

NISE Network Professional Impacts Summative Evaluation

Executive Summary and Appendix E: Technical Appendix

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Nanoscale Informal Science Education Network Professional Impacts Summative Evaluation

This document is an executive summary of the Nanoscale Informal Science Education Network (NISE Net) Professional Impacts Summative Evaluation. **Sections 1-4 below correspond to the points in the report's *Summary of Findings and Discussion*** (Goss et al., 2016, pp. 86-100). The icons displayed to the left of each finding indicate the related section(s) in the report. This page includes a description of the study, and the final two pages include graphs and quotes that are meant to highlight major findings; much more detail is included in the complete report.

Background of the NISE Network

The Nanoscale Informal Science Education Network is a national community of researchers and informal science educators dedicated to fostering public awareness, engagement, and understanding of nanoscale science, engineering, and technology (nano). Funded by the National Science Foundation through two consecutive grants totaling over \$40 million that extended over 10+ years, NISE Net is one of the largest informal science education initiatives ever undertaken in the United States.

NISE Net Goals for Professionals

- Identify with a broader community that includes scientists and museums
- Value local research-ISE collaborations
- Understand and appreciate key concepts in nanoscale science, engineering, and technology and its relationship with our lives, society, and environment
- Understand theories, methods, and practices for effectively engaging diverse public audiences in nano
- Utilize professional resources and educational products for engaging diverse public audiences in nano

Background of this Study

This study was a longitudinal examination of individual professionals over the final three years of the NISE Network (Goss et al., 2016). Based on the NISE Network's goals for professionals, this study explored how involvement with NISE Net impacted an individual professional's sense of community, learning about nano, and use of nano educational products and practices.

This evaluation primarily included professional partners who were:

Informal Science Educators (ISE): Professionals from science museums and children's museums implementing informal science education

University professionals: Individuals from large and small universities and colleges throughout the United States including researchers, scientists, education outreach coordinators, and others

Methods

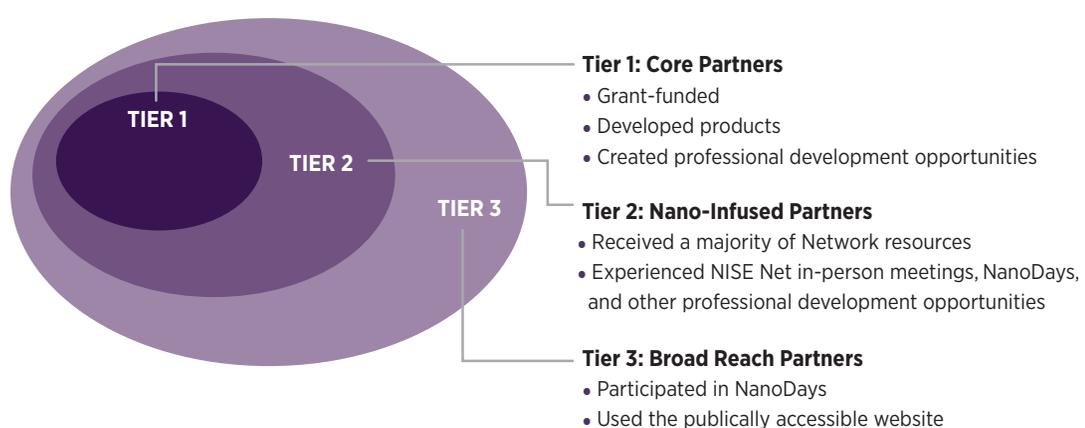
This study employed two data collection methods over three years:

- An **Annual Partner Survey** which involved a total of 597 professionals in Tiers 1-3
- **Yearly interviews** with a representative subset of 21 professionals from Tiers 2 and 3

The survey presented a broad view of how professionals were impacted by participating in the NISE Net as well as how their sense of community, learning about nano, and use of nano educational products and practices changed over time. Interviews provided a deeper understanding of professional involvement in the Network.

NISE Network Tiers of Involvement

NISE Network partners were categorized into tiers based on the roles and responsibilities of the partner institutions, their level of involvement in the Network, and the amount of NISE Net support they received. Descriptions of typical involvement are below.



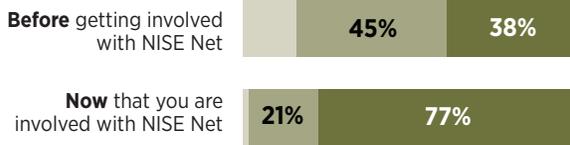
NISE Network Professional Impacts Summative Evaluation



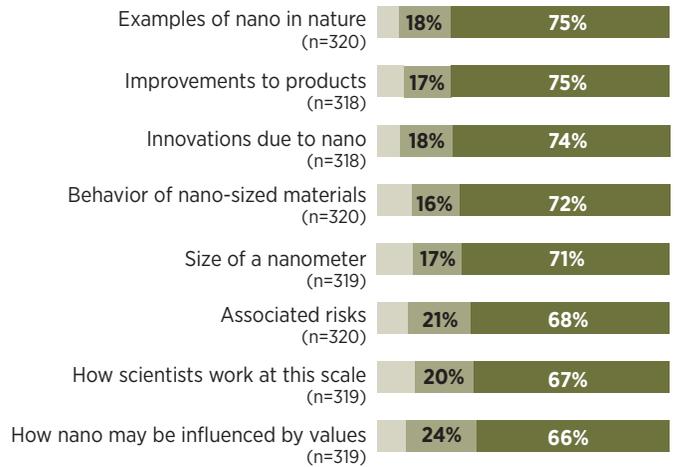
COMMUNITY & COLLABORATION UNDERSTANDING NANO

1 NISE Net professional partners reported that their **sense of community increased** after they became involved with the Network and that **NISE Net affected their understanding of nano**.

To what extent did you identify with a broader community that includes both scientists and museum professionals? (n=321)



How much has NISE Net affected your confidence in explaining the following nano concepts to another adult?



Not at all/Very little A little/Somewhat A lot/A great deal

“I think what it’s done is kind of give a catalyst to come together. Like this new person in engineering—I never would have met him. We actually put out a little news brief on campus that just said, ‘Hey, are you into nano?’ and he came out of the woodwork because he saw that [flyer].”

–Tier 2 University professional, Year 8 interview

“I didn’t even know what nano was. Pretty much everything I know about nano, I know from NISE Net. And if you look at those concepts, I’m certainly able to talk about those concepts, but it is pretty much solely because of NISE Net.”

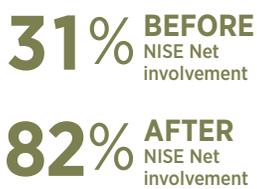
–Tier 2 ISE professional, Year 10 interview



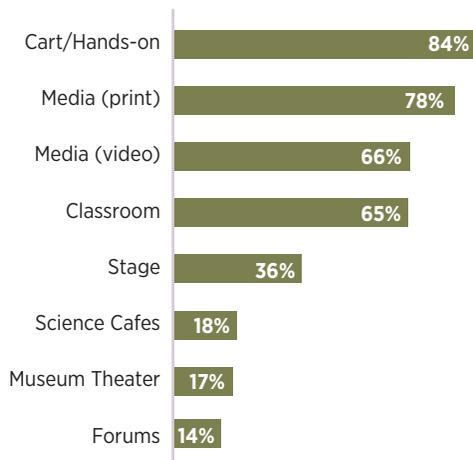
PRODUCTS PRACTICES

2 NISE Net professional partners reported **engaging the public with all types of Network products and practices**, though some were used less than others.

