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Rural Gateways: Fostering the Development of Rural Librarians as Informal Science Facilitators – Summative Evaluation

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EXECUTIVE SUMMARY

Rural Gateways: Fostering the Development of Rural Librarians as Informal Science Facilitators is an NSF-funded program designed to enhance rural and underserved librarians' self-efficacy and professional self-identification as informal science facilitators (ISFs). Librarians received a $3,500 mini-grant, program materials, professional development (PD), and scaffolded practice providing adult science programs.

Goodman Research Group, Inc. (GRG) conducted the summative evaluation of Gateways and consulted on the research component of the project. Librarians were randomly assigned to 1 of 2 PD groups: Foundations PD (N=34-51) and Foundations + Advanced PD (N=25-53). A retrospective comparison group was recruited at the end of the project (N=24), and science partners were surveyed as well (N=80).

Key Findings

- Librarians made significant gains in their self-identification as adult science program developers, science self-efficacy, and preparation to lead their library's ISL efforts.
- Librarians in the Foundations + Advanced PD group made significantly greater gains than those made by Foundations PD group.
- In contrast to the comparison group, Gateways librarians made significantly greater gains in science self-efficacy and preparation for ISL leadership, as well as marginally greater gains in self-identification as a science program developer.
- Librarian gains tended to persist; a year after the end of the PD, librarians had retained their increased science self-efficacy, but dropped in their self-identification as a science program developer.
- The majority of the librarians who completed the Advanced PD continued to provide adult science programming after the Gateways program had ended for them, most self developed.
- Gateways programming was successful in engaging audiences, piquing interest in science, demonstrating the relevance of science to everyday life, and enhancing understanding of some science topics.
- Science partners gained science communication capacity, enjoyed their participation, and are quite likely to continue to be involved with informal public science, whether at the library or elsewhere.

Key Recommendations

- GRG recommends expanding the availability of the Gateways programming to additional libraries. Plans are underway to migrate materials to Infopeople, Califa's education and training branch; GRG recommends a publicity push once Gateways is live given the increasing focus on STEM programming among libraries.
- Once the Gateways training is live, it will be used independently; therefore, GRG recommends increasing its usability; for example, by offering specific examples of the variety of ways to connect STEM content to the broader program themes.

- GRG recommends providing additional supplementary materials, including longer lists of suggested readings and videos so librarians may better tailor selections to their audiences.
- Some of the more useful background materials for science partners were severely underutilized, so GRG recommends strongly emphasizing to librarians the importance of (1) the guide to program themes, and (2) the archived science partner webinar. GRG also recommends the team consider shortening the webinar recording to its key elements.
- Given how much the Gateways librarians valued the chance to interact with other librarians implementing similar programming, GRG recommends that the team consider whether there may be existing online venues that could be used for this purpose.

INTRODUCTION

Rural Gateways: Fostering the Development of Rural Librarians as Informal Science Facilitators (Gateways), funded by the National Science Foundation, is a program designed to enhance rural and underserved librarians' self-efficacy and professional self-identification as informal science facilitators (ISFs). By providing professional development (PD) and scaffolded experiences of providing adult science programming in their communities, the team hopes to build the librarians' capacity to sustain this programming beyond the life of the project in communities that have historically had less access to STEM programs.

The Gateways program was created by an interdisciplinary team of librarians, scientists, and filmmakers from Dartmouth College, the Institute for Learning Innovation, Dominican University, Dawson Media Group, and the Califa Library Group, with evaluation by Goodman Research Group, Inc., and recruiting assistance from the Association for Rural and Small Libraries and the Public Library Association.

The project builds on the findings of an earlier NSF-funded project carried out and evaluated by the same team, ***Pushing the Limits: Making Sense of Science (PTL)***. PTL provided PD, funding, and specially produced video segments for librarians at rural and small libraries and their local science partners to co-facilitate 4 science café-style guided public discussions for adult library patrons.

Gateways aimed to replicate the positive results of the PTL program while also providing added PD and scaffolded, increasingly independent practice in developing and co-facilitating adult science programming. The supplementary PD and practice was designed to enhance librarians' self-efficacy as ISFs and move them further along the continuum from Convener to Facilitator to Developer of adult science programming, increasing the likelihood that such programming would be sustained after the formal end of the Gateways project.

The Rural Gateways Program

Participating librarians in the 2 treatment groups received PD, materials, and a $3,500 mini-grant; they also received a Certificate of Completion from the Califa Library Group for completing the PD. Materials available on the Gateways website included:

- **Professional Development:** The PD consisted of interactive learning activities designed to build competencies to plan, develop, and implement adult science programming in libraries, including interactive webinars, PD videos, independent learning activities, and a virtual community of practice.

- **Public Program Resources**: Each science program is organized around a different theme (e.g., nature, transformation, heritage) with a feature-film quality video, suggested accompanying books, and discussion question ideas for the librarian and science partner to use to co-facilitate engaging science café-style discussions with adult patrons, structured around the notion that we all use science in our daily lives.

- **Science Partner Resources**: Background information for the science partners included project overview readings, recommended discussion questions, videos of sample program events in action, and a webinar recording of science partners from the initial PTL project.

- **Online Community of Practice**: A series of threaded discussions where librarians could share experiences, questions, successes, and challenges with each other as they completed the PD and held their programs.

In addition to the 4 original PTL themes and videos, the Gateways team created 4 additional videos, as described below.

Exhibit 1. Gateways Programming Themes and Videos

Original Themes and Videos from *Pushing the Limits* Project	
	Cameron Clapp is an athlete who is also a triple amputee; his goal is to compete in a triathlon, a challenging feat with 2 prosthetic legs.
	Roxanne Swentzell is a renowned sculptor whose art connects her heritage from a long line of Native pot makers to her contemporary views of family and culture.
	Julie and Cory Shrum work a family farm, but also compete in demolition derbies with modified combines, using their engineering and materials science skills.
	Chef Sean Brock is preserving and revitalizing knowledge from the golden age of Southern Cuisine, saving heirloom crop seeds and raising heritage breed pigs.
New Themes and Videos for *Rural Gateways* Project	
	Bob Boyer is a high school football coach with a unique style; he believes he can build team success by creating traditions to connect his players and build character.
	Heather Doyle created a blacksmithing program at a technical college, and, when that closed, created a space where kids and adults can learn to work with their hands.
	Darrel Petry's family has a deep rodeo heritage; he is the first Black man to hold the prestigious position of SW Director of the Professional Rodeo Cowboys Association.
	Joe and Kristen Souza are working to reset the natural growth cycle of native forest land in Hawaii, regrowing some of the resources they use in their ukulele business.
Self-Designed Programming	In the final phase, librarians in the Advanced PD group created 2 self-designed programs.

The PD units are shown below. The Foundations PD was created for the PTL program and was clearly successful in moving librarians along a continuum from Convener to Facilitator of adult science programming. The Advanced PD was designed to push the librarians considerably further along the continuum, from Facilitator to Developer of adult science programming.

Exhibit 2. Professional Development Units Used in the Rural Gateways Project

Original Foundations PD from *Pushing the Limits* Project
Unit 1: **Adult STEM Programs in Your Library**
Unit 2: **What Is Informal Science Learning (ISL)?**
Unit 3: **Libraries as Resources for ISL**
Unit 4: **Selecting and Working with Your Science Partner**
Unit 5: **Planning and Marketing Your ISL Programs**
Unit 6: **Fostering Engaging ISL Discussions**
New Advanced PD for *Rural Gateways* Project
Introduction: **Advanced Leadership in Informal STEM Learning**
Unit 7: **Focusing on STEM Concepts**
Unit 8: **Strengthening Your Library's ISL Programs**
Unit 9: **Expanding & Enriching Library STEM Programs**
Unit 10: **Library Leadership & Community Collaboration**
Unit 11: **Community Analysis of Needs and STEM Interests and Issues**
Unit 12: **Sustaining STEM Programming**

GRG's Evaluation of the Rural Gateways Program

Since 1989, Goodman Research Group, Inc. (GRG), a Cambridge, MA research firm specializing in the evaluation of educational programs and materials has evaluated over 450 NSF and non-NSF projects using a full complement of quantitative and qualitative evaluation methods. GRG conducted the summative evaluation of Gateways and consulted on the research component of the project, led by co-PI John Falk and his ILI colleagues.

GRG's summative evaluation focuses on the quality of the Foundations + Advanced PD model, the success of the adult science programming, and outcomes for librarians, adult library patrons, and science partners. Our evaluation is one component of a larger research project funded by NSF AISL designed to inform the field of informal science learning, with particular emphasis on how to reach new and underserved audiences.

Research and Evaluation Design

There were 3 groups of librarians,[1] 2 treatment groups and a comparison group:

- Treatment group librarians were recruited at the beginning of the project and randomly assigned to 1 of the 2 treatment groups.
- The comparison group was recruited at the end of the project to fill out a survey assessing their status on key Gateways outcomes both concurrently and retrospectively.

Librarians provided names and contact information for their science partners so the science partners could be asked to complete surveys as well. (All surveys are shown in Appendix.)

The diagram below shows the research and evaluation design. Thick orange lines indicate the points at which participants completed online surveys, starting at baseline.

- Thus, the 3 librarian groups took 3, 7, and 1 survey, respectively.
- Science partners completed surveys in 2 waves, once after the PTL programming and once after the fully and partially supported programming.

