Measuring Effects Across NASA Space Science Education Consortium Activities Using NSF Impact Categories

Hilarie Davis[1], Daniella Scalice[2], C Alex Young[3], Louis Mayo[3], and Bradford Davey[1]

[1]Technology for Learning Consortium, Inc.
[2]NASA Astrobiology Program
[3]NASA Goddard Space Flight Center

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Abstract

Measuring the effects of education and communication space science activities is a challenge due to different audiences, formats, dosage, and objectives. What claims can be made about the effect of a collection of different activities? What methods and measures can evaluators provide to activity managers to collect data that can be aggregated across activities? A summative evaluation approach was devised based on the National Science Foundation Framework impact categories of behavior, attitudes, skills, interest/engagement, and knowledge (BASIK), "Identification of these categories was based on analysis of project impacts from a comprehensive review carried out on a representative sample of Informal Science Education proposals, final reports, and summative evaluations" ((Friedman, 2008, p. 11). Measurable objectives were developed for each of the 53 activities offered by the 21 institutions with specific identification of the intended impact categories. Methods and measures were then complied to evaluate the effect of those activities on their audiences' behaviors, attitudes, skills, interest and/or knowledge. For the knowledge impact, the space science concepts were identified for each activity from the Science Literacy Strandmaps (http://nasawavelength.org/strandmaps). This provided a portfolio overview by concept and level, as well as concept. Methods and measures were identified by impact category to provide data across activity on effects. Results from evaluations of projects are reported in an online portfolio by institutions and summarized across projects for annual reporting.
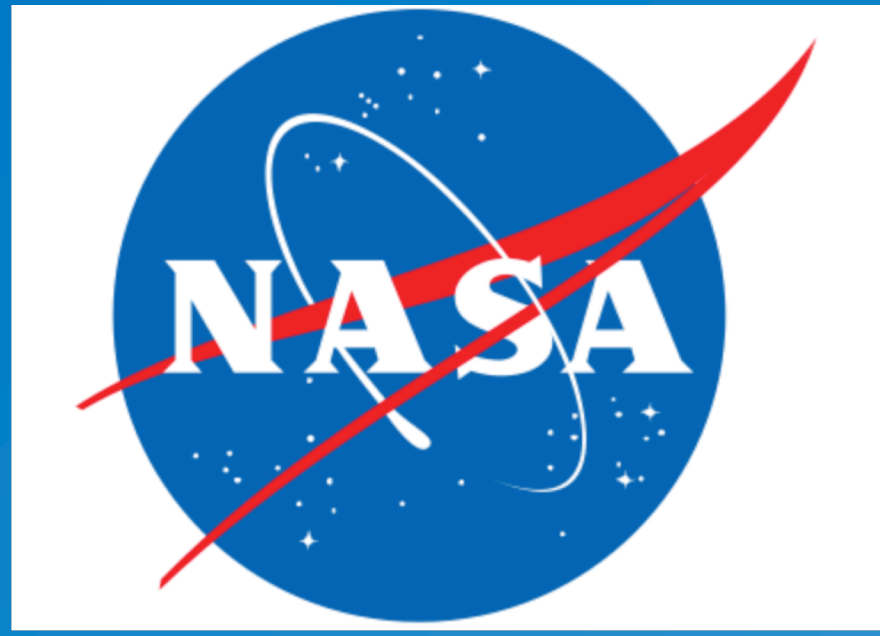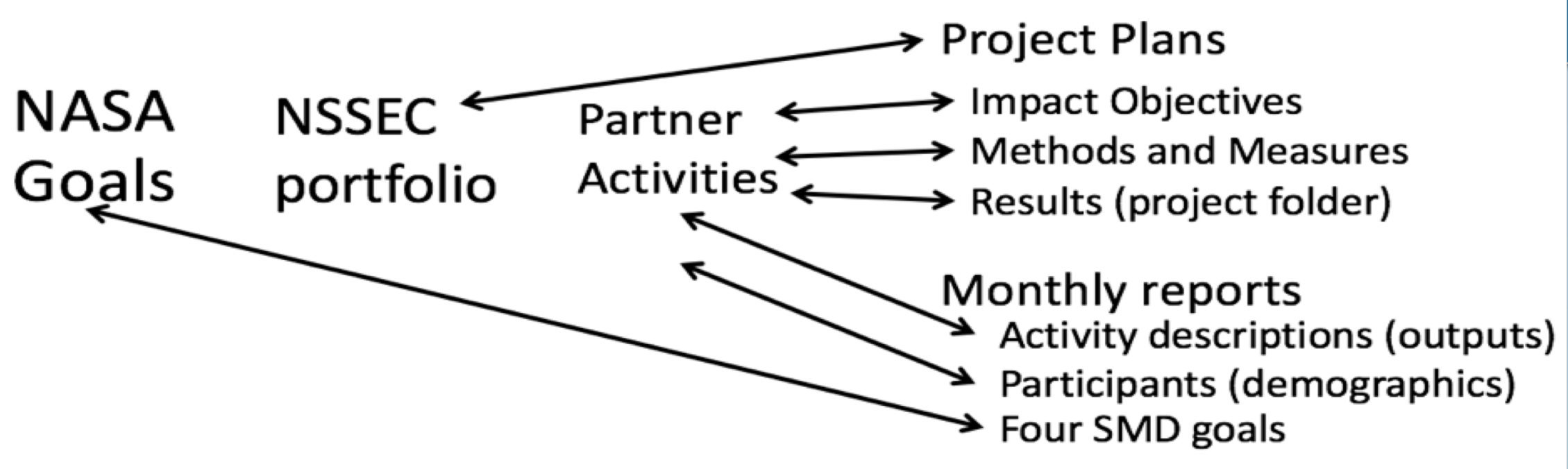
ED31D-1082 Measuring Effects Across NASA Space Science Education Consortium Activities Using NSF Impact Categories