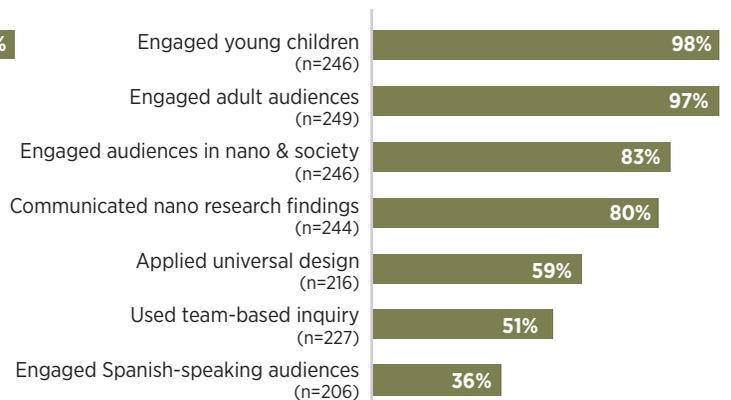
What percent of NISE Net professional partners engaged the public in nano? (n=320)



Did you personally implement any of the following NISE Net educational products with the public? (n=264)



As part of your nano education efforts, have you done any of the following?



“I think one of the things that’s really great about NISE Net is that they have different iterations [of activities] with different lengths of times, different set ups, for different aged people... we were just so impressed that [the kit] had everything, including the little plastic standup stand and the tablecloth!”

–Tier 3 University professional, Year 8 interview

“[W]hen we’re thinking about signage or something big or small, we have focused on [universal design]... I think [in] the 2012 kit there was a nice guide to universal design [and] we’ve used that.”

–Tier 3 ISE professional, Year 8 interview

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PRODUCTS



PRACTICES

3 While the majority of NISE Net professional partners reported gains related to the Network’s goals, **Tier 2 and ISE professionals specifically reported positive change over time from their NISE Net involvement**, especially concerning nano and society content.



COMMUNITY & COLLABORATION



UNDERSTANDING NANO

As of Year 10, what percent of NISE Net professional partners engaged the public in nano and society content? (n=246)

83% OF ALL PARTNERS

Across Years 8–10, as a part of your nano education efforts, have you engaged audiences with nano and society content?



■ First survey response— Percent responding "Yes" ■ Last survey response— Percent responding "Yes"

“I think that the activities and kits help create a broader understanding of how it’s affecting society and what research is being done in the field.”

–Tier 2 ISE professional, Year 9 interview

“It’s just my go-to place for knowledge... if I want to talk about nano and society, science and society, [NISE Net is] the first place I’m going to go.”

–Tier 2 ISE professional, Year 10 interview



BEYOND NANO

4 Evidence indicates that a range of NISE Net professional partners **integrated aspects of NISE Net into their work that is unrelated to nano.**

To what extent has NISE Net increased the amount of ANY partnerships or collaborations between your organization and another? (n=248)



To what extent has NISE Net helped you communicate ANY science, technology, engineering, and math with the public? (n=274)



■ Not at all/Very little ■ A little/Somewhat ■ A lot/A great deal

“I don’t know if I’d be working with the library [if it wasn’t] for the mini-exhibit and NanoDays. [These opportunities have] probably opened the door [for us] and that’s [going to] be a fruitful partnership I see for years to come.”

–Tier 2 University professional, Year 10 interview

“[NISE Net materials have] guided the amount and kind of information that we give to the public because I think NISE Net resources are very good at giving the facilitators an appropriate amount of background information and then boiling that down to the appropriate amount of information to share with the public.”

–Tier 2 ISE professional, Year 10 interview

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Appendix E: Overview of Technical Appendix

The following section provides a more detailed look at the data from the Annual Partner Survey (APS) presented in the graphs and figures located throughout the *NISE Network Professional Impacts Summative Evaluation* report (Goss et al., 2016). Specifically, frequency tables with counts and percentages are provided for all descriptive analyses including overall or subgroup sample sizes. When inferential tests were used—those findings noted as statistically significant and marked with an asterisk in the figure title of the report—the type of test is included, along with the observed test statistic and significance level (“*p*-value”) evaluated at $\alpha=.05$ ¹. As was stated in the report, almost all data were negatively skewed, indicating that parametric procedures were not appropriate. Instead, non-parametric alternatives were conducted, depending on the nature of the analysis:

Type of Test	Used when...
Chi-square (χ^2) test of association	Data are frequency counts and the proportion between two or more categories is desired.
Wilcoxon Signed Ranks test	Data are ordinal (e.g., 6-point Likert-style scale) and longitudinal in nature (either between first/last responses to the APS or retrospective pre/post).
McNemar’s test	Data are dichotomous (e.g., “Yes” or “No” only) and longitudinal in nature.
Mann-Whitney test	Data are continuous in nature but not normally distributed.

Along with the test statistics, additional information about the data are included in this appendix. In many cases, the contingency tables evaluated with chi-square tests are 2 x 2, for which the Fisher’s exact *p*-value is provided – although in many instances the sample sizes were large enough that this may not have been necessary, in several cases there were concerns about low expected cell frequencies, so Fisher’s exact test was used consistently throughout to alleviate such concerns (Barnard’s test was considered but not used). For all other tests, the asymptotic significance level was used. For all Wilcoxon Signed Ranks tests, measures of central tendency and dispersion (i.e., mean, median, and standard deviation) are included along with the frequency table, and the degrees of freedom for each chi-square test are listed before the test statistic.

A note on power: Although power analyses were not conducted for every statistical test that follows, most can be considered to be sufficiently powered. For example, with an overall sample of 321 and a relatively small desired standardized effect size ($d_z=0.2$), the two-tailed Wilcoxon Signed Ranks test reported on page 5 of this Technical Appendix has an achieved power of 0.94; even when this sample is reduced to examine Tier 2

¹ Used in this context, α represents the Type I error rate: probabilistically, the chance that any one test indicates statistical significance when, in fact, there is no difference (between groups or over time). The stated value of $\alpha=.05$ was selected in line with common practice in social science research and in effort to balance concerns for Type II error (failing to find significance when it exists) and maximize power.

professionals alone ($n=170$), the achieved power is 0.72.² Similarly, for an effect size of $w=0.2$, the chi-square test reported on page 20 has an achieved power of 0.90.

A note on comparisons over time: Throughout the report, the final analytical frame presented in each subsection of the Findings is titled “Change Over Years 8 Through 10.” These sections only include respondents who provided data for the APS in multiple years, allowing within-subject comparisons to be made (i.e., analyzing an individual’s change in response to the same question over time). Due to varying nature of the Nanoscale Informal Science Education (NISE) Network and the fact that survey responses were not mandatory, the pattern of repeat responders could take on any number of patterns, as displayed below:

		Last response	
		Repeat Respondents ($n=267$)	
First response	Year 8	68 (25.5%)	130 (48.7%)
	Year 9		69 (25.8%)

Visible above, 267 professionals responded to the APS in multiple years. A subsection of the 130 professionals with a “pre” (first) response in Year 8 and “post” (last) response in Year 10 actually responded in all three years the APS was administered ($n=103$, 38.6% of all repeat respondents); thus, their first responses in Year 8 were considered “pre” and their final responses in Year 10 were considered “post”, while their Year 9 responses were not considered in the sections analyzing change over time. Additional analyses were performed to ensure both pre and post groups were, in fact, comparable in nature, specifically with regard to characteristics frequently used to test throughout the report, namely organization type (i.e., ISE vs. University) and Tier affiliation as shown below.

² G*Power v.3.1.9.2 was used to conduct example power analyses. Desired power is 0.8 or higher.

Repeat Respondents (n=255)*	ISE (n=179)		University (n=76)	
Pre – Year 8 (n=189)	128	(67.7%)	61	(32.3%)
Pre – Year 9 (n=66)	51	(77.3%)	15	(22.7%)
$\chi^2 (1, n=255) = 2.132, p = .16$				
Post – Year 9 (n=64)	45	(70.3%)	19	(29.7%)
Post – Year 10 (n=191)	134	(70.2%)	57	(29.8%)
$\chi^2 (1, n=255) = 0.001, p > .99$				

* Professionals from organizations other than universities and ISEs were excluded (n=12).