Exhibit 3: Study Design

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Librarians: Treatment Group 1[a]	**Foundations PD** Units 1-6	**PTL Programs** Nature Survival Connection Knowledge				
Librarians: Treatment Group 2	**Foundations PD** Units 1-6	**PTL Programs** Nature Survival Connection Knowledge	**Advanced PD** Intro, Units 7-8 **Fully Supported Programs** Tradition Transformation	**Advanced PD** Units 9-10 **Partially Supported Programs** Motion Heritage	**Advanced PD** Units 11-12 **Independent Programs** 2 Self-Designed Programs	
Librarians: Comparison Group						
Science Partners		**PTL Programs** Nature Survival Connection Knowledge	**Fully Supported Programs** Tradition Transformation	**Partially Supported Programs** Motion Heritage	**Independent Programs** 2 Self-Designed Programs	

[a]For purposes of equity, Treatment Group 1 was given self-guided access to the Advanced PD materials and programs on the Gateways website after Phase 5.

The summative evaluation was guided by the following questions:

- How do participating librarians' science self-efficacy and ISF identity evolve?
  - How successful is the Foundations + Advanced PD model at enhancing these outcomes, compared to the Foundations-Only PD model and a no-PD comparison group?
  - What specific PD components contribute to outcomes?

[1] Note that we use the term "librarian" to refer to library professionals who are responsible for providing programming in their libraries, regardless of whether they hold an MLS or equivalent degree.

    - How do librarian outcomes change after the experiences of offering fully supported, partially supported, and independent science programming?
- How do participants assess the PD?
    - Did participants learn the skills and concepts presented?
    - Do the various PD elements provide the support and information needed?
- How much and what types of independently developed adult science programming do the librarians provide, and what are their future programming plans?
- How successful is the fully supported, partially supported, and independent programming at engaging patrons and enhancing their understanding of science, from the point view of librarians and their science partners?

Participants

Our target sample sizes for the librarians were at least 50 in each treatment group and at least 25 in the comparison group. To allow for attrition, we recruited 110 librarians and randomly assigned 55 each to the 2 treatment groups at the beginning of the study.[2] At the end of the study, we recruited 33 comparison group librarians to fill out a retrospective survey.

To recruit treatment group librarians, Califa Library Group and the rest of the Gateways team distributed a call for applications for mini-grants to rural[3] public libraries interested in providing adult science programming, regardless of their level of previous experience leading such programming. Comparison group librarians met the same criteria as treatment group librarians, with the additional stipulation that they have at least 5 years' experience in a library (so they could answer retrospective questions dating back to when treatment group librarians began the Gateways program).

As noted earlier, treatment group librarians received a $3,500 mini-grant, program materials, professional development, and a PD Certificate of Completion from the Califa Library Group. Comparison group librarians received a $100 honorarium and self-guided access to the Foundations and Advanced PD and to the PTL and Rural Gateways program materials on the Gateways website.

[2] There were no statistically significant differences between the 2 groups in terms of census region, populations served by system and facility, miles to nearest metro area, median income of population in service area, approximate staffing levels, and experience with adult programming.
[3] "Rural" was loosely defined as a total population under 25,000, a population density under 1,000 per square mile, and a distance over 25 miles to the nearest urban area. Librarians who had participated in the original PTL project were not eligible to participate in the Gateways project.

Procedures

The table below shows the survey timeline, respondent totals, and response rates for the various participant groups.

- Note that attrition rates over the 4 years that Treatment Group 2 participated were greater than anticipated, resulting in 41 instead of the desired 50 total remaining by May of 2020.
- For Treatment Group 1, attrition over the shorter 15-month time period of the PTL replication left 47 of the desired 50 remaining by May of 2017.

Exhibit 4. Survey Timeline, Respondent Totals, and Response Rates

Survey	Date	Treatment Group 1 Response Rate	Treatment Group 2 Response Rate
Librarians: Treatment Groups			
Baseline	April 2016	51/55=93%	53/55=96%
Post–Foundations PD	November-March 2016-17	45/55=82%	48/55=87%
Post–PTL Programs	May-July 2017	34/47=72%	39/51=77%
Fully Supported Programming	January-June 2018		45/51=88%
Partially Supported Programming	June-August 2018		37/49=76%
Independent Programming	March-April 2019		28/45=62%
Follow-Up Programming	April-May 2020		25/41=61%
Librarians: Comparison Group (No PD)			
Post-Only Retrospective	April 2020	24/33=73%	
Science Partners			
Post–PTL Programs	July 2018	23/56=41%	48/114=42%
Post–Rural Gateways Programs[a]	April-May 2019		20/41=49%

[a]There were 11 science partners who took the survey after both sets of programs, for a total of 80 individual science partners.

Responses for librarians in the treatment groups started extremely high (93-96%), but declined over time to rates that were lower, but still adequate (72% after 15 months; 61% over 49 months). This decline may have been due to attrition and staff turnover beyond what we were able to account for;[4] further, the surveys were fairly long (see Appendix). Still, the librarians — who were in communication with the Gateways team and were familiar with GRG's evaluation of the Gateways program — were more responsive than were science partners (41-49%). Comparison group librarians had a fairly high response rate, at 73%.

RESULTS

- In this section, we first describe the demographics and background experience of the librarians and their science partners as well as their initial attitudes and skills related to facilitating adult science programming.
- Next, we turn to the usefulness of the librarian PD and science partner resources in preparing them to implement the Gateways science programming.
- Both librarians and science partners assessed the quality of the programming, and the librarians in the Advanced PD group described their self-designed programming.

[4] Unless librarians told the team explicitly that they were dropping out or their emailed survey invitations bounced, we cannot be sure how many non-respondents were no longer at their libraries.

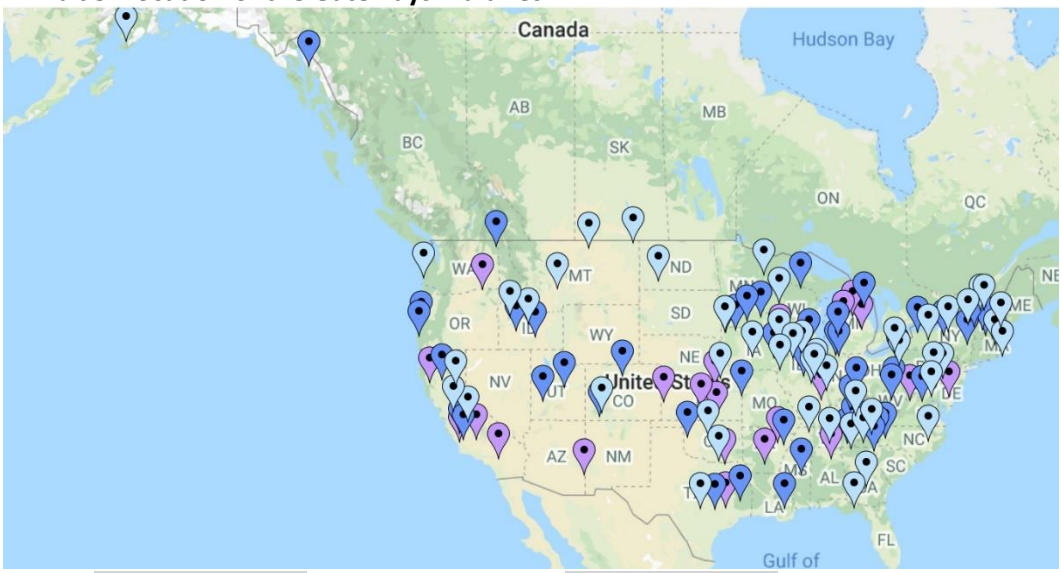
- The following section describes outcomes of the Gateways program in terms of:
  - audience responses,
  - librarian science self-efficacy and identification as science program developers, and
  - science partner self-ratings as public science communicators and assessments of the outcomes of public science engagement.
- Finally, we discuss librarian and science partner suggestions for improving the Gateways program.

Who Are the Librarians and Science Partners?

Librarians

Most of the librarians (88%) are women, with a median current age of 47 (*range*=30-73).[5] The Gateways libraries were distributed widely across the United States, as shown below. While the distribution of the 2 treatment groups (light and dark blue) was fairly similar, the comparison group (purple) was somewhat more Midwestern and less Northeastern than were the other 2 groups.

Exhibit 5. Location of the Gateways Libraries



Legend: Treatment Group 1 (Foundations PD only); Treatment Group 2 (Foundations + Advanced PD); Comparison Group

[5] Because survey response rates declined over time, demographics from the earliest possible survey are reported here to maximize the N.

Not surprisingly, the Gateways librarians began the program already positively disposed toward science and science programming:

- Most (88%) reported participating in a science activity — reading a book about science, watching a science-related show, going to a science museum, etc. — during their leisure time.
- The vast majority (95%) agreed there was a need in their communities for programs on local STEM issues.
- Almost all (98%) agreed that scientists can help strengthen community interest in science via library programming and other community outreach (98%).

At baseline, the librarians did not necessarily have the requisite background or experience to develop science programming:

- Over half (53%) have a master's or professional degree, but just 7% hold an undergraduate or higher degree in a STEM field.[6]
- Most (90%) had facilitated adult programming, but only about 15% had facilitated what could be described as science programming (e.g., scientist talks on CRISPR and astronomy, sustainable agricultural practices, Raspberry Pi projects, maker space programming).
- Only 9% agreed at least *somewhat* that their libraries were currently meeting the science-related needs of the adults in their communities; the rest were neutral or disagreed.

Although librarians may have lacked formal STEM credentials, they began the Gateways project fairly confident in their skills to facilitate, if not necessarily to develop, adult science programming:

- On a continuum from 1 (Convener) to 5 (Facilitator) to 9 (Developer) of adult science programming, librarians rated themselves at 5.45, on average, at baseline.[7] Thus, they already saw themselves as something more than facilitators.
- Librarians also completed a measure of science self-efficacy developed for this project by the research team.[8] At baseline, librarians were reasonably comfortable with their ability to carry out science-related activities, with an average score of 26.7 on a scale that can range from −63 to +63.[9]

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[6] Educational data are only available for Treatment Group 2, but because the librarians were randomly assigned to the 2 treatment groups, we have no reason to believe these figures would differ significantly in Treatment Group 1.