Dr. Hilarie Davis TLC, Inc., Daniella Scalice, Dr, C. Alex Young, Louis Mayo, Dr. Bradford Davey, TLC, Inc.

21 NSSEC Members

- To track and report on the activities of the 21 members of the NSSEC, each project developed a project plan with impact objectives, methods and measures. Detailed results are also posted in the project folder. When activities are completed, a form is completed to report on demographics and outputs and relate them to the overall SMD goals.

NASA Goals → NSSEC portfolio → Partner Activities → Project Plans
- Impact Objectives
- Methods and Measures
- Results (project folder)

Monthly reports
- Activity descriptions (outputs)
- Participants (demographics)
- Four SMD goals

Monthly reporting form
Email address _____ Person reporting _____
Institutional or Organizational Affiliation (pulldown)
Project or Activity (pulldown)
Activity Description _____
Zip code for activity location _____

Participants
1) Youth (Elementary School age students, Middle, High, undergrads, grad students)
2) Educators - formal or informal (elementary, middle, high, inservice, preservice, higher ed, colleagues)
3) Public audiences
4) Disadvantaged or under-represented across all types of audiences noted above (socioeconomically, physically, minority female, Hispanic, African American, AI/AN/Pacific Islander, other)

Results
1) Impact Objectives of this activity: Behavior, Attitude, Skills, Interest, Knowledge
2) NASA themes related to this activity? Earth Rise, Touch the Sun, Eclipses, Apollo 50th (check all that apply)
3) NASA SMD goals supported by this activity? (check all that apply) 1) Enable STEM Ed, 2) Improve Science Literacy, 3) Advance National Ed

Other information you would like to share about
Personnel Changes
External Interactions
Presentations and Publications
Proposals

Astronomical League · Aurorasaurus · UC Berkeley Space Sciences Lab · Citizen Science · ISTE · Montana Space Grant Consortium · MSFC