Repeat Respondents (n=267)	Tier 1 (n=31)		Tier 2 (n=175)		Tier 3 (n=61)	
Pre – Year 8 (n=198)	23	(11.6%)	130	(65.7%)	45	(22.7%)
Pre – Year 9 (n=69)	8	(11.6%)	45	(65.2%)	16	(23.2%)
$\chi^2 (2, n=267) = 0.006, p = .99$						
Post – Year 9 (n=68)	9	(13.2%)	38	(55.9%)	21	(30.9%)
Post – Year 10 (n=199)	22	(11.1%)	137	(68.8%)	40	(20.1%)
$\chi^2 (2, n=267) = 4.085, p = .13$						

Note that the above tables test the Year 8 “pre” group to the Year 9 “pre” group, and the Year 9 “post” group to the Year 10 “post” group; testing overall pre to post is irrelevant because the same individuals are in both groups, with the same Tier and organization characteristics. As no differences were detected, there is no reason to believe that the combination of these separate “pre” or “post” groups when conducting longitudinal analyses poses any threat to the reliability of the findings.

A note on missing values: Due to the branching that was used on the APS, different subsets of NISE Network professionals received different questions based on their role within their institution, their role within the Network, or their responses on the survey. And, as professionals were not required to respond to every question, the number of valid responses can – and, as shown below, does – change from item to item, which is why n’s are provided for all available categories or sub-items. No attempt was made to replace missing values due the nature of these missing responses, and it is extremely unlikely that these cases represent a threat to the internal validity of the findings since the sample of individuals comes from the list of NISE Network professionals included in Quickbase, as described in the Methods section on page 8 of the report, and is intended to generalize *only* to the population of professionals who participated in the NISE Network. It is

possible that a non-responder bias may have been introduced by those professionals who chose not to respond to the survey.

A note on multiple comparisons: When conducting exploratory research with large data sets – even when research questions and plans for analysis are outlined prior to data collection – the practice of evaluating “significant differences” by conducting repeated statistical tests and looking for sufficiently low significance levels (i.e., $p < .05$) is relatively common, but has serious drawbacks, the most egregious of which is an inflated Type I error rate. That is, the probability that any of these “significant” differences in truth is just a chance occurrence and represents no real difference but *appears* meaningful based on the sample in our analysis increases beyond an acceptable level. One method for dealing with this issue (Benjamini & Hochberg, 1995) is presented at the conclusion of the Technical Appendix (p. E 93).

Similarly, because of the exploratory nature of the analyses that were employed, it is impossible to present to the readers all of the *non*-significant findings that were encountered. Although the practice of sharing such tests and results would help to avoid outcome reporting bias (Kirkham et al., 2010), it would unnecessarily complicate and lengthen this appendix dramatically. A great deal of consideration went into the presentation of findings for the purposes of clarity and conciseness, and every effort was made to be faithful to the data.

This Technical Appendix follows the sequence presented in the report, beginning with Figure 3 on page 16, up to and including the figures presented in Appendix A for the Tier 2-specific analyses.

Example

This page provides an example to orient readers to how information is conveyed in the Technical Appendix.

X.X [Report section header will be listed here, following the numbered section of the report.]

Figure Y. [Figure title will be listed here, following the figure number from the report.]

Year B APS question #: Z (see Instrument Appendix for item format)

[Corresponding APS year will be referenced, in this case B, as well as APS question number, in this example Z, which can be cross-referenced with the Instrument Appendix for further details on item format.]

QZ: [Survey question will be written out here.]

Test used: [If applicable, the inferential test used will be listed here.]

Test result: [If an inferential test was used, the observed test statistic and corresponding *p*-value will be listed here.]

Frequency table:

<i>(n=sample size)</i>		QZ	
1	Response option 1	Count	(%)
2	Response option 2	Count	(%)
3	Response option 3	Count	(%)
4	Response option 4	Count	(%)
5	Response option 5	Count	(%)
6	Response option 6	Count	(%)
	Mean	--	
	Median	--	
	Std. Deviation	--	

Note: [Any pertinent notes on data or analysis will be listed here.]

Technical Appendix

1.1 Tier 1-3 professionals reported an increased sense of community after getting involved with the NISE Net.

Figure 3. Tier 1-3 professionals reported an increased sense of community.

Year 10 APS question #s: 11 & 12 (see Instrument Appendix for item format)

Q11: Before getting involved with NISE Net, to what extent did you identify with a broader community that includes both scientists and museum professionals?

Q12: Now that you are involved with NISE Net, to what extent do you identify with a broader community that includes both scientists and museum professionals?

Test used: Wilcoxon Signed Ranks Test

Test result: $Z = -11.349, p < .001$

Frequency table:

(n=321)		Q11		Q12	
1	Not at all	14	(4.4%)	1	(0.3%)
2	Very little	39	(12.1%)	5	(1.6%)
3	A little	39	(12.1%)	9	(2.8%)
4	Somewhat	106	(33.0%)	59	(18.4%)
5	A lot	74	(23.1%)	125	(38.9%)
6	A great deal	49	(15.3%)	122	(38.0%)
	Mean	4.04		5.08	
	Median	4		5	
	Std. Deviation	1.36		0.93	

Note: (none)

1.2 As of Year 10, Tier 1-3 professionals participated in the NISE Network in a variety of ways and valued the opportunities provided.

Figure 4. Tier 1-3 professionals agreed that NISE Net provided opportunities to participate in the Network.

Year 10 APS question #: 9 (see Instrument Appendix for item format)

- Q9: The NISE Net gives me the opportunity to...
- a. Receive new educational materials for engaging the public in nano.
 - b. Meet professionals outside my organization.
 - c. Learn from professionals outside my organization.
 - d. Share with other professionals how I engage the public in nano.
 - e. Foster local partnerships to engage the public in nano.

Test used: N/A (descriptive data)

Frequency table:

	A (n=321)	B (n=321)	C (n=321)	D (n=318)	E (n=319)
Completely Disagree	0 --	3 (0.9%)	3 (0.9%)	2 (0.6%)	4 (1.3%)
Mostly Disagree	1 (0.3%)	12 (3.7%)	7 (2.2%)	6 (1.9%)	7 (2.2%)
Slightly Disagree	1 (0.3%)	16 (5.0%)	7 (2.2%)	10 (3.1%)	8 (2.5%)
Slightly Agree	19 (5.9%)	57 (17.8%)	45 (14.0%)	58 (18.2%)	61 (19.1%)
Mostly Agree	51 (15.9%)	67 (20.9%)	89 (27.7%)	85 (26.3%)	67 (21.0%)
Completely Agree	230 (71.7%)	152 (47.4%)	158 (49.2%)	135 (42.5%)	152 (47.6%)
Not Applicable	19 (5.9%)	14 (4.4%)	12 (3.7%)	22 (6.9%)	20 (6.3%)

Note: All “Not Applicable” responses were removed from analysis, resulting in adjusted sample sizes and percentages as displayed in the report:

	A (n=302)	B (n=307)	C (n=309)	D (n=296)	E (n=299)
Completely Disagree	0 --	3 (1.0%)	3 (1.0%)	2 (0.7%)	4 (1.3%)
Mostly Disagree	1 (0.3%)	12 (3.9%)	7 (2.3%)	6 (2.0%)	7 (2.3%)
Slightly Disagree	1 (0.3%)	16 (5.2%)	7 (2.3%)	10 (3.4%)	8 (2.7%)
Slightly Agree	19 (6.3%)	57 (18.6%)	45 (14.6%)	58 (19.6%)	61 (20.4%)
Mostly Agree	51 (16.9%)	67 (21.8%)	89 (28.8%)	85 (28.7%)	67 (22.4%)
Completely Agree	230 (76.2%)	152 (49.5%)	158 (51.1%)	135 (45.6%)	152 (50.8%)

1.2 [cont.]

Figure 5. NISE Net provided Tier 1-3 professionals with opportunities to participate in the Network that aligned with professionals’ interests in general.

Year 10 APS question #: 10 (see Instrument Appendix for item format)

Q10: Thinking beyond the NISE Net, how much do you value the following opportunities in general?

- a. Receiving new educational materials for engaging the public.
- b. Meeting professionals outside my organization.
- c. Learning from professionals outside my organization.
- d. Sharing with other professionals how I engage the public.
- e. Fostering local partnerships to engage the public.