[7] As expected given the random assignment to the 2 treatment groups, there were no statistically significant differences between Treatment Groups 1 and 2 in where they placed themselves along the continuum.

[8] Verbeke, M., Falk, J. H., Brown, K. & Meier, D. (2019). A study of rural librarians' self-efficacy in facilitating and developing adult science programs. *Library Quarterly: Information, Community, Policy, 89*(2), 116–136. https://www.researchgate.net/publication/332126994_A_Study_of_Rural_Librarians%27_Self-Efficacy_in_Facilitating_and_Developing_Adult_Science_Programs

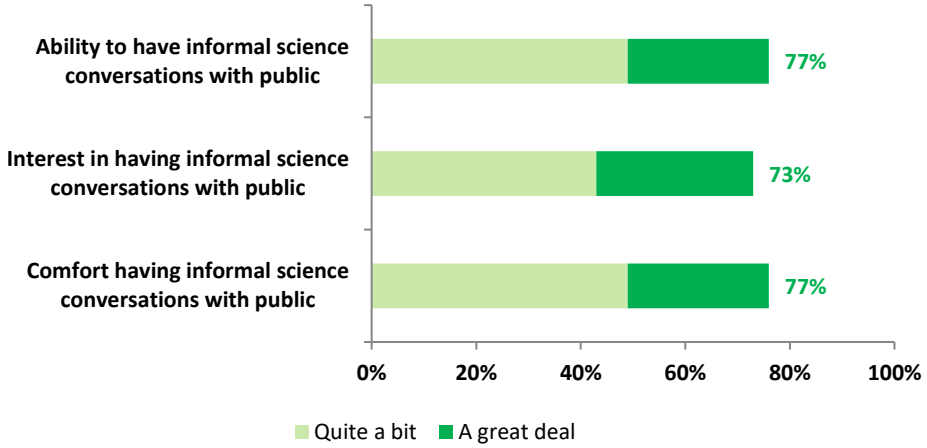
[9] Scores for 21 Likert-scaled items were summed. Items were coded from −3 to +3 based on level of agreement with positively framed items and disagreement with negatively framed items. Thus, potential science self-efficacy scores could range from –63 to +63; the actual obtained range was –11 to 60. Again, as expected at baseline, there were no statistically significant differences between Treatment Groups 1 and 2.

Science Partners

Some 60% of the science partners are women, with a median current age of 55 (*range*=26-84). Science partners were comfortable with public engagement from the start:

- For 65% of the science partners, public engagement is an explicit part of their jobs.
- Just over half (52%) have had specific experience with informal science programming for adults.
- Asked to reflect on their ability, interest, and comfort in informal science conversations with the public, science partners gave themselves high ratings, with 77-73%s responding *quite a bit* or *a great deal* to each item, as shown below.
- Not surprisingly, science partners with previous experience with adult public science programming rated themselves statistically significantly higher on ability, interest, and comfort with public science communicators (composite scores of 4.14 vs. 4.79 on a scale from 1-5).

Exhibit 6. Science Partners' Initial Self-Ratings as Public Science Communicators



N=77

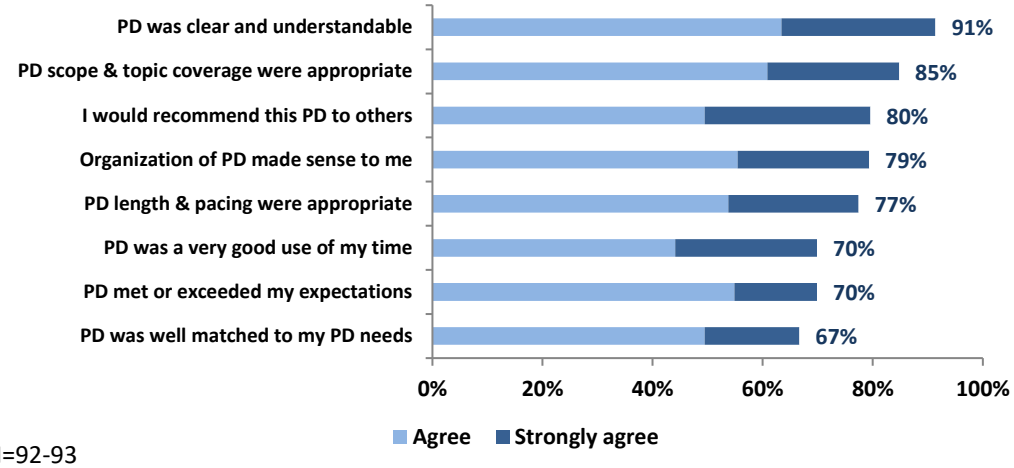
- On average, science partners of librarians in Treatment Group 1 co-facilitated between 1-2 of the 4 possible events, with 23% co-facilitating all 4 events.
- Partners of Treatment Group 2 librarians co-facilitated between 2-3 of the 8 possible events, with 21% co-facilitating all 8 events.

How Useful Were the PD Resources?

Librarian Preparation to Implement Gateways Programming

- Librarians in both treatment groups gave very high marks to the quality of the first 6 units of the PD, which were based on the PD from the original PTL project.
- Treatment Group 2 gave similarly high ratings to the quality of the Advanced PD (not shown).

Exhibit 7. Librarian Ratings of Quality of PD Units 1-6

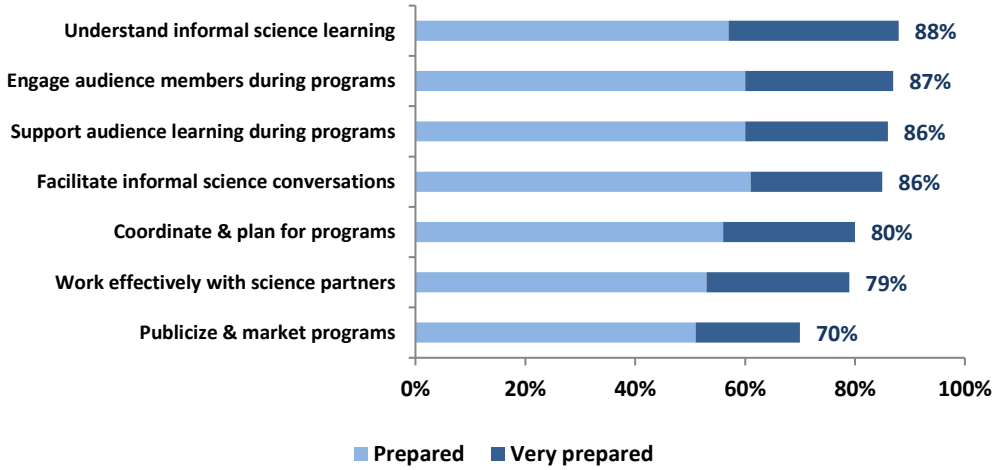


N=92-93

The PD was designed to help librarians develop specific competencies in planning and co-facilitating Gateways programs.

- After completing the Foundations PD and the initial set of 4 PTL programs, the majority reported feeling *prepared* or *very prepared* in each area below.
- Treatment Group 2 rated their preparation even higher after completing the Advanced PD, 4 additional Gateways programs, and their self-designed programs, reaching 89-100% who rated themselves as *prepared* or *very prepared* in each area (not shown).

Exhibit 8. Librarian Preparation to Implement Gateways Programs After Foundations PD

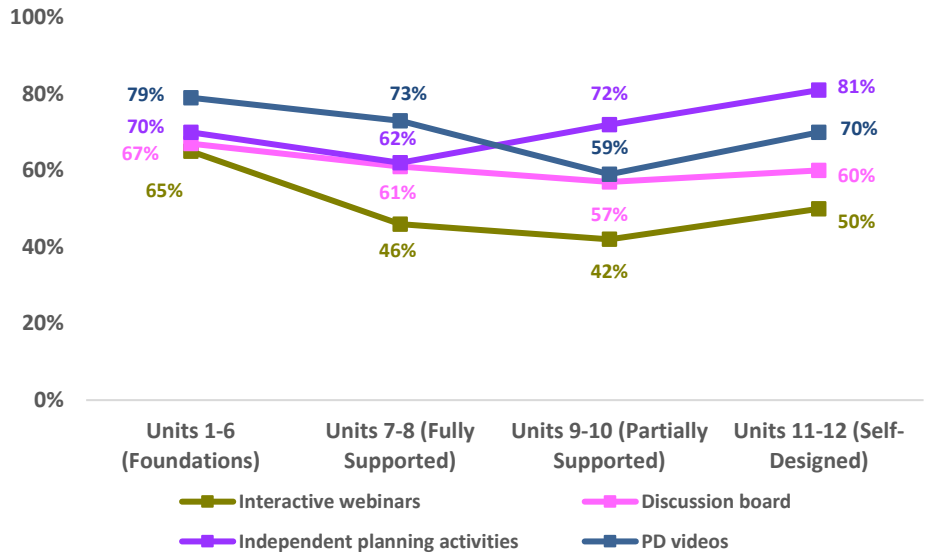


N=80-93

In terms of the various PD components, at all phases:

- More librarians found the PD videos (59-79%) and the independent planning activities (62-81%) to be *very* or *extremely* useful.
- Fewer librarians (42-65%) found the interactive webinars to be equally useful.

Exhibit 9. Librarian Ratings of Specific PD Components at 4 Phases



Foundations N=81-92; Fully Supported Programs N=40-44; Partially Supported Programs N=33-37; Self-Designed Programs N= 27-28.
Note: Bars represent the percentages at each phase who responded that the PD component had been *very* or *extremely* useful.

Librarians were quite satisfied with the Gateways website: On average, librarians *agreed* or *strongly agreed* that:

- the website is easy to navigate,
- they could confidently use its tools,
- the online format is a fitting PD delivery method,
- they rarely had technical issues, and
- when they had issues, adequate assistance was available.