Monthly reports go into a google smartsheet so the community can review each other's reports and the management team can search and sort.
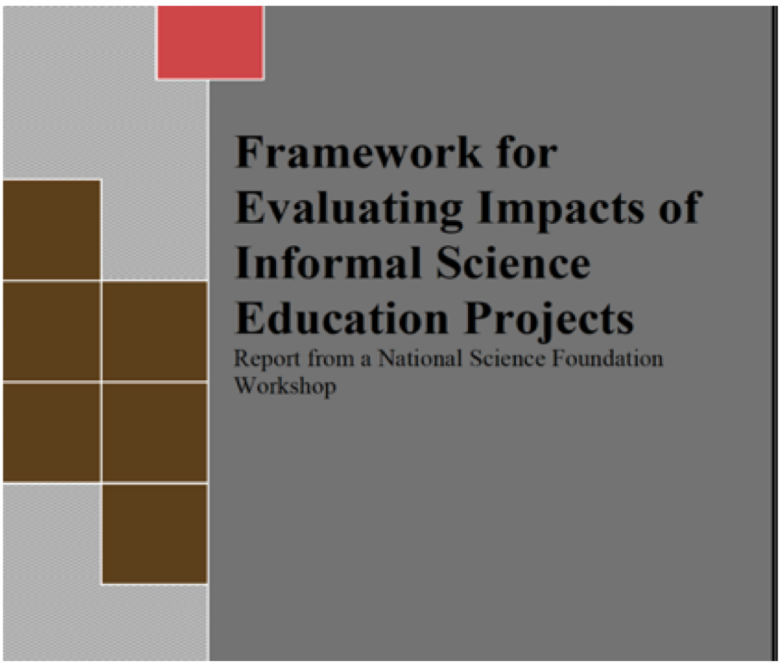
Methods and Measures