Test used: N/A (descriptive data)

Frequency table:

	A (n=320)	B (n=320)	C (n=320)	D (n=318)	E (n=319)
Completely Disagree	0 --	1 (0.3%)	1 (0.3%)	2 (0.6%)	3 (0.9%)
Mostly Disagree	1 (0.3%)	5 (1.6%)	1 (0.3%)	4 (1.3%)	3 (0.9%)
Slightly Disagree	4 (1.3%)	14 (4.4%)	12 (3.8%)	20 (6.3%)	13 (4.1%)
Slightly Agree	24 (7.5%)	38 (11.9%)	20 (6.3%)	57 (17.9%)	33 (10.3%)
Mostly Agree	58 (18.1%)	76 (23.8%)	95 (29.7%)	84 (26.4%)	75 (23.5%)
Completely Agree	223 (69.7%)	180 (56.3%)	187 (58.4%)	141 (44.3%)	184 (57.7%)
Not Applicable	10 (3.1%)	6 (1.9%)	4 (1.3%)	10 (3.1%)	8 (2.5%)

Note: All “Not Applicable” responses were removed from analysis, resulting in adjusted sample sizes and percentages as displayed in the report:

	A (n=310)	B (n=314)	C (n=316)	D (n=308)	E (n=311)
Completely Disagree	0 --	1 (0.3%)	1 (0.3%)	2 (0.6%)	3 (1.0%)
Mostly Disagree	1 (0.3%)	5 (1.6%)	1 (0.3%)	4 (1.3%)	3 (1.0%)
Slightly Disagree	4 (1.3%)	14 (4.5%)	12 (3.8%)	20 (6.5%)	13 (4.2%)
Slightly Agree	24 (7.7%)	38 (12.1%)	20 (6.3%)	57 (18.5%)	33 (10.6%)
Mostly Agree	58 (18.7%)	76 (24.2%)	95 (30.1%)	84 (27.3%)	75 (24.1%)
Completely Agree	223 (71.9%)	180 (57.3%)	187 (59.2%)	141 (45.8%)	184 (59.2%)

1.2 [cont.]

Figure 6. The majority of Year 10 Tier 1-3 respondents have participated in NISE Net by visiting the website, reading the monthly e-newsletter, or connecting with their Regional Hub Leader.

Year 10 APS question #: 3 (see Instrument Appendix for item format)

- Q3: In the past 12 months, how many times have you...
- a. Visited www.nisenet.org
 - b. Contacted or replied to your Regional Hub Leader
 - c. Read the Nano Bite monthly e-newsletter

Test used: N/A (descriptive data)

Frequency table:

	A (n=321)		B (n=314)		C (n=319)	
Never, and I am not aware of this resource	8	(2.5%)	61	(19.4%)	62	(19.4%)
Never, but I am aware of this resource	12	(3.7%)	69	(21.9%)	36	(11.3%)
1-2 times a year	78	(24.3%)	91	(28.9%)	75	(23.5%)
3-6 times a year	93	(29.0%)	67	(21.6%)	71	(22.5%)
7-12 times a year	57	(17.8%)	19	(6.0%)	68	(21.3%)
More than 12 times a year	73	(22.7%)	7	(2.2%)	7	(2.2%)

Note: (none)

1.3 As of Year 10, Tier 1-3 professionals felt confident initiating a partnership with an informal learning or research organization and often used NISE Net resources to do so.

Figure 7. Of the Tier 1-3 professionals who responded that their organization has partnered, the majority of Year 10 respondents reported between 1 and 5 collaborators in the previous year.

Year 10 APS question #: 17 (see Instrument Appendix for item format)

Q17: In the past 12 months, about how many partners or collaborators has your organization had around engaging the public in nano?

Test used: N/A (descriptive data)

Frequency table:

	(n=248)	
1 to 2	76	(30.6%)
3 to 5	87	(35.1%)
6 to 10	35	(14.1%)
11 to 20	11	(4.4%)
21 to 40	8	(3.2%)
More than 40	11	(4.4%)
I don't know	20	(8.1%)

Note: Question only asked to professionals responding “Yes” to the preceding question (16), “Has your organization partnered or collaborated with another around engaging the public in nano?” All “I don’t know” responses were removed from analysis, resulting in the adjusted sample size and percentages as displayed in the report:

	(n=228)	
1 to 2	76	(33.3%)
3 to 5	87	(38.2%)
6 to 10	35	(15.4%)
11 to 20	11	(4.8%)
21 to 40	8	(3.5%)
More than 40	11	(4.8%)

1.3 [cont.]

Figure 8. Of the Tier 1-3 professionals who responded that their organization has partnered, the majority of Year 10 respondents reported that their organization has partnered with Universities to engage the public in nano.

Year 10 APS question #: 18 (see Instrument Appendix for item format)

Q18: In the past 12 months, which types of partners or collaborators has your organization had around engaging the public in nano?

Test used: N/A (descriptive data)

Frequency table:

University or College (n=250)	199	(79.6%)
K-12 school (n=240)	129	(53.8%)
Museum or Science Center (n=242)	124	(51.2%)
Community organization (n=242)	99	(40.9%)
Industry (n=237)	68	(28.7%)
Other (n=236)	26	(11.0%)

Note: Question only asked to professionals responding “Yes” to the earlier question (16), “Has your organization partnered or collaborated with another around engaging the public in nano?”

1.3 [cont.]

Figure 9. The majority of Tier 1-3 professionals feel confident in their ability to initiate a partnership with an informal learning or research organization.

Year 10 APS question #: 25h (see Instrument Appendix for item format)

Q25: Please rate the extent to which you agree with the following: As part of my nano education efforts, I feel confident in my ability to:

- h. initiate a partnership with an informal learning or research organization.

Test used: N/A (descriptive data)

Frequency table:

	H (n=260)	
Completely Disagree	1	(0.4%)
Mostly Disagree	1	(0.4%)
Slightly Disagree	13	(5.0%)
Slightly Agree	48	(18.5%)
Mostly Agree	68	(26.2%)
Completely Agree	121	(46.5%)
Not Applicable	8	(3.1%)

Note: All “Not Applicable” responses were removed from analysis, resulting in adjusted sample sizes and percentages as displayed in the report:

	H (n=252)	
Completely Disagree	1	(0.4%)
Mostly Disagree	1	(0.4%)
Slightly Disagree	13	(5.2%)
Slightly Agree	48	(19.0%)
Mostly Agree	68	(27.0%)
Completely Agree	121	(48.0%)

1.4 Over Years 8-10, ISE professionals’ confidence in initiating a partnership increased, possibly because of NanoDays.

Figure 10. Over Years 8-10, ISE professionals’ mean confidence in initiating partnerships increased.

Year 10 APS question #: 25h (see Instrument Appendix for item format)

Q25: Please rate the extent to which you agree with the following: As part of my nano education efforts, I feel confident in my ability to:
 h. initiate a partnership with an informal learning or research organization.

Test used: Wilcoxon Signed Ranks Test

Test result: Wilcoxon $z = -2.288$, $p = .022$

Frequency table:

(n=128)		Pre		Post	
1	Completely Disagree	2	(1.6%)	0	--
2	Mostly Disagree	2	(1.6%)	1	(0.8%)
3	Slightly Disagree	6	(4.7%)	9	(7.0%)
4	Slightly Agree	29	(22.7%)	22	(17.2%)
5	Mostly Agree	45	(35.2%)	35	(27.3%)
6	Completely Agree	44	(34.4%)	61	(47.7%)
Mean		4.91		5.14	
Median		5		5	
Std. Deviation		1.07		0.99	

Note: All “Not Applicable” responses were removed *prior to* analysis (for Pre, N/A $n=12$, for Post, N/A $n=6$). This analysis compared only ISE professionals and filtered out all others.

This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

1.5 Over Years 8-10, University professionals became less likely to initiate a partnership with an informal learning or research organization, possibly because on-going partnerships were already in place.

Figure 11. University professionals became less likely to initiate partnerships over Years 8-10.