In terms of the specific PD units, the majority of librarians found all of them *very* or *extremely* helpful, with the largest group (75%) rating "Unit 3: Libraries as Resources for Informal Science Learning" this high and the smallest group (but still fairly large at 55%) rating "Introduction: Advanced Leadership in Informal STEM Learning" this high.

Finally, librarians had a sense of belonging to a community of practice during the PD: On average, librarians *agreed* or *strongly agreed* that

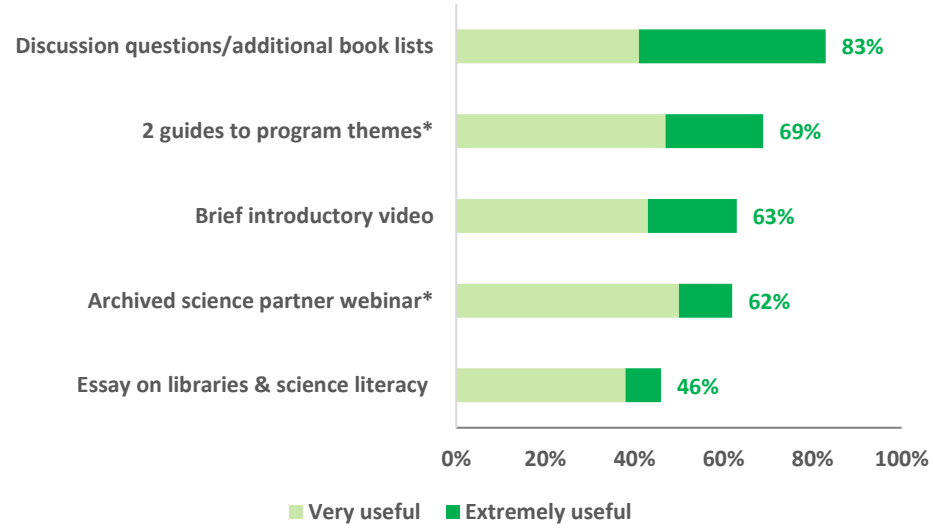
- They felt they were part of a professional community of ISFs,
- The online discussion group helped with this feeling of community,
- They had somewhere to go with questions, and
- The community was useful as they planned and delivered adult science programming in their communities.

Science Partner Preparation to Implement Gateways Programming

There was a suite of materials available to the science partners on the Gateways website:

- Partners found the discussion questions and additional suggested books for each program especially valuable, with 83% rating these as *very* or *extremely helpful*.
- However, the second most helpful resource, a pair of handouts on the PTL and Gateways themes, was used by just 51% of responding science partners.
- Similarly, just 49% of responding partners reported viewing the archived webinar, but 62% of those who viewed it found it *very* or *extremely* helpful.

Exhibit 10. Science Partner Ratings of Background Materials



N=80-93
*Roughly half of the science partners reported that they did not use these materials.

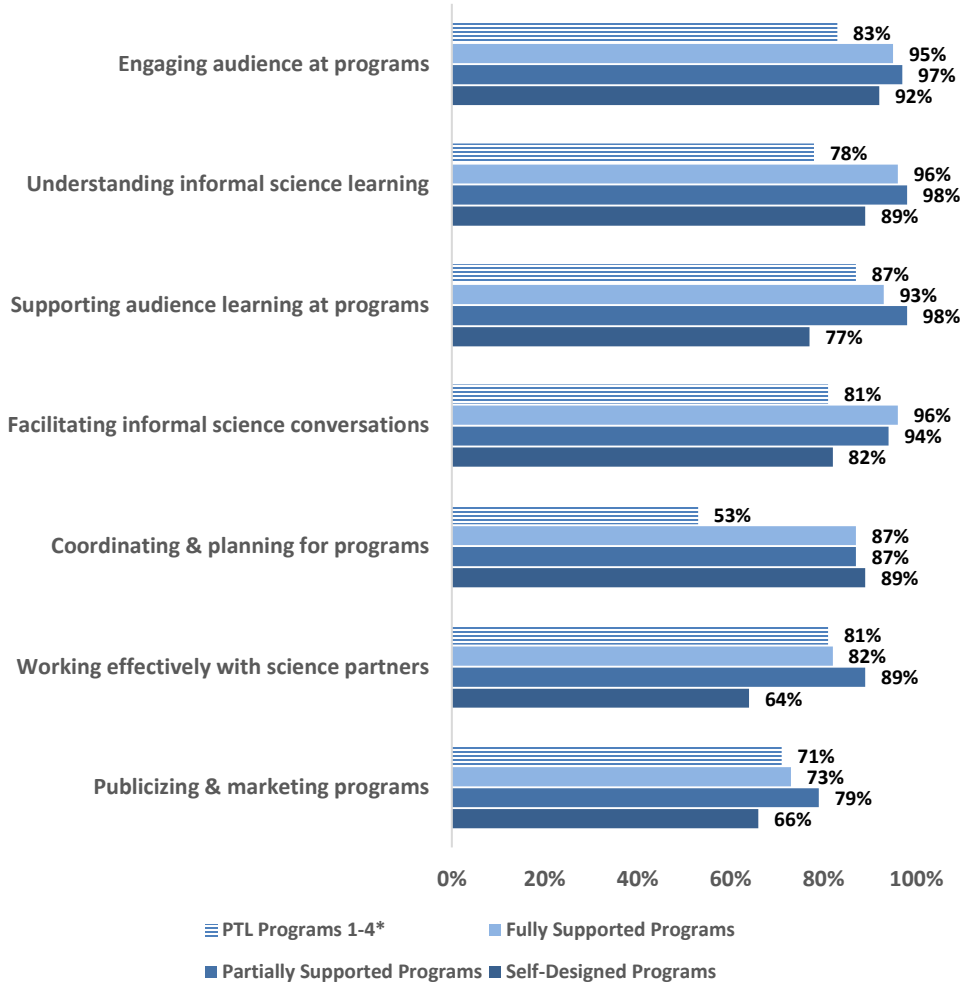
How Successful Was the Implementation of the Gateways Programming?

After each phase of programming, librarians reported on their level of success in planning, promoting, and delivering their Gateways programming.[10]

- Overall, most librarians reported that their programs were successful, particularly in terms of delivery; that is, engaging and supporting the audience in their learning, facilitating science conversations, and so on.
- Librarians reported somewhat lower levels of success in publicizing and marketing the programs, although the majority still rated themselves as successful in this area.

[10] Note that these areas correspond to the specific PD competencies shown above in Exhibit 8.

Exhibit 11. Success of Program Implementation at 4 Phases



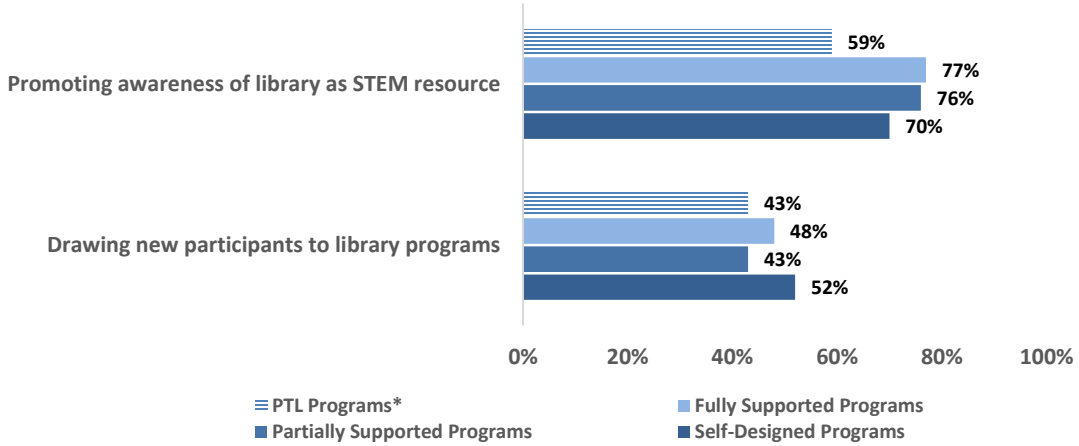
PTL Programs 1-4 N=67-70; Fully Supported Programs N=43-44; Partially Supported Programs N=37; Self-Designed Programs N= 25-27.

*Note that the response scale changed after PTL programs 1-4 such that the striped bar represents percentage responding *successful* (the top rating), whereas the solid bars at the other phases represent percentage responding *successful* or *very successful* (the top 2 ratings).

In terms of meeting broader library goals:

- The majority of the librarians reported that the Gateways programming was successful in promoting the library as a STEM resource in their communities.
- Substantially fewer reported success in drawing new participants to library programs, although 43-52% did draw new participants.

Exhibit 12. Success in Meeting Broader Library Goals at 4 Phases



PTL Programs 1-4 N=67-70; Fully Supported Programs N=43-44; Partially Supported Programs N=37; Self-Designed Programs N= 25-27.
*Note that the response scale changed after PTL programs 1-4 such that the striped bar represents percentage responding *successful* (the top rating), whereas the solid bars at the other phases represent percentage responding *successful* or *very successful* (the top 2 ratings).