- What methods and measures can evaluators use to provide activity managers with evidence of effects that can be aggregated across activities? How rigorous can the different methods and measures be?
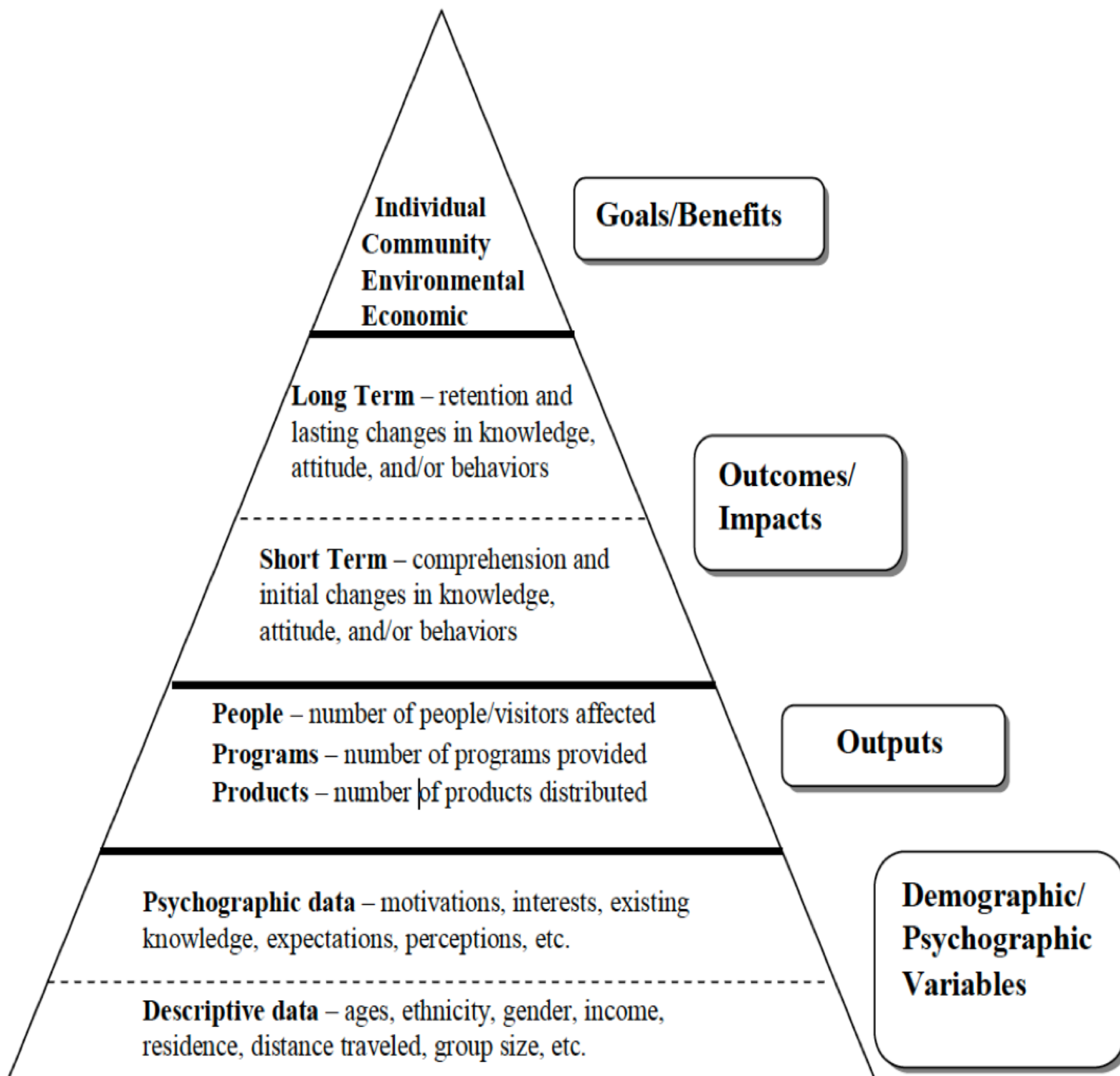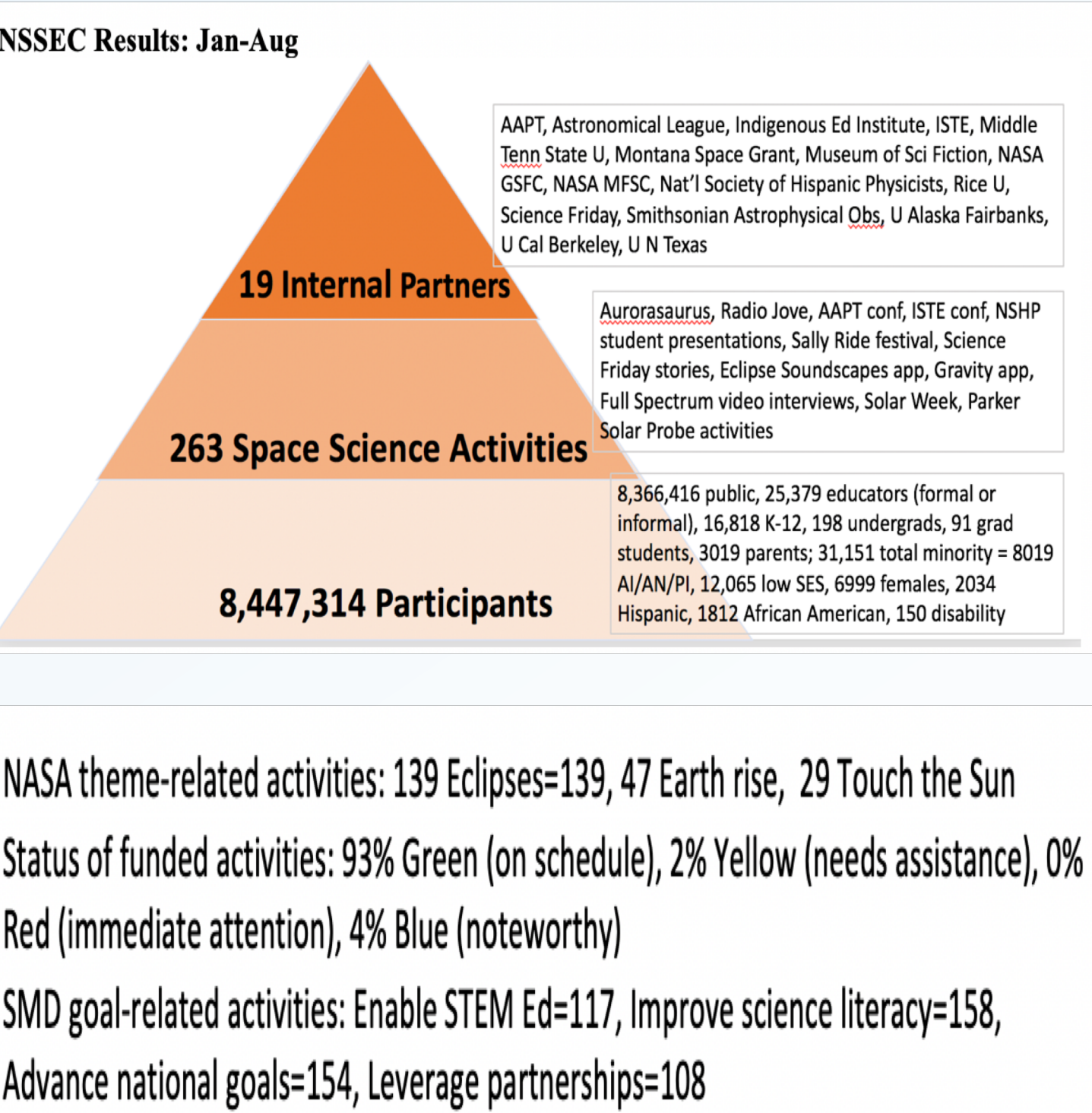