Year 10 APS question #: 26h (see Instrument Appendix for item format)

Q26: As part of your nano education efforts, have you done any of the following?
 h. Initiated a partnership with an informal learning or research organization.

Test used: McNemar’s Test

Test result: $\chi^2 (1, n=61) = 4.765, p = .049$

Frequency table:

Pre / First survey response	Post / Last survey response	
	No	Yes
No	6 (9.8%)	4 (6.6%)
Yes	13 (21.3%)	38 (62.3%)

*n=61

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only University professionals and filtered out all others.

2.1 As of Year 10, the majority of Tier 1-3 professionals rated highly both their confidence in their ability to explain nano to another adult and the amount that NISE Net has affected this confidence.

Figure 14. On the Year 10 survey, the majority of Tier 1-3 professionals reported that they felt confident in explaining nano concepts.

Year 10 APS question #: 20 (see Instrument Appendix for item format)

- Q20: I feel confident in my ability to explain to another adult...
- a. The size of a nanometer
 - b. How nano-sized materials behave compared to macro-sized materials
 - c. How scientists work at the nanoscale
 - d. Examples of nano in nature
 - e. Innovations that are possible because of nanotechnology
 - f. Ways that nanotechnology improves existing products
 - g. Risks or potential risks of nanotechnology
 - h. How the future of nanotechnology may be influenced by political, economic, and personal values

Test used: N/A (descriptive data)

Frequency table:

	A (n=323)	B (n=323)	C (n=322)	D (n=322)
Completely Disagree	8 (2.5%)	9 (2.8%)	8 (2.5%)	4 (1.2%)
Mostly Disagree	5 (1.5%)	5 (1.5%)	3 (0.9%)	4 (1.2%)
Slightly Disagree	4 (1.2%)	6 (1.9%)	13 (4.0%)	5 (1.6%)
Slightly Agree	16 (5.0%)	25 (7.7%)	28 (8.7%)	22 (6.8%)
Mostly Agree	60 (18.6%)	90 (27.9%)	114 (35.4%)	95 (29.5%)
Completely Agree	230 (71.2%)	188 (58.2%)	156 (48.4%)	192 (59.6%)

	E (n=321)	F (n=322)	G (n=322)	H (n=321)
Completely Disagree	3 (0.9%)	3 (0.9%)	6 (1.9%)	7 (2.2%)
Mostly Disagree	2 (0.6%)	2 (0.6%)	9 (2.8%)	6 (1.9%)
Slightly Disagree	3 (0.9%)	7 (2.2%)	15 (4.7%)	18 (5.6%)
Slightly Agree	24 (7.5%)	32 (9.9%)	55 (17.1%)	62 (19.3%)
Mostly Agree	101 (31.5%)	108 (33.5%)	107 (33.2%)	113 (35.2%)
Completely Agree	188 (58.6%)	170 (52.8%)	130 (40.4%)	115 (35.8%)

Note: (none)

2.1 [cont.]

Figure 15. On the Year 10 survey, the majority of Tier 1-3 professionals reported that NISE Net had affected their confidence in explaining nano concepts a lot or a great deal.

Year 10 APS question #: 21 (see Instrument Appendix for item format)

Q21: How much has NISE Net affected your confidence in explaining to another adult...

- a. The size of a nanometer
- b. How nano-sized materials behave compared to macro-sized materials
- c. How scientists work at the nanoscale
- d. Examples of nano in nature
- e. Innovations that are possible because of nanotechnology
- f. Ways that nanotechnology improves existing products
- g. Risks or potential risks of nanotechnology
- h. How the future of nanotechnology may be influenced by political, economic, and personal values

Test used: N/A (descriptive data)

Frequency table:

	A (n=319)	B (n=320)	C (n=319)	D (n=320)
Not at all	21 (6.6%)	19 (5.9%)	20 (6.3%)	11 (3.4%)
Very little	19 (6.0%)	18 (5.6%)	21 (6.6%)	12 (3.8%)
A little	16 (5.0%)	16 (5.0%)	21 (6.6%)	20 (6.3%)
Somewhat	37 (11.6%)	36 (11.3%)	44 (13.8%)	38 (11.9%)
A lot	60 (18.8%)	58 (18.1%)	62 (19.4%)	66 (20.6%)
A great deal	166 (52.0%)	173 (54.1%)	151 (47.3%)	173 (54.1%)

	E (n=318)	F (n=318)	G (n=320)	H (n=319)
Not at all	14 (4.4%)	15 (4.7%)	19 (5.9%)	16 (5.0%)
Very little	12 (3.8%)	13 (4.1%)	16 (5.0%)	17 (5.3%)
A little	16 (5.0%)	15 (4.7%)	19 (5.9%)	24 (7.5%)
Somewhat	41 (12.9%)	38 (11.9%)	48 (15.0%)	52 (16.3%)
A lot	65 (20.4%)	75 (23.6%)	68 (21.3%)	64 (20.1%)
A great deal	170 (53.5%)	162 (50.9%)	150 (46.9%)	146 (45.8%)

Note: (none)

2.2 As of Year 10, Tier 2 and ISE professionals were more likely than Tier 3 or University partners to attribute NISE Net with impacting their confidence in nano.

Creation of “confidence” indices:

Year 10 APS question #s: 20 & 21 (see Instrument Appendix for item format)

In order to examine Tier 1-3 professionals’ understanding of nano concepts as a whole rather than by the individual concepts, responses from Year 10 survey questions 20 and 21 were aggregated across all eight sub-items (a-h; see Instrument Appendix for item format) to create two indices. The table below provides the original response options and numbered scales for both survey questions:

Q20: I feel confident in my ability to explain to another adult...					
Completely Disagree	Mostly Disagree	Slightly Disagree	Slightly Agree	Mostly Agree	Completely Agree
1	2	3	4	5	6
Q21: How much has NISE Net affected your confidence in explaining to another adult...					
Not at all	Very Little	A Little	Somewhat	A Lot	A Great Deal
1	2	3	4	5	6

Combining sub-items provides more variance in the construct – helping both measures of confidence move from ordinal data toward continuous – thus allowing professionals’ responses to be examined using different tests (and one test, rather than one for each sub-item). More importantly, analyzing the data in this way provides a broader indicator of professionals’ overall confidence in nano concepts and overall feeling of how this confidence has been impacted by the NISE Network.

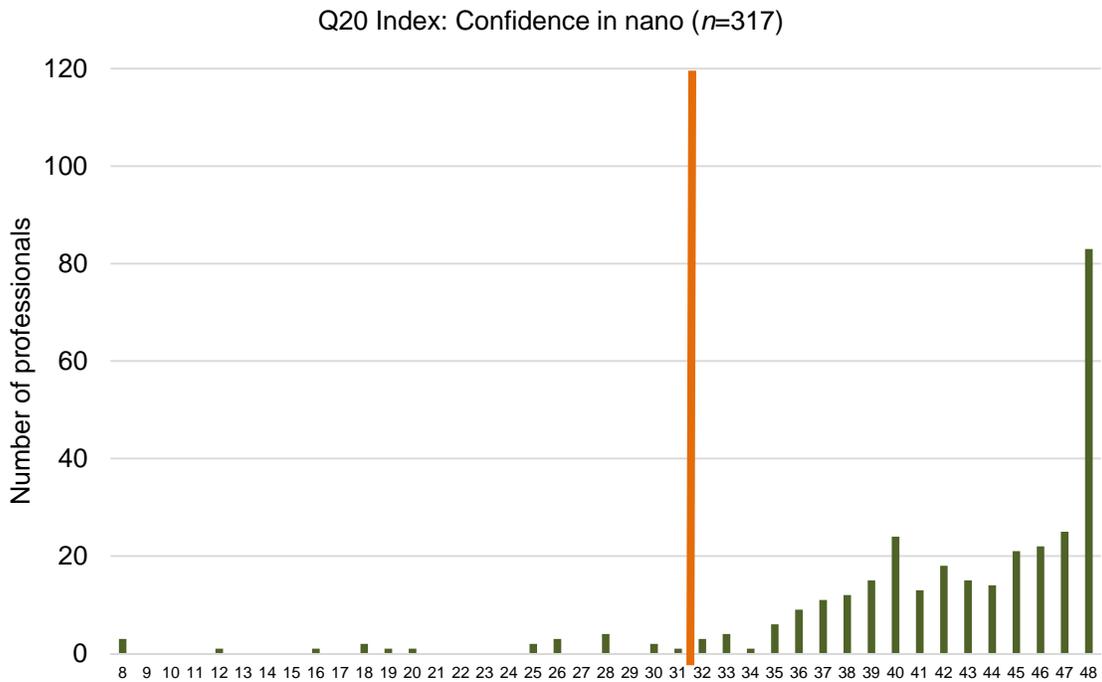
Aggregating responses across all 8 sub-items for both questions 20 and 21, the lowest score possible on either index was 8, where the professional responded in the lowest category (1 out of 6) for each of the eight concepts (1 x 8 = 8). The highest possible score on either index was 48, where the professional responded in the highest category (6 out of 6) for each of the eight concepts (6 x 8 = 48)³.