One of the 27 librarians who reported drawing new participants said:

> ***The majority of the attendees (although we did not have really big groups) were not regular library patrons. Three were new to the library (and got new library cards!) and 5 were occasional users who came in to the library 1-2 times per year.*** *(Librarian)*

Others described ways in which their audiences were somewhat different than those they typically draw. Some libraries had not previously offered adult programming, or had trouble drawing adults vs. parents and children (n=10); for example:

> ***Mainly, [the difference was that] they attended! We have had some difficulty drawing adult program participants, so it was good to have so many attend and keep coming back.*** *(Librarian)*

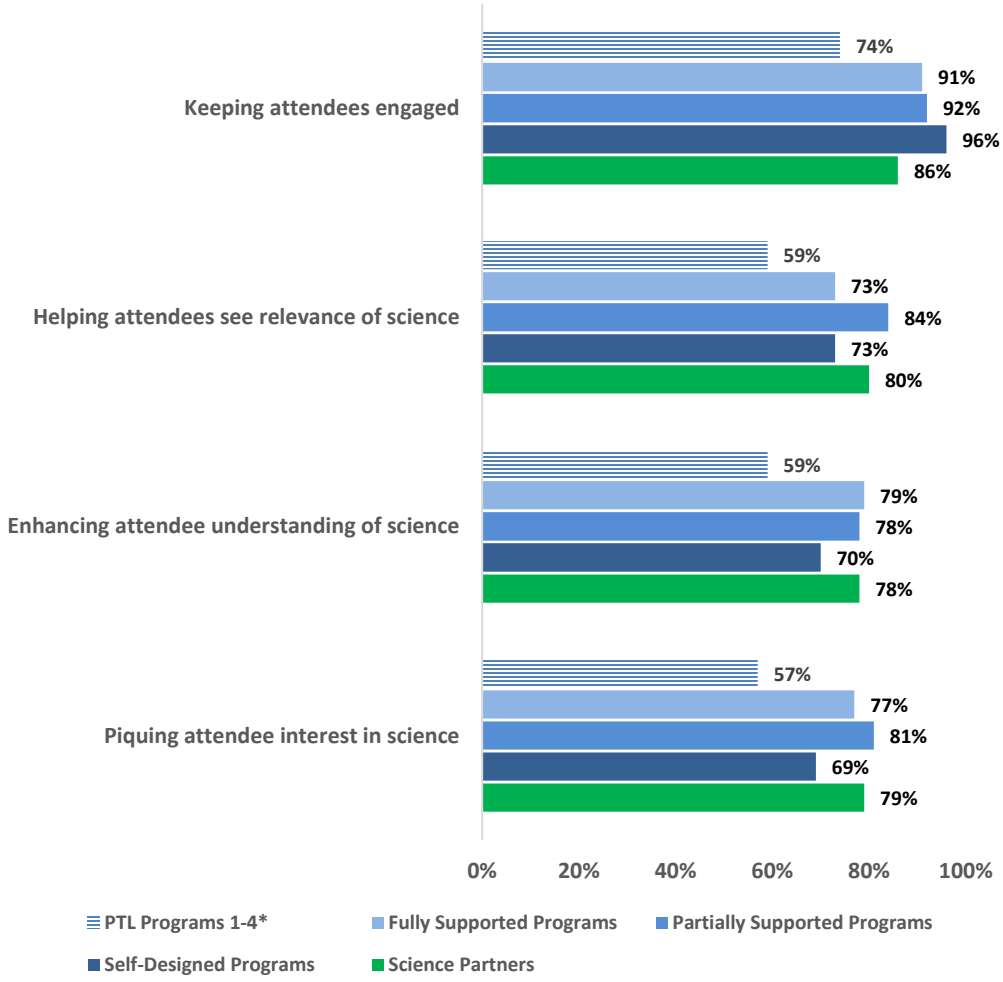
More than a few librarians also noted that the Gateways programming drew more men than typically attend programs (n=9), younger adults than typically attend programs (n=5), people who were interested in a discussion rather than a lecture (n=8), and people who were already interested in or connected to science (n=9).

What Were the Outcomes of the Rural Gateways Project?

Perceptions of Audience Responses to Programming

The majority of both librarians and science partners rated the Gateways programming as successful in engaging the audience, helping them see the relevance of science to daily life, enhancing their understanding of some science topics, and piquing their interest in science.

Exhibit 13. Librarian & Science Partner Ratings of Audience Engagement and Learning



Librarians: PTL Programs 1-4 N=67-70; Fully Supported Programs N=43-44; Partially Supported Programs N=37; Self-Designed Programs N= 25-27. Science Partners: N=73-76.
*Note that the response scale changed after PTL programs 1-4 such that the striped bar represents percentage responding *successful* (the top rating), whereas the solid bars at the other phases, and for science partners, represent those responding *successful* or *very successful* (the top 2 ratings).

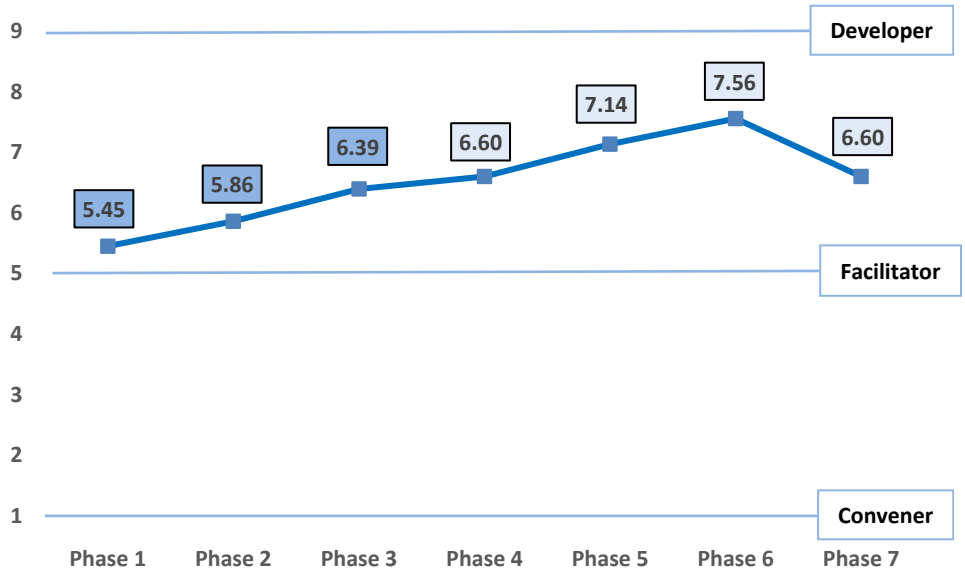
Librarian Outcomes

One of the primary goals of the Gateways project was to move librarians along the continuum from Convener to Facilitator to Developer of adult science programming, with the hope of increasing the sustainability of library-based science programming beyond the life of the grant.

As discussed above, on average, librarians began the project seeing themselves as something more than Facilitators already.

- Librarians made modest but steady gains after each successive phase of the project, as they completed the PD units and implemented successive Gateways programs.
- Self-ratings maxed out for Treatment Group 2 (Foundations + Advanced PD) after they had delivered their self-designed programs, and then dropped during the follow-up period, after the Gateways program had formally ended for them.
- Overall, the effect of the Gateways program is statistically significant, with a large effect size. Examining each change in the mean shows statistically significant gains at all phases except Phase 3 to Phase 4 (6.39→6.60), and a significant drop at Phase 7.[11]

Exhibit 14. Librarian Identification as a Science Program Developer Over Time



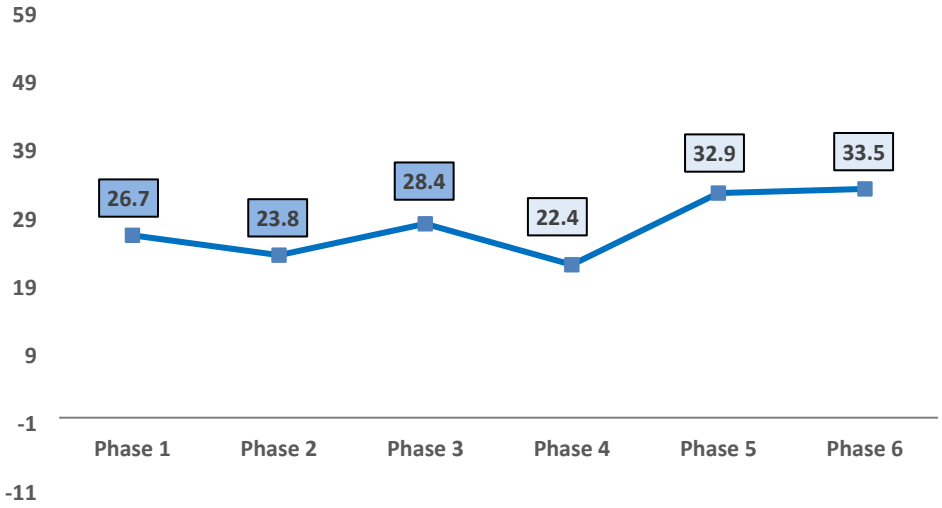
Phase 1/Baseline: N=102; Phase 2/Foundations PD: N=92; Phase 3/PTL Programs 1-4: N=71; Phase 4/Fully Supported Programs: N=45; Phase 5/Partially Supported Programs: N=37; Phase 6/Self-Designed Programs: N=27; Phase 7/Follow-Up: N=25.
Response Scale: 1 (Convener) to 5 (Facilitator) to 9 (Developer)
Note: Darker blue labels include Treatment Groups 1 & 2, while lighter blue labels only include Treatment Group 2 (Foundations + Advanced PD).

[11] Repeated-measures ANOVA shows a significant main effect; $F(6,78)=16.78$, $p=.000$, *partial* $Eta^2=.56$. However, only 14 respondents took all 7 surveys, which is not a sufficient sample size to allow for pairwise comparisons to see where differences lie. To maximize sample size and statistical power (as well as to be able to base findings on more than 14 respondents), we conducted a series of repeated-measure t-tests. Results of these should be interpreted with some caution, as multiple comparisons increase the experiment-wide false positive rate.

In terms of science self-efficacy, at baseline, librarians were already reasonably comfortable with their ability to carry out science-related activities. The pattern of change for self-efficacy is somewhat mixed:

- There was a statistically significant gain after implementing PTL Programs 1-4 (23.8→28.4).
- However, this was followed by a statistically significant *drop* in science self-efficacy after implementing the fully supported programs (28.4→22.4).[12]
- This was followed by another statistically significant gain after implementing the partially supported programs (22.4→32.9).