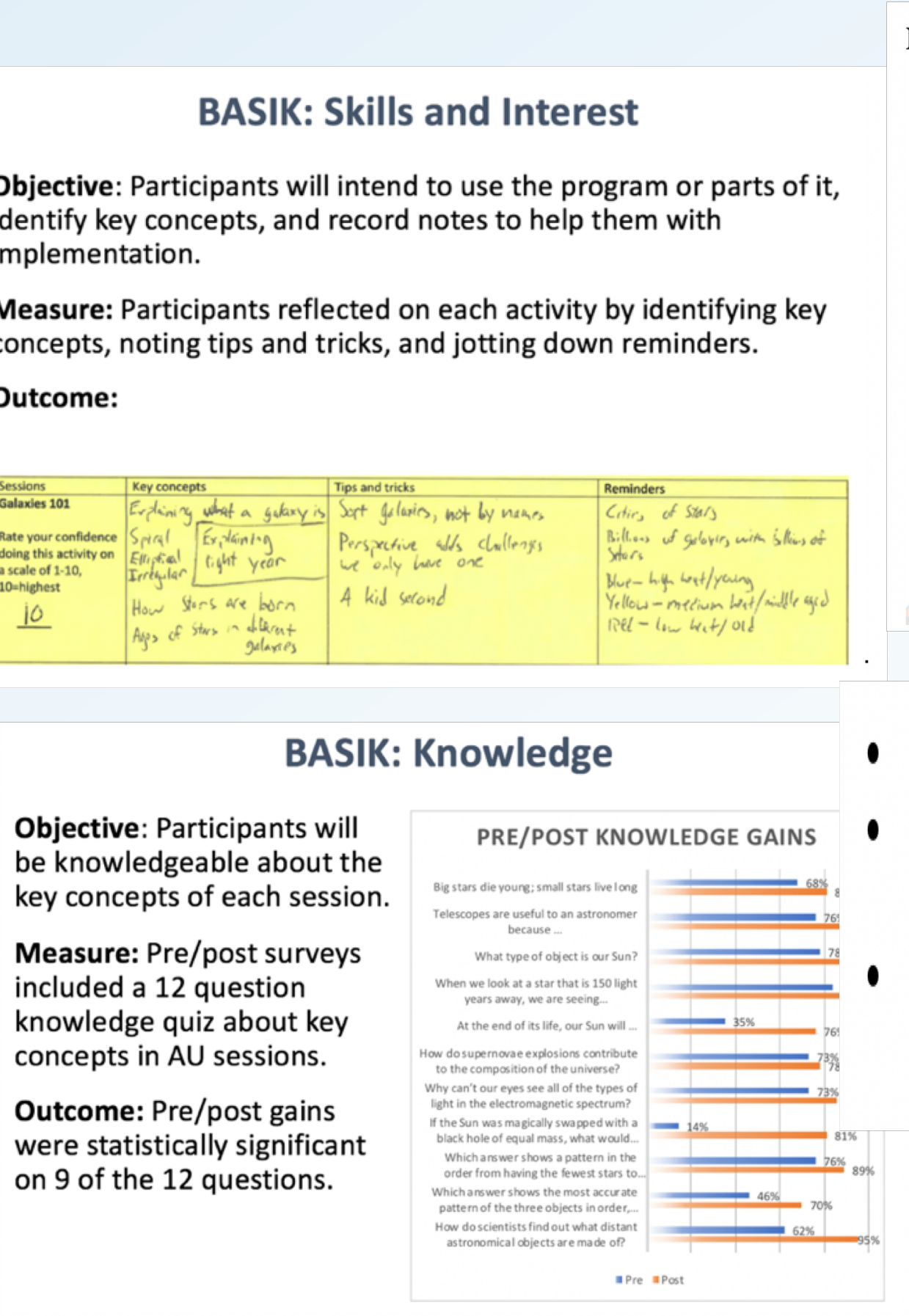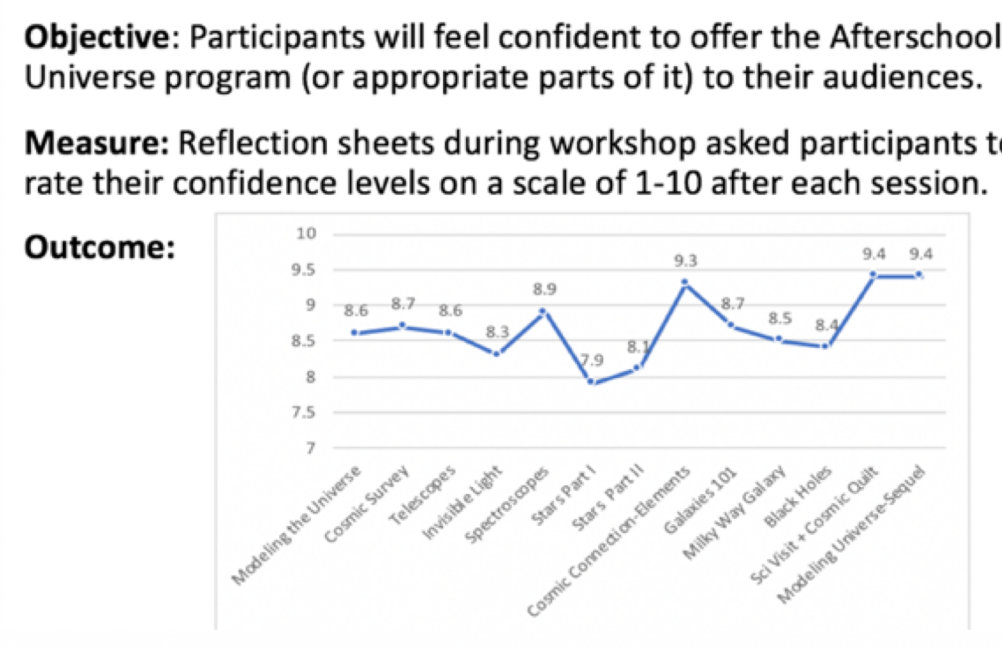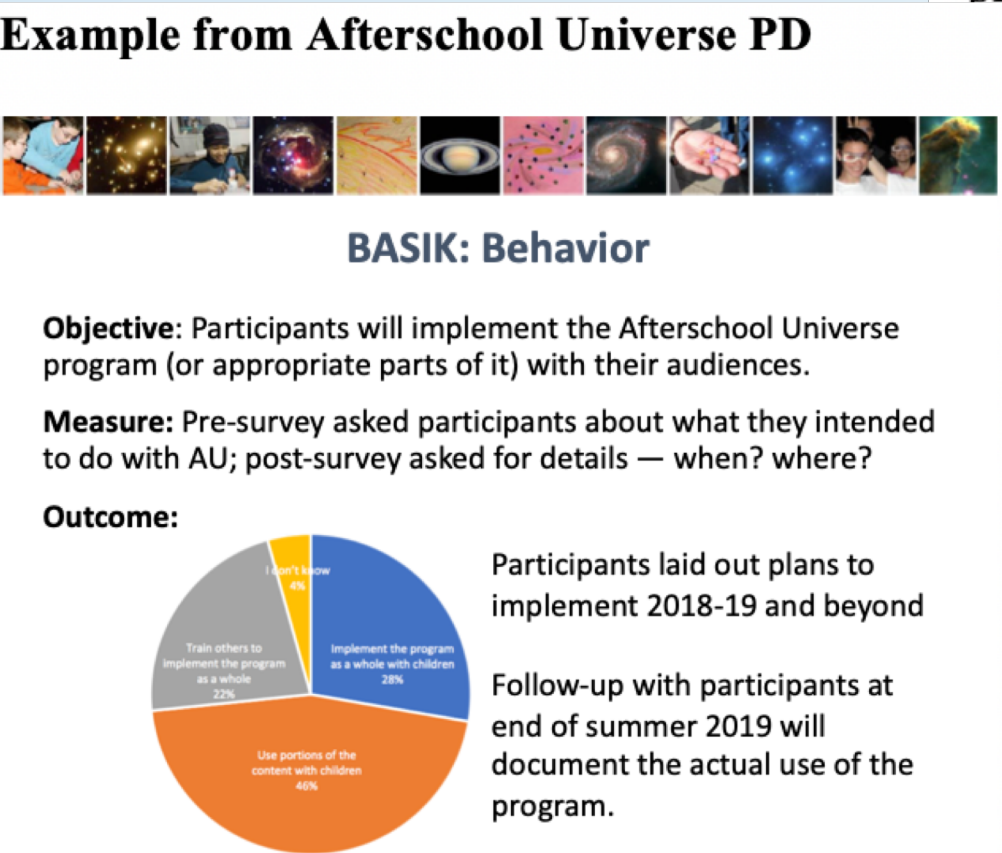
Less rigorous ——→ More rigorous