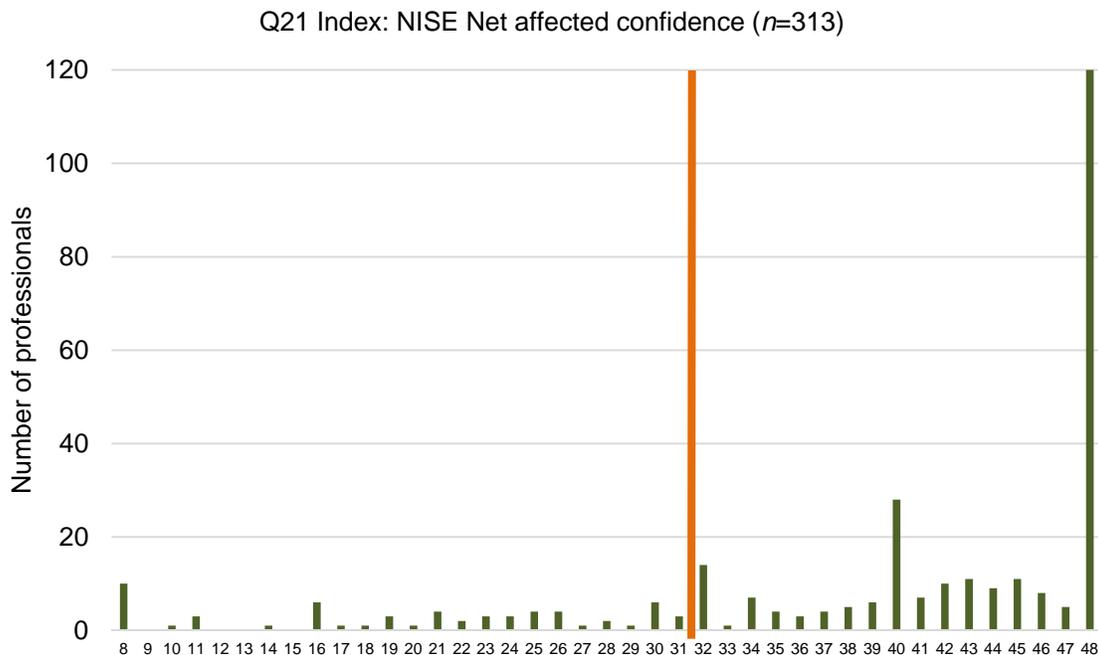
As shown in the graphs that follow, Tier 1-3 professionals responded overwhelmingly positively to both survey questions relating to confidence in nano concepts. For question 20 asking how confident professionals felt explaining nano, about one-quarter (83 of 317,

³ If professionals omitted one or more responses to these questions around confidence, they were removed from analysis as their aggregated score would not be out of the same total (48). Weighting responses to correct for missing data was deemed inappropriate as it was unknown if these omissions were Missing Completely At Random (MCAR) or not applicable for other reasons. For the Q20 index, 6 professionals had at least one missing value and were removed from analysis (n=317), while for the Q21 index, 10 professionals were removed for missing values (n=313).

26%) of all respondents replied in the highest category (selecting “Completely Agree”) for all eight concepts. Moreover, for question 21 asking how much the NISE Net affected this confidence in explaining nano, nearly 40% of respondents replied in the highest category, “A Great Deal,” for all eight concepts (120 of 313, 38%).

The orange lines on the graphs below distinguish those professionals who, on average, were neutral or tended to disagree with the sub-items about confidence in nano and those who tended to agree (32 represents the index score at which professionals responded “Slightly Agree” or “Somewhat” – a 4 on either scale, on average – so any score that is a 31 or lower indicates an index that tends toward the bottom half of each scale, on average). As can be seen in each of the distributions, many more professionals felt positive about both their aggregated confidence in nano as well as the degree to which they felt the NISE Net affected their confidence in nano (the bars to the right of each orange line). The table following these graphs provides further information about the index values and corresponding survey options.