Exhibit 15. Librarian Science Self-Efficacy Over Time



Phase 1/Baseline: N=104; Phase 2/Foundations PD: N=93; Phase 3/PTL Programs 1-4: N=73; Phase 4/Fully Supported Programs: N=45; Phase 5/Partially Supported Programs: N=37; Phase 6/Self-Designed Programs: N=28.
Note: Darker blue labels include Treatment Groups 1 & 2, while lighter blue labels only include Treatment Group 2 (Foundations + Advanced PD).
Note: The response scale ranges from −63 to +63.

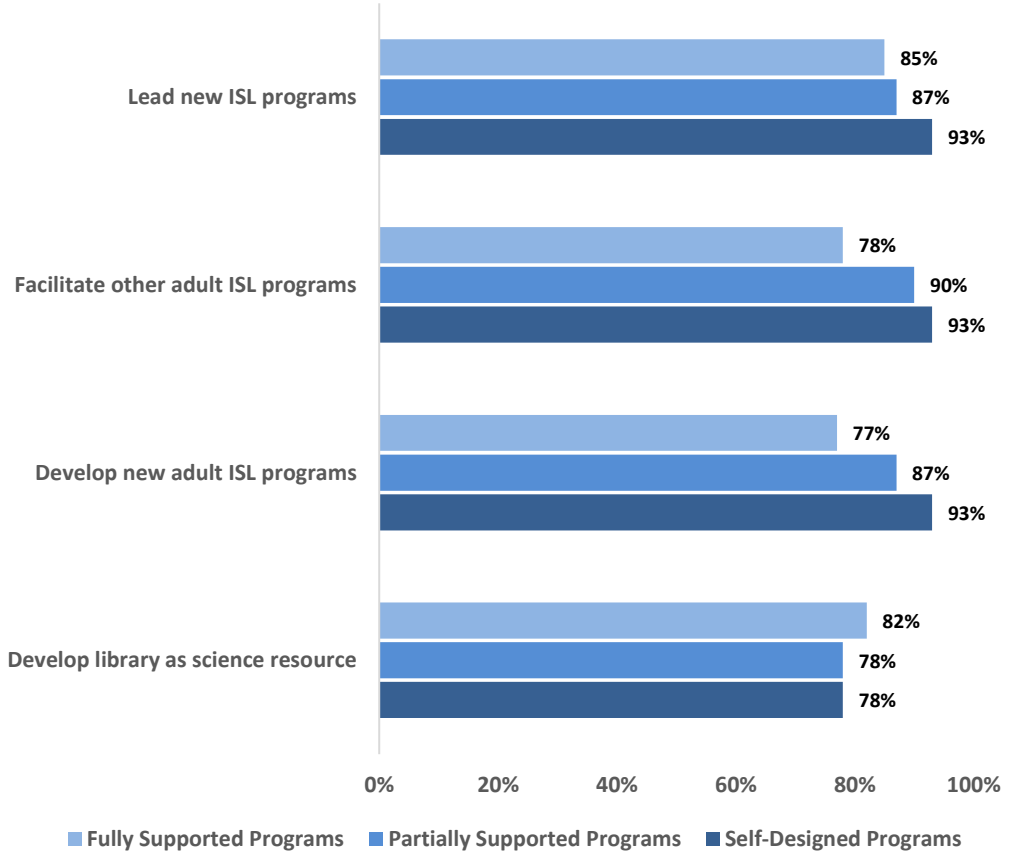
During the Advanced PD, librarians in Treatment Group 2 progressed from implementing fully supported programming to working more independently to offer partially supported programming. As the culmination of this phase of the PD, librarians — with science partners, in some cases — designed and implemented 2 of their own self-designed science programs.

After each phase of the Advanced PD, librarians were asked a series of questions about their preparation to take on a leadership role in their library's ISL programming for adults.

[12] Again, repeated-measures ANOVA shows a significant main effect; $F(5,100)=12.88$, $p=.000$, *partial Eta*^{2}=.39. However, only 21 respondents took all 6 surveys with the science self-efficacy measure. To maximize sample size and statistical power (as well as to be able to base findings on more than 21 respondents), we conducted a series of repeated-measure t-tests. These should be interpreted with caution, as multiple comparisons increase the experiment-wide false positive rate.

- At each step in the scaffolded series of programs, librarians reported feeling increasingly prepared to take on the lead in developing, facilitating, and leading new ISL programming.
- There were statistically significant gains in composite scores of librarians' preparation to lead.[13] Planned comparisons indicated that the real gain occurred after librarians had developed and implemented their own self-designed programs.

Exhibit 16. Librarian Preparation to Take Leadership Role in ISL at 3 Phases



Fully Supported Programs N=45; Partially Supported Programs N=37; Self-Designed Programs N=27.

[13] Repeated-measures ANOVA shows a significant main effect; $F(2,48)=86.92$, $p=.000$, *partial* $Eta^2=.78$.

Librarians were asked for brief descriptions of their self-designed programs; these were coded for whether they clearly involved explicit discussion of STEM content.

- Just over two-thirds (69%) of the programs clearly involved explicit STEM content, as shown below, with a further 15% possibly involving such content (total=84%).
- Each library held 2 programs, and for 80% of the libraries, at least 1 of those programs involved explicit STEM content.

Exhibit 17. Explicit STEM Content in Self-Designed Programming

Examples

Not STEM Program	Possibly STEM Program*	STEM Program
Book Chat Book: *At Home in Mitford* Video(s): — Science Partner: [name] Simple book chat with compare, contrast, conversation, and fun.	**Book Discussion at Aerodrome** Book: *One Summer, America 1927* Science Partner: [name] Met at Aerodrome where there are replicas of planes discussed in book. Director of Aerodrome there gave a tour and a talk.	**Death by Hot Chocolate** Book: *Bean-to-Bar Chocolate* Video(s): 2 YouTube clips Science Partner: — Discussed book & scientific aspects of chocolate production; made 5 versions of hot chocolate from around world & had tasting; watched videos on role of salt in tasting & science of chocolate.

N=30 librarians describing 59 programs

*Some program descriptions did not contain enough information to determine whether STEM topics were explicitly discussed.

Finally, we followed up with the Advanced PD librarians to learn whether they had provided any additional adult STEM programming during the roughly 1-year period after the formal end of the Gateways project for them. Again, program descriptions were coded for whether they involved explicit STEM content.[14] Some 44% of responding librarians described at least 1 program that involved explicit STEM content, with an additional 24% of programs possibly involving such content (total=68%).

As shown below, for those who provided descriptions of their programming during the follow-up period, a few characteristics stood out:

- The most popular element of the Gateways programming that the librarians continued to use was working with a science partner (71%).
- Expert talks were the most common type of program; half of the post-Gateways programs involved expert talks.
- The most frequent program topics were agriculture/horticulture and nature (e.g., environment, dinosaurs, extreme weather, geology).
- Fully 90% of the programs were developed by the librarians and/or their science partners.

[14] Note that because descriptions were extremely brief on the follow-up survey, coding was more difficult, so more programs had to be coded as *possibly STEM*.

- Most (81%) of the programs were described as very successful; the 2 programs described as unsuccessful were not successful due to poor attendance.

Exhibit 18. Profile of Programming Provided During Follow-Up Period

		N	%
Explicit STEM Content	Yes, STEM	11	65%
	Possibly STEM	6	35%
	Not STEM	–	–
Elements of Gateways programs (all that apply)	Involved science partner	30	71%
	Used book or other reading material	14	33%
	Showed videos or films	11	26%
Program type (all that apply)	Expert talk	21	50%
	Book discussion	13	31%
	Hands-on activity, demo, field trip	11	26%
	Film or video	9	21%
	Other	5	12%
Content areas	Agriculture, horticulture	11	26%
	Nature	11	26%
	Health, medical	9	22%
	Astronomy	2	5%
	Technology	2	5%
	Other	7	17%
Source of program	Self developed	21	50%
	Developed with/by science partner	17	40%
	Adapted program	3	7%
	Used existing program	1	3%
Success of program	Very successful	34	81%
	Mixed	6	14%
	Unsuccessful	2	5%

N=17 librarians who reported providing STEM programming describing 42 programs

Librarian Comparison Group Outcomes

Data from the comparison group librarians sheds light on the extent to which changes over time among project librarians are due to the Gateways program rather than to changes in the general landscape of STEM programming in libraries over the course of the 5 years of the project. Therefore, the Gateways Advanced PD librarians and the comparison group librarians filled out similar surveys in the spring of 2020.

Results suggest that, indeed, there was an increasing focus on STEM PD for librarians and STEM programming for library audiences during the period from 2015-2020:

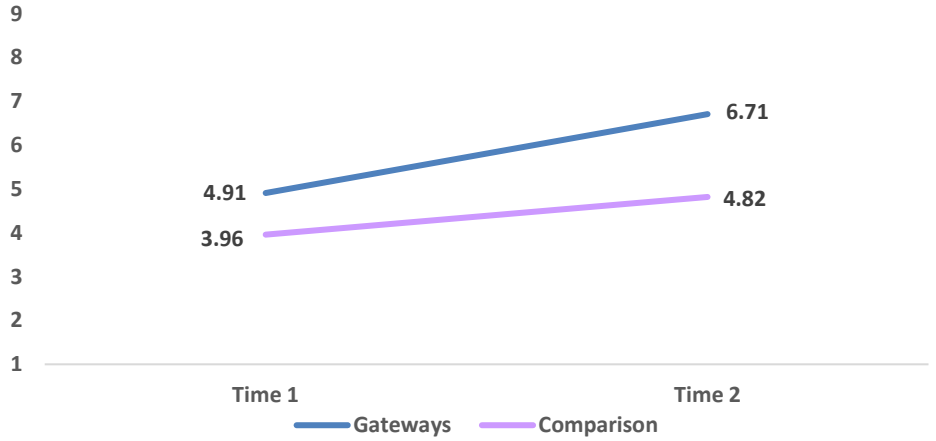
- 72% of Gateways librarians and 67% of comparison group librarians reported an increase in their library's adult science programming over this time period.
- 72% of Gateways librarians and 79% of comparison group librarians reported that they had participated in (non-Gateways) STEM PD over this time period.