| Post only survey or reflection; Follow up survey or interview; Web stats; Anecdotes; Facilitator reports | External evaluator observes, or does case studies; Pre/post self-report survey, reflections; Post only measures (test, retrospective survey, task) | Pre/post measures (performance tasks, tests, observation); Pre/post follow-up | Comparison group studies (quasi-experimental); Experimental studies (random assignment) |

The summative evaluation included the National Science Foundation Framework (Friedman, 2008) impact categories of behavior, attitudes, skills, interest/engagement, and knowledge (BASIK).

Framework for Evaluating Impacts of Informal Science Education Projects *Report from a National Science Foundation Workshop*

B Behavior
A Attitude, aspirations, confidence
S Skills
I Interest, engagement
K Knowledge

Online Portfolio Results

Afterschool Universe
BRINGING ASTRONOMY DOWN TO EARTH

Goals/Benefits — Individual, Community, Environmental, Economic
Long Term – retention and lasting changes in knowledge, attitude, and/or behaviors
Outcomes/Impacts
Short Term – comprehension and initial changes in knowledge, attitude, and/or behaviors
People – number of people/visitors affected
Programs – number of programs provided
Products – number of products distributed
Outputs
Psychographic data – motivations, interests, existing knowledge, expectations, perceptions, etc.
Descriptive data – ages, ethnicity, gender, income, residence, distance traveled, group size, etc.
Demographic/ Psychographic Variables

Hierarchy of Anticipated Outcomes (Adapted from Wells, M & Butler, B. 2004 in Friedman, 2008)

Results

- Results from evaluations of projects are reported in an online portfolio by institution and summarized across projects for annual reporting. For example, Afterschool Universe workshops developed methods and measures for each impact objective. Total NSSEC output data is shown in the pyramid.