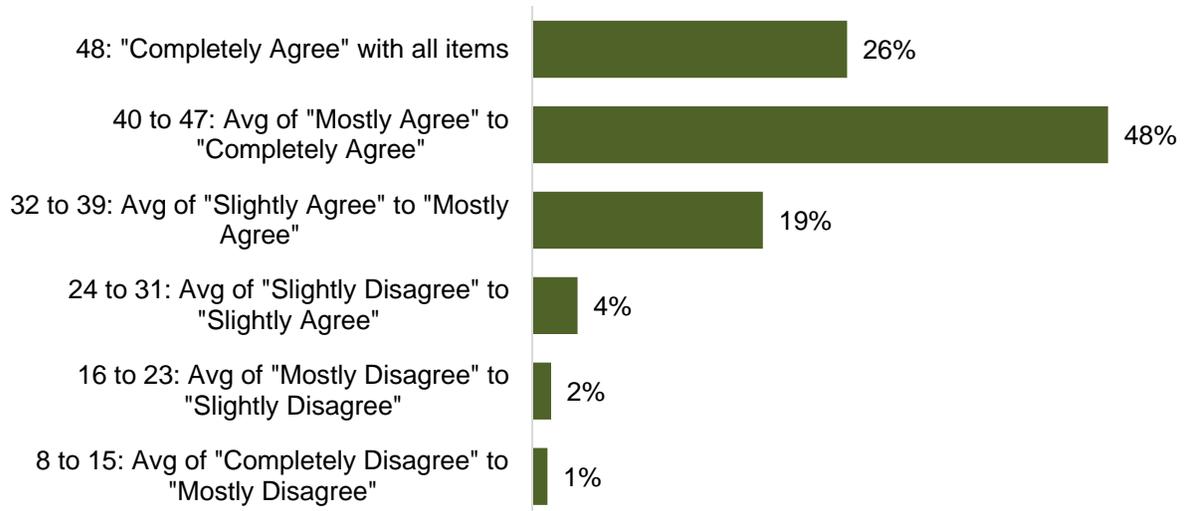




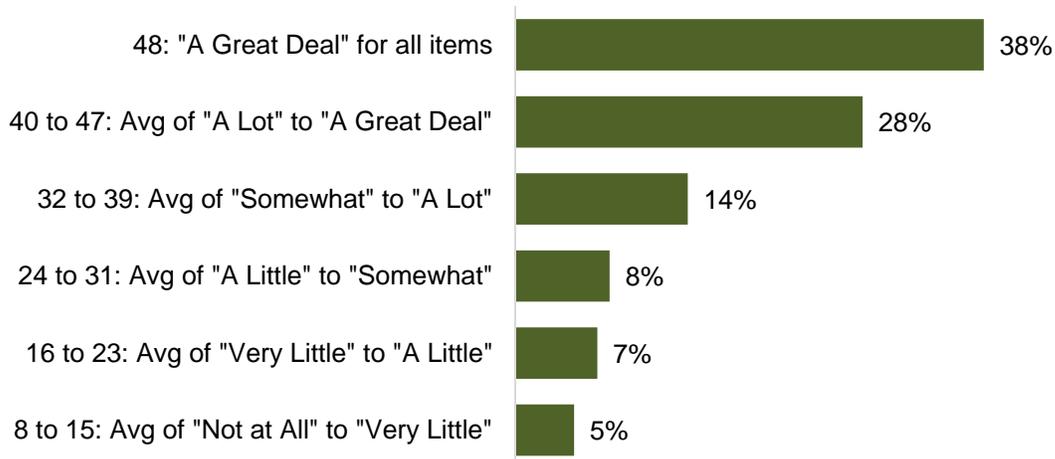
Index value	
8	Selected “Completely Disagree” (Q20) / “Not at All” (Q21) to all sub-items
9-15	Average response somewhere between “Completely Disagree” and “Mostly Disagree” (Q20) / “Not at All” and “Very Little” (Q21) across sub-items
16	Average response of “Mostly Disagree” (Q20) / “Very Little” (Q21) across sub-items
17-23	Average response somewhere between “Mostly Disagree” and “Slightly Disagree” (Q20) / “Very Little” and “A Little” (Q21) across sub-items
24	Average response of “Slightly Disagree” (Q20) / “A Little” (Q21) across sub-items
25-31	Average response somewhere between “Slightly Disagree” and “Slightly Agree” (Q20) / “A Little” and “Somewhat” (Q21) across sub-items
32	Average response of “Slightly Agree” (Q20) / “Somewhat” (Q21) across sub-items
33-39	Average response somewhere between “Slightly Agree” and “Mostly Agree” (Q20) / “Somewhat” and “A Lot” (Q21) across sub-items
40	Average response of “Mostly Agree” (Q20) / “A Lot” (Q21) across sub-items
41-47	Average response somewhere between “Mostly Agree” and “Completely Agree” (Q20) / “Very Lot” and “A Great Deal” (Q21) across sub-items
48	Selected “Completely Agree” (Q20) / “A Great Deal” (Q21) to all sub-items

The figures below show the distribution of these indices' ranges.

I feel confident in my ability to explain to another adult [nano concepts]. (n=317)



How much has NISE Net affected your confidence in explaining to another adult [nano concepts]? (n=313)



The analyses that follow explore differences between professionals with an index of 32 or above and those with an index of 31 or below. Although the Q21 (NISE Net affected confidence) index was not presented in detail in the main text of the report, it is presented in the Tier 2-focused analyses at the conclusion of the report, and included in this Technical Appendix as well (beginning on p. E 90).

2.2 [cont.]

Figure 16. Tier 3 professionals were less likely than Tier 1 and 2 professionals to attribute their understanding of nano to NISE Net.

Year 10 APS question #: 21 Index (see preceding pages for a discussion of the Index creation)

Test used: Chi-square test

Test result: $\chi^2 (2, n=320) = 10.896, p = .004$

Frequency table:

	Tier 1 (n=30)		Tier 2 (n=194)		Tier 3 (n=96)	
Index of 31 or lower	5	(16.7%)	29	(14.9%)	30	(31.3%)
Index of 32 or above	25	(83.3%)	165	(85.1%)	66	(68.8%)

Note: The cell including Tier 3 professionals with an index below 32 (n=30, 31.3%) had a standardized residual of 2.5, indicating that the observed number of respondents in this category was significantly different than expected, and moreover, that the proportion of Tier 3 professionals in this index category (below 32) was significantly different than that of either Tiers 1 or 2. All other standardized residuals were less than 2.0.

2.2 [cont.]

Figure 17. ISE professionals were more likely than University professionals to attribute their understanding of nano to NISE Net.

Year 10 APS question #: 21 Index (see preceding pages for a discussion of the Index creation)

Test used: Chi-square test

Test result: χ^2 (1, $n=305$) = 31.285, Fisher’s Exact 2-tailed $p < .001$

Frequency table:

	ISE ($n=211$)		University ($n=94$)	
Index of 31 or lower	23	(10.9%)	36	(38.3%)
Index of 32 or above	188	(89.1%)	58	(61.7%)

Note: The cell including University professionals with an index below 32 ($n=36$, 38.3%) had a standardized residual of 4.2, indicating that the observed number of respondents in this category was significantly different than expected, and moreover, that the proportion of University professionals in this index category (below 32) was significantly different than that of ISE professionals. (Conversely, the standardized residual of the cell including ISE professionals with an index below 32 ($n=23$, 10.9%) was -2.8, indicating that there were significantly fewer respondents in this category than expected.) All other standardized residuals were less than 2.0.

2.3 Tier 1-3 professionals reported that NISE Net resources such as NanoDays kits, face-to-face meetings, and the website were particularly useful for their learning, though they also reported learning about nano through methods outside of NISE Net.

Figure 18. When asked what most impacted their level of confidence in nano concepts, the majority of Year 9 survey respondents from Tiers 1-3 mentioned a NISE Net resource as part or all of their response. (*n*=145)

Year 9 APS question #: 24 (see Instrument Appendix for item format)

Q24: For the nano concept(s) from the table above that you feel the most confident about, what has helped you reach this level of confidence? This could be a NISE Net resource or something outside of NISE Net.

Test used: N/A (descriptive data)

Frequency table:

<i>(n</i> =145)	
NISE Net resource only	72 (49.7%)
Non-NISE Net resource only	38 (26.2%)
Both NISE Net and other resources	35 (24.1%)

Note: Inductive coding analysis was used for these open-ended responses. See Table 7 on page 39 of the report for the more detailed qualitative codes used.

2.4 Over Years 8-10, Tier 2 professionals and ISE professionals became more confident in nano and society concepts and increased the extent to which they attributed NISE Net with that confidence.

Figure 19. Over Years 8-10, Tier 2 professionals and ISE professionals reported an increase in their ability to explain a nano and society concept.

Tier 2 Professionals

Year 10 APS question #: 20g (see Instrument Appendix for item format)

Q20: I feel confident in my ability to explain to another adult...
 g. Risks or potential risks of nanotechnology.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.200, p = .028$

Frequency table:

(n=170)		Pre		Post	
1	Completely Disagree	2	(1.2%)	1	(0.6%)
2	Mostly Disagree	5	(2.9%)	3	(1.8%)
3	Slightly Disagree	10	(5.9%)	5	(2.9%)
4	Slightly Agree	30	(17.6%)	30	(17.6%)
5	Mostly Agree	69	(40.6%)	67	(39.4%)
6	Completely Agree	54	(31.8%)	64	(37.6%)
	Mean	4.89		5.06	
	Median	5		5	
	Std. Deviation	1.09		.962	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

2.4 [cont.]

Figure 19. Over Years 8-10, Tier 2 professionals and ISE professionals reported an increase in their ability to explain a nano and society concept.

ISE Professionals

Year 10 APS question #: 20g (see Instrument Appendix for item format)

Q20: I feel confident in my ability to explain to another adult...
 g. Risks or potential risks of nanotechnology.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.095$, $p = .036$

Frequency table:

(n=174)		Pre		Post	
1	Completely Disagree	1	(0.6%)	1	(0.6%)
2	Mostly Disagree	4	(2.3%)	5	(2.9%)
3	Slightly Disagree	13	(7.5%)	5	(2.9%)
4	Slightly Agree	33	(19.0%)	33	(19.0%)
5	Mostly Agree	68	(39.1%)	62	(35.6%)
6	Completely Agree	55	(31.6%)	68	(39.1%)
	Mean	4.89		5.03	
	Median	5		5	
	Std. Deviation	1.05		1.03	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

2.4 [cont.]

Figure 20. Over Years 8-10, Tier 2 professionals and ISE professionals increased the extent to which they attributed their confidence in nano and society concepts to NISE Net.