However, there were differences between the 2 groups of librarians that we can attribute — with some degree of confidence — to the Gateways program:

- Gateways librarians were statistically significantly more likely than were comparison group librarians to *agree* or *strongly agree* there is someone they can ask about facilitating science discussions for adults (81% vs. 48%).

- Both groups showed significant gains in identification as a science program developer, but the Gateways group made marginally significantly greater gains than did the comparison group, as shown below.[15]

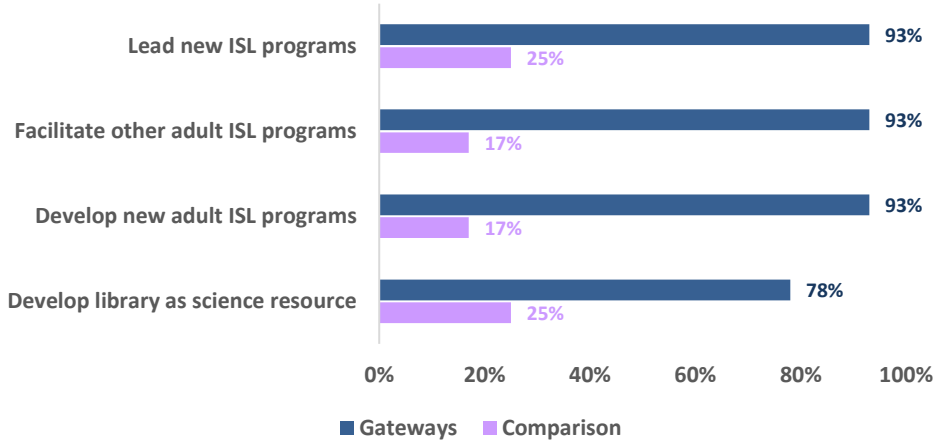
Exhibit 19. Identification as a Science Program Developer: Gateways vs. Comparison



Gateways Librarians: Baseline N=51; Follow-Up N=25; Comparison Group: Retrospective Baseline N=22; Current N=23.
Response Scale: 1 (Convener) to 5 (Facilitator) to 9 (Developer)

- Gateways librarians reported statistically significantly higher science self-efficacy scores than did comparison group librarians (33.54 vs. 22.96 on a scale from –63-+63).
- Gateways librarians reported being statistically significantly more prepared to take leadership in their library's ISL programming (composite scores of 6.41 vs. 4.04 on a scale from 1-7). This finding is broken out into more detail below.

Exhibit 20. Preparation to Lead in ISL: Gateways vs. Comparison



Gateways Librarians After Self-Designed Programs N=27; Comparison Group N=24.
Note: Bars represent the percentages responding that they felt *prepared* or *very prepared*.

[15] Repeated-measures ANOVA shows a significant main effect; $F(1,41)=28.66$, $p=.000$, *partial* $Eta^2=.41$ and a marginally significant interaction effect; $F(1,41)=3.59$, $p=.065$, *partial* $Eta^2=.08$.

Science Partner Outcomes

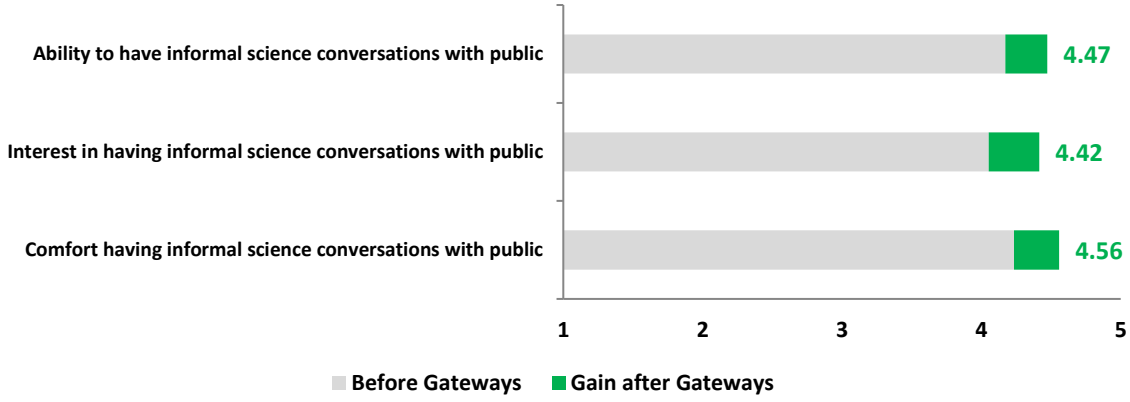
The science partners were not the primary target of the Gateways project. However, to the extent that they are willing to continue working on public science projects like Gateways, the science partners are a key component of their communities' capacity to sustain public science programming.

- Most science partners (90%) reported that, based on their experience with the Gateways project, they are *very* or *extremely* likely to continue their involvement with informal public science, whether at the library or elsewhere.
- Science partners with previous public science experience were statistically significantly more likely to say they would continue (95% vs. 86%), but both groups appear to have had a positive experience with the Gateways program.

As discussed above, science partners reported that even before the Gateways project, their ability, interest, and comfort having informal science conversations with the public were high.

- Nevertheless, they still reported statistically significant, though modest, gains in these areas after participating in Gateways.
- Gains were marginally significantly higher for science partners without previous public science experience.

Exhibit 21. Science Partner Gains in Self-Ratings as Public Science Communicators



N=77-80

Note: Each bar represents post-participation ratings of *quite a bit* or *a great deal*. The lighter segment shows retrospective ratings, while the darker segment shows self-reported gains over time. For all gains, means were statistically significantly different at the $p < .05$ level.

Science partners also reported on the outcomes of their public engagement with science (PES) as Gateways co-facilitators using a scale developed and validated by Karen Peterman and her colleagues.[16] A scientist's outcome expectations related to outreach likely inform the extent to which they continue to engage with the public in this way.

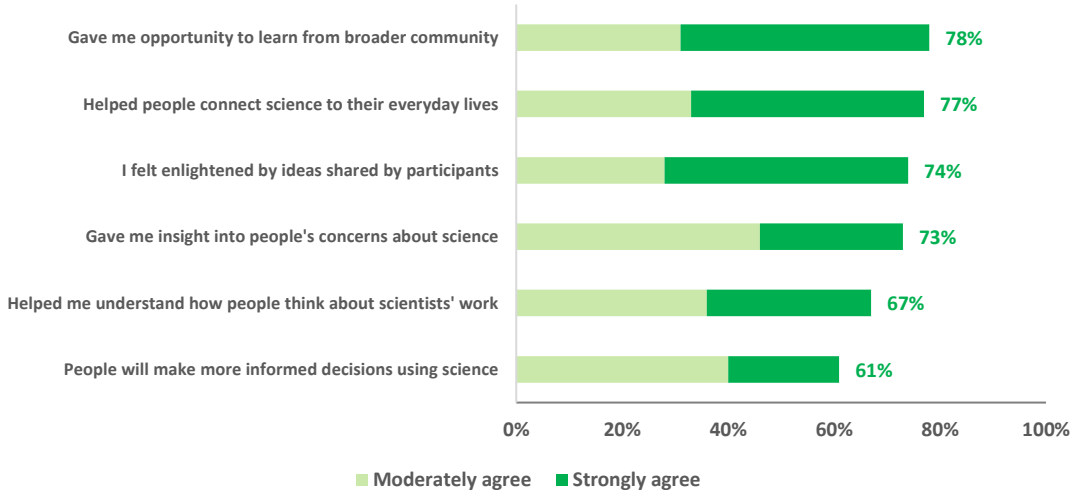
- Science partner experiences as Gateways co-facilitators were quite positive, especially in the areas of the scientists' own learning and enlightenment and in

[16] Peterman, K., Robertson Evia, J., Cloyd, E., & Besley, J. C. (2017). Assessing public engagement outcomes by the use of an outcome expectations scale for scientists, *Science Communicatio*n, *39*(6), 782–97.

helping the public to connect science to the everyday, which is the point of the Gateways programming.

- Gateways science partners had an average composite score of 4.93 (*range*=1.50-6.00), indicating that they *moderately agree* with most items below. This is somewhat higher than the average score of 4.64 (range=1.50-6.00) obtained by Peterman et al. in their study of 364 scientists who had engaged in PES activities of all descriptions in the past year.
- There were no significant differences in composite scores between science partners with and without prior experience with adult public science programming.

Exhibit 22. Science Partner Ratings of Outcomes of Public Engagement with Science



N=78

Science partners' positive experiences were also reflected in their answers to the question of what most surprised them about the Gateways programming. By far the most common response was surprise at the audience's level of interest in and engagement with science topics:

> ***I think the most surprising element for me was how interested and willing the general public is to engage in discussion on science-related topics. Oftentimes we educators feel as though students have little to no interest in the topics being presented in our courses; however, this program served as a reminder that we humans generally are a curious bunch.*** *(Science partner)*

> ***I was impressed with the worldly knowledge of the attendees. They all brought their unique experiences and knowledge to the program, and it was very enjoyable to discuss the science topics with them.*** *(Science partner)*

> ***How many individuals showed up to participate in the program, despite being in a small town, and were interested in learning more about science.*** *(Science partner)*

How Could the Gateways Program Be Improved?

Librarians and science partners were given the opportunity on each survey the completed to make suggestions for improving the programming; their comments were coded by topic, as shown below.