Table of Specifications with Methods and Measures for Afterschool Universe

Impact Objective	Methods/Measures
Behavior: Use the activities with their audiences	**1yr follow up survey** on actual use
Attitude: Feel confident; Affect audiences' attitudes	**During PD by educator reflection sheet** *Rate your confidence level for doing this activity, 1-10=highest* **1yr follow up with educator** *On a scale of 1-10, how much did AU affect your participants' attitude. What evidence do you have?*
Skills: Plan during; Audiences will develop skills	**During PD Reflection sheet** *By session with "Tips and Tricks" and "Reminders"* **1yr Follow up survey** *On a scale of 1-10, how much did AU affect your participants" skills? What evidence do you have?*
Interest: Plan during PD; AU will interest audiences in space science	**Post PD Survey** *What do you plan to do with this training once you have completed it? When do you plan to do the sessions? With whom? Where?* **1yr follow up survey** *On a scale of 1-10, how did AU affect your participants; interest? What evidence do you have?*
Knowledge AU PD participants will increase their knowledge of key concepts in the program	**Pre/post PD knowledge questions** *Gains in content knowledge for each lesson* **1yr follow up survey** *On a scale of 1-10, how did AU affect your participants knowledge? What evidence do you have?*

Example from Afterschool Universe PD

BASIK: Behavior
Objective: Participants will implement the Afterschool Universe program (or appropriate parts of it) with their audiences.
Measure: Pre-survey asked participants about what they intended to do with AU; post-survey asked for details — when? where?
Outcome: Participants laid out plans to implement 2018-19 and beyond. Follow-up with participants at end of summer 2019 will document the actual use of the program.

BASIK: Attitude toward self and program
Objective: Participants will feel confident in the Afterschool Universe program (or appropriate parts of it) to their audiences.
Measure: Reflection sheets during workshop asked participants to rate their confidence levels on a scale of 1-10 after each session.
Outcome:

BASIK: Skills and Interest
Objective: Participants will intend to use the program or parts of it, identify key concepts, and record notes to help them with implementation.
Measure: Participants reflected on each activity by identifying key concepts, noting tips and tricks, and jotting down reminders.
Outcome:

BASIK: Knowledge
Objective: Participants will be knowledgeable about the key concepts of each session.
Measure: Pre/post surveys included a 12 question knowledge quiz about key concepts in all AU sessions.
Outcome: Pre/post gains were statistically significant on 9 of the 12 questions.

PRE/POST KNOWLEDGE GAINS

NSSEC Results: Jan-Aug
19 Internal Partners
263 Space Science Activities
8,447,314 Participants

AAPT, Astronomical League, Indigenous Ed Institute, ISTE, Middle Tenn State U, Montana Space Grant, Museum of Sci Fiction, NASA GSFC, NASA MFSC, Nat'l Society of Hispanic Physicists, Rice U, Science Friday, Smithsonian Astrophysical Obs, U Alaska Fairbanks, U Cal Berkeley, U N Texas

Aurorasaurus, Radio Jove, AAPT conf, ISTE conf, NSHP student presentations, Sally Ride festival, Science Friday stories, Eclipse Soundscapes app, Gravity app, Full Spectrum video interviews, Solar Week, Parker Solar Probe activities

8,366,416 public, 25,379 educators (formal or informal), 16,818 K-12, 198 undergrads, 91 grad students, 3019 parents; 31,151 total minority = 8019 AI/AN/PI; 12,065 low SES, 6999 females, 2034 Hispanic, 1812 African American, 150 disability

- NASA theme-related activities: 139 Eclipses=139, 47 Earth rise, 29 Touch the Sun
- Status of funded activities: 93% Green (on schedule), 2% Yellow (needs assistance), 0% Red (immediate attention), 4% Blue (noteworthy)
- SMD goal-related activities: Enable STEM Ed=117, Improve science literacy=158, Advance national goals=154, Leverage partnerships=108

2019 Plans have identified BASIK impact categories for their objectives and will report outcomes by category in their monthly reports and post the supporting documents with data in their Project Folders in the community workspace.