitude</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Behavior</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Skills</td>
<td>2</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Afterschool Education</th>
<th>Informal Education</th>
<th>General Public</th>
<th>Families</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness, Knowledge, Understanding</td>
<td>5</td>
<td>16</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>Engagement, Interest</td>
<td>3</td>
<td>9</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Attitude</td>
<td>1</td>
<td>6</td>
<td>5</td>
<td>4</td>
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<td>Behavior</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Skills</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

The results of this initial activity allowed workshop facilitators to identify the four audience groupings into which participants would self-select for breakout discussions. Based on the total number of EPO programs represented in all impact categories, the audience groupings selected for discussion were elementary school, middle school, high school, and the general public.

2.2. Breakout Group Discussion

For the next phase of the workshop, participants discussed a number of questions relating to evaluation and impacts of their EPO programs:

- What have you measured through your evaluations?
- What tools have you used?
- What impacts have you demonstrated (i.e., results)?
- What strengths and/or challenges have you had while measuring impact?

Each group met for approximately 30 minutes, led by a facilitator. Following the small-group discussions, everyone met as a large group to present summaries.

2.3. Elementary School Discussion Results

EPO program staff who participated in the elementary school audience discussion are using a number of tools for measuring impact with their audiences:
• Misconceptions-Oriented Standards-Based Assessment Resources for Teachers (MOSART)\(^3\) test inventories,

• Review of teacher and student artifacts (e.g., lesson plans, student work examples, etc.), and

• Other custom evaluation instruments such as surveys, pre/post-tests, interviews, focus groups, open-ended questions, concept maps, and self-evaluation questions.

There are a number of challenges that EPO staff identified with regards to evaluating impact with elementary school educator and student audiences:

• understanding where student and educators audiences are in terms of preconceptions, prior knowledge, and misconceptions;

• facilitating an educator workshop when participants represent a spread of grade levels;

• the high cost of performing longitudinal studies; and

• obtaining IRB approval when gathering information from younger audiences.

2.4. Middle School Discussion Results

EPO program staff who participated in the middle school audience discussion are measuring several impacts, such as impacts on student/educator knowledge, out-of-school-time impacts, impacts on cultural knowledge (i.e., different cultures’ world views of science), and participant interest levels. These measurements run the full spectrum of qualitative to quantitative studies using tools such as the pre/post assessments from the GEMS Space Science Sequence for grade 6–8 curriculum, quasi-experimental designs, reflections, group discussions, and oral histories.

Several challenges for these impact measurements were identified, including obtaining evaluation data from participants at a time frame that is further from the original intervention, such as weeks or months later, and obtaining evaluation data from participants who are physically located a far distance from the original professional development site.

2.5. High School Discussion Results

Workshop participants’ EPO programs involving high school educator and student participants largely utilize pre/post-tests and participant reflections on content gains.

The challenge identified by this group is similar to the previous groups, namely, trying to measure longer-term sustained impact, especially on a smaller program budget and months or years removed from the original date of the intervention.

\(^3\)http://www.cfa.harvard.edu/smgphp/mosart/index.html
2.6. General Public Discussion Results

When reflecting on general public audiences, there were a number of challenges identified. These include the difficulty in quantifying “general public,” as there are many “publics” that the participating EPO staff are trying to reach, and trying to meet the needs of such wide-ranging types of people who participate in programs. Other challenges include obtaining useful information from website statistics and quantifying evidence that is largely anecdotal. Methods of obtaining data include counting attendance, utilizing questionnaires given to program participants, and asking program participants about their interest levels.

3. Future Community Directions

There were several suggestions that were offered to help community members overcome challenges to measuring and communicating impact, such as the following:

- Use participatory evaluation techniques, especially with underrepresented populations.
- Present summaries of gathered data back to the audiences who provided the initial information. They can also share the results with their colleagues to help spread the word about the impact of a program.

EPO workshop participants did not identify specific solutions to other discussed challenges, but some suggestions were offered that may be investigated at a future date:

- There are drawbacks to articulating impacts across an entire portfolio of EPO programs; EPO program staff need to preserve the integrity of each individual project while the impacts across the spectrum of EPO programs is also very important to articulate. A compromise between the two is needed.
- Use specific validated tools across all programs involving similar types of audiences.
- Tracking the same participants across several EPO programs across a longer time period is difficult. One suggestion is to use digital badging on a universal platform from which data can be extracted as participants are tracked from program to program. The HIVE Learning Network in New York, Chicago, and Pittsburgh is a resource from which ideas may be gleaned.\(^4\)
- Sharing of evaluation tools and results via an online tool, listserv, workspace etc. Some participants took this suggestion a step further to suggest that the community could develop common tools or questions so that results could be compared.

Acknowledgments. The workshop facilitators gratefully acknowledge all of the NASA SMD EPO community members who participated in this Special Interest Group workshop. The Science Education and Public Outreach Forums are supported by NASA under Cooperative Agreement issued through the NASA Science Mission Directorate.

\(^4\)http://hivelearningnetwork.org/
References


Hive Learning Network 2013, retrieved from http://hivelearningnetwork.org