Exhibit 23. Librarian and Science Partner Suggestions for Improvement

TOPIC	Librarians		Science Partners	
	N	%	N	%
Compliments/continue program	28	24%	18	38%
Book selections	33	28%	13	27%
Human interest videos	18	15%	9	19%
Program themes	17	15%	3	6%
Scheduling of PD/programs	13	11%	–	–
Chance to interact w/each other	11	9%	–	–
Science partners	9	8%	–	–
Marketing	8	7%	10	21%
Hands-on activities	6	5%	2	4%
PD content	5	4%	–	–
Program content	–	–	4	8%
Other resources	3	3%	6	13%
Other	11	9%	5	10%

N=117 comments from 72 librarians; 48 science partner comments.
Note: Total percentage in each column exceeds 100% because some comments addressed multiple topics.

Asked to suggest ways to improve the Gateways PD and programming, 24% of librarians and 38% of science partners took the opportunity to compliment the program:

> ***I have been quite pleased with our PTL experience. By introducing the libraries to the process of offering science or STEM related programming over time the way PTL did, it gave us time to adjust and learn. I appreciate that.*** *(Librarian)*

> ***The series is wonderful, and I have no improvement suggestions. The PTL program series gave me confidence and a much-needed boost to expand my adult programming goals. I am delighted with the quality of the series, the resources I was given access to, and the overall design of the program.*** *(Librarian)*

> ***I thought materials were well thought out and useful.*** *(Science partner)*

> ***I thought it was excellent and would like to be involved again, possibly through other nearby libraries.*** *(Science partner)*

Both librarians and science partners made a number of suggestions regarding the books and the human interest videos. Some disliked particular books or wanted newer or more science-heavy selections, but others suggested providing longer lists of book suggestions to allow them to better tailor selections to their audiences and including shorter books, or even non-book-length readings, to reduce burden on participants.

For the human interest videos, the most common comments were that it was challenging to figure out when to show them during the program and that librarians and science partners had difficulty figuring out how to tie the human interest videos to the program themes. The videos also had fans, with some asking for more suggestions or guidance in finding additional videos:

> ***One of the highlights of the programs has been the great videos. Pointers on where to find similar resources for future programs would be incredibly helpful.*** *(Librarian)*

> ***The videos were great! Not too long or too short. Interesting and inspiring.*** *(Librarian)*

> ***The quality of the program videos was great, well told and well photographed. We enjoyed meeting the subjects of the program videos very much and would love updates on their status.*** *(Librarian)*

> ***The videos really made it seem like anyone could be a scientist of sorts.*** *(Science partner)*

Program themes were designed to be broad, allowing for greater variety in approach and content, but some of the librarians found the very breadth to be a challenge:

> ***I found that the themes coupled with the concepts of the book and video often didn't mesh well. The themes were awfully broad, and trying to get a discussion that didn't go all over the place was sometimes difficult. I found it hard, for instance, to somehow connect Roxanne Swentzel's work with the Larson book.*** *(Librarian)*

> ***At times, I felt the programming options were so abstract that I had difficulty tying them to science-based concepts.*** *(Librarian)*

> ***Many patrons wanted science and didn't see how knowledge, connection, survival, and nature had anything to do with STEM.*** *(Librarian)*

Science partners tended to talk about marketing, particularly in the sense of attracting a larger audience as well as a broader one:

> ***Get out the word about these sessions. Once we discovered them, we became engaged and benefitted from the interchanges.*** *(Science partner)*

> ***Perhaps a little help on how to advertise the programs to bring in people who are initially turned off by the "science" feel to it.*** *(Science partner)*

> ***Other ways to advertise the program, like short videos of heterogeneous groups meeting and discussing ideas, to encourage a broader range of community participation.*** *(Science partner)*

A final area of interest to librarians was having additional opportunities to interact with each other. Some regretted not participating more in the online community of practice, and others suggested other methods of interacting:

> ***It's a great program. Hearing what other libraries were doing in the community of practice was especially helpful. Please continue this.*** *(Librarian)*

> ***I liked to read the comments on the discussion panels when I had a chance. I felt bad at times for not participating, but time constraints for me were a problem.*** *(Librarian)*

> ***The community of practice…doesn't seem like it's being actively used or moderated, so I don't really get much out of that. It's too bad too…Those types of message boards have been the best part of the library college courses I've taken because the exchange between librarians all over the country is invaluable.*** *(Librarian)*

> ***I don't feel the sense of camaraderie that I do with my colleagues in other similar grant programs. I don't know how this could be improved. Another platform for the forum that is more discussion style instead of answering assigned questions? An initial face-to-face meeting? Shared contact info? More frequent webinar conference calls?*** *(Librarian)*

> ***I'd like to see private/closed Facebook discussion groups for the librarians/staff participating because many people are on there, and perhaps better conversation/discussion would happen if it were available in a place where people already "are" virtually.*** *(Librarian)*

CONCLUSIONS

Librarians Gained Capacity to Independently Develop Science Programs, Lead Library ISL Efforts

The Rural Gateways program aimed to both replicate and extend the positive results of the PTL program, providing additional PD and scaffolded practice to produce librarians with the capacity to create adult science programming for their libraries on their own. There are a number of indicators that the Gateways project met its goals:

- Librarians in the Foundations PD (or PTL replication) group made significant gains in their self-identification as adult science program developers, in their science self-efficacy, and in their preparation to lead their library's ISL efforts.
- Librarians in the Advanced PD group made gains significantly greater than those made by the PTL replication group. For preparation to lead, the gain did not occur until the final phase of training, when librarians had created and held their own self-designed programs.

Librarian Gains Were Due to Gateways PD and Programming Practice

Results from the comparison group allow us to attribute these gains primarily to the Gateways program. The general landscape for adult science programming did change between 2015-2020, with increasing emphasis on STEM PD and programming.

However, in contrast to the comparison group, Gateways librarians made significantly greater gains in science self-efficacy, dramatically greater gains in preparation to lead their library's ISL efforts, and marginally greater gains in self-identification as an adult science program developer.

Librarian Gains Tended to Persist Over Time

About 1 year past the formal end of the program for the Advanced PD librarians, they had retained their increased science self-efficacy, but showed a significant drop in self-identification as an adult science program developer, to the level achieved at the end of the Foundations PD.

The Majority of Librarians Continued to Provide Adult Science Programming

Just over two-thirds (68%) of the Gateways librarians responding to the follow-up survey had provided some form of adult science programming, loosely defined, during the interim. (Note that this figure may be inflated somewhat if the more active librarians were also more likely to respond to the survey.) Almost all of this programming was self-developed, the majority continued to co-facilitate with a science partner, and most described these programs as very successful.

Gateways Programming Was Successful in Engaging Audiences

The majority of both librarians and science partners rated the Gateways programming as successful in engaging the audience, piquing their interest in science, helping them see the relevance of science to daily life, and enhancing their understanding of some science topics.

Science Partners Gained Science Communication Capacity and Enjoyed Their Participation

Although they were not the primary focus of the Gateways project, science partners also experienced positive outcomes as a result of their participation.

- Science partners started out with high self-ratings as public science communicators, but still reported significant (though modest) gains after participating in Gateways; this was especially true for those without previous public science experience.
- Science partners had very positive experiences, especially in terms of their own learning and in helping the public connect science to daily life. Many were pleasantly surprised by the audience's level of interest in and engagement with science topics.
- Almost all responding science partners reported that, based on their Gateways experiences, they are *very* or *extremely* likely to continue their involvement with informal public science, whether at the library or elsewhere.

RECOMMENDATIONS

Expand Availability of Gateways Program

GRG's first recommendation, given the success of the Gateways programming, is to expand its availability to additional libraries. Plans are already underway to migrate the materials on the Gateways website to Infopeople, Califa's education and training branch. Infopeople is one of the places librarians go when they are looking for PD or continuing education. *GRG recommends a publicity push once Gateways is live there. Given the increased recent focus on STEM programming for libraries, interest in the program should be high.*

Increase Independent Usability of Gateways Materials

Once the Gateways training is available on Infopeople, librarians will be using it independently, without the level of support provided by the Gateways team during this project. Therefore, *GRG recommends providing additional guidance for librarians on how the broad themes of the programs can be connected to STEM content in a wide variety of ways. The team could provide 3-4 specific examples, perhaps from Gateways project librarians, that illustrate a broad range of approaches.*

Provide Additional Supplementary Materials

GRG suggests providing longer lists of suggested readings — including books as well as much shorter readings — to allow librarians to better tailor selections to their particular audiences and reduce potential participation barriers for participants. Project participants also asked for lists of additional suggested videos, or additional guidance in finding them, including author videos. Again, examples from Gateways librarians might be useful to share.

Boost Science Partner Use of Background Materials

After the original PTL project, the Gateways team added more supplemental materials as background for the science partners. The Gateways science partners found these materials quite useful, but some of the more helpful materials were severely underutilized; specifically, the guide to program themes and the archived science partner webinar. *GRG recommends that the team strongly emphasize to librarians the usefulness of these materials to their science partners. GRG also recommends that the team consider cutting the archived webinar down to its key elements, as the 60-minute length is likely a barrier.*

Consider Promoting An Existing Community of Practice for Librarians

The Gateways librarians especially valued the chance to brainstorm and consult with other librarians who were putting on similar programming. The project's online discussion threads were underutilized and therefore less useful. *GRG recommends that the team brainstorm about whether there may be existing venues that could be used for this purpose; for example, ASTC's communities of practice or CAISE's community forums.*

In sum, then, the evaluation provides further strong evidence — beyond that already seen for the original PTL project — that the librarian PD model and the PTL-style library science programming models are successful, and that the Rural Gateways extension of that model has been even more successful in enhancing rural librarians' capacity to develop and provide adult science programming in their communities.

APPENDIX

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