Tier 2 Professionals

Year 10 APS question #: 21g (see Instrument Appendix for item format)

Q21: How much has NISE Net affected your confidence in explaining to another adult...
 g. Risks or potential risks of nanotechnology.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.219$, $p = .026$

Frequency table:

(n=172)		Pre		Post	
1	Not at All	5	(2.9%)	3	(1.7%)
2	Very Little	5	(2.9%)	5	(2.9%)
3	A Little	14	(8.1%)	7	(4.1%)
4	Somewhat	19	(11.0%)	22	(12.8%)
5	A Lot	40	(23.3%)	32	(18.6%)
6	A Great Deal	89	(51.7%)	103	(59.9%)
	Mean	5.04		5.23	
	Median	6		6	
	Std. Deviation	1.30		1.18	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

2.4 [cont.]

Figure 20. Over Years 8-10, Tier 2 professionals and ISE professionals reported an increase in their ability to explain a nano and society concept.

ISE Professionals

Year 10 APS question #: 21h (see Instrument Appendix for item format)

Q21: How much has NISE Net affected your confidence in explaining to another adult...

- h. How the future of nanotechnology may be influenced by political, economic, and personal values.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -1.967, p = .049$

Frequency table:

(n=173)		Pre		Post	
1	Not at All	5	(2.9%)	4	(2.3%)
2	Very Little	4	(2.3%)	2	(1.2%)
3	A Little	11	(6.4%)	6	(3.5%)
4	Somewhat	21	(12.1%)	22	(12.7%)
5	A Lot	37	(21.4%)	34	(19.7%)
6	A Great Deal	95	(54.9%)	105	(60.7%)
	Mean	5.12		5.28	
	Median	6		6	
	Std. Deviation	1.26		1.13	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

2.4 [cont.]

In-text finding (page 43 of report, below Figure 20).

Tier 2 Professionals

Year 10 APS question #: 20b (see Instrument Appendix for item format)

Q20: I feel confident in my ability to explain to another adult...

b. How nano-sized materials behave compared to macro-sized materials.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.309$, $p = .021$

Frequency table:

(n=172)		Pre		Post	
1	Completely Disagree	2	(1.2%)	0	(0%)
2	Mostly Disagree	3	(1.7%)	3	(1.7%)
3	Slightly Disagree	2	(1.2%)	3	(1.7%)
4	Slightly Agree	15	(8.7%)	7	(4.1%)
5	Mostly Agree	63	(36.6%)	56	(32.6%)
6	Completely Agree	87	(50.6%)	103	(59.9%)
	Mean	5.30		5.47	
	Median	6		6	
	Std. Deviation	0.95		0.81	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

2.4 [in-text findings, cont.]

ISE Professionals

Year 10 APS question #: 20b (see Instrument Appendix for item format)

Q20: I feel confident in my ability to explain to another adult...
 b. How nano-sized materials behave compared to macro-sized materials.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.429$, $p = .015$

Frequency table:

(n=174)		Pre		Post	
1	Completely Disagree	1	(0.6%)	1	(0.6%)
2	Mostly Disagree	3	(1.7%)	2	(1.1%)
3	Slightly Disagree	3	(1.7%)	3	(1.7%)
4	Slightly Agree	17	(9.8%)	10	(5.7%)
5	Mostly Agree	65	(37.4%)	56	(32.2%)
6	Completely Agree	85	(48.9%)	102	(58.6%)
	Mean	5.28		5.44	
	Median	5		6	
	Std. Deviation	0.91		0.85	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

2.4 [in-text findings, cont.]

Tier 2 Professionals

Year 10 APS question #: 21b (see Instrument Appendix for item format)

Q21: How much has NISE Net affected your confidence in explaining to another adult...

b. How nano-sized materials behave compared to macro-sized materials.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.532$, $p = .011$

Frequency table:

(n=173)		Pre		Post	
1	Not at All	6	(3.5%)	3	(1.7%)
2	Very Little	5	(2.9%)	6	(3.5%)
3	A Little	7	(4.0%)	3	(1.7%)
4	Somewhat	15	(8.7%)	11	(6.4%)
5	A Lot	38	(22.0%)	34	(19.7%)
6	A Great Deal	102	(59.0%)	116	(67.1%)
	Mean	5.20		5.40	
	Median	6		6	
	Std. Deviation	1.27		1.11	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

2.4 [in-text findings, cont.]

Tier 2 Professionals

Year 10 APS question #: 20c (see Instrument Appendix for item format)

Q20: I feel confident in my ability to explain to another adult...
 c. How scientists work at the nanoscale.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -1.978$, $p = .048$

Frequency table:

(n=168)		Pre		Post	
1	Completely Disagree	1	(0.6%)	0	(0%)
2	Mostly Disagree	3	(1.8%)	3	(1.8%)
3	Slightly Disagree	6	(3.6%)	4	(2.4%)
4	Slightly Agree	30	(17.9%)	21	(12.5%)
5	Mostly Agree	57	(33.9%)	62	(36.9%)
6	Completely Agree	71	(42.3%)	78	(46.4%)
	Mean	5.10		5.24	
	Median	5		5	
	Std. Deviation	1.00		0.89	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

2.4 [in-text findings, cont.]

ISE Professionals

Year 10 APS question #: 20c (see Instrument Appendix for item format)

Q20: I feel confident in my ability to explain to another adult...
 c. How scientists work at the nanoscale.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.746$, $p = .006$

Frequency table:

(n=174)		Pre		Post	
1	Completely Disagree	0	(0%)	1	(0.6%)
2	Mostly Disagree	4	(2.3%)	2	(1.1%)
3	Slightly Disagree	6	(3.4%)	5	(2.9%)
4	Slightly Agree	37	(21.3%)	25	(14.4%)
5	Mostly Agree	64	(36.8%)	65	(37.4%)
6	Completely Agree	63	(36.2%)	76	(43.7%)
	Mean	5.01		5.18	
	Median	5		5	
	Std. Deviation	0.96		0.93	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

2.4 [in-text findings, cont.]

ISE Professionals

Year 10 APS question #: 20a (see Instrument Appendix for item format)

Q20: I feel confident in my ability to explain to another adult...
 a. The size of a nanometer.

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.282$, $p = .022$

Frequency table:

(n=176)		Pre		Post	
1	Completely Disagree	1	(0.6%)	0	(0%)
2	Mostly Disagree	1	(0.6%)	4	(2.3%)
3	Slightly Disagree	6	(3.4%)	4	(2.3%)
4	Slightly Agree	13	(7.4%)	6	(3.4%)
5	Mostly Agree	38	(21.6%)	31	(17.6%)
6	Completely Agree	117	(66.5%)	131	(74.4%)
	Mean	5.48		5.60	
	Median	6		6	
	Std. Deviation	0.89		0.85	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

3.1 On a retrospective pre/post question, Tier 1-3 professionals reported they were significantly more likely to engage the public in nano as of Year 10 than they were prior to Network involvement.

Figure 21. Before getting involved with NISE Net, 31% of Year 10 Tier 1-3 respondents were personally engaging the public in nano, whereas 82% of respondents are doing so in their current role.

Year 10 APS question #s: 22 & 23 (see Instrument Appendix for item format)

Q22: Before getting involved with NISE Net, did you personally engage any public audience in nano at any time of the year?

Q23: In your current role at your organization, do you personally engage any public audience in nano at any time of the year?

Test used: N/A (descriptive data)

Frequency table:

	Q22 (n=322)		Q23 (n=321)	
No	222	(68.9%)	59	(18.4%)
Yes	100	(31.1%)	262	(81.6%)

Note: (none)

3.1 [cont.]

Figure 22. There was an increase in the percentage of professionals who reported they personally engaged any public audience in nano from before getting involved with NISE Net to their current role in Year 10. This is true for all tiers and organization types.

Tier 1 Professionals

Year 10 APS question #s: 22 & 23 (see Instrument Appendix for item format)

Q22: Before getting involved with NISE Net, did you personally engage any public audience in nano at any time of the year?

Q23: In your current role at your organization, do you personally engage any public audience in nano at any time of the year?

Test used: McNemar’s Test

Test result: $\chi^2 (1, n=29) = 15.000, p < .001$

Frequency table:

Q22 / Before	Q23 / Currently	
	No	Yes
No	6 (20.7%)	15 (51.7%)
Yes	0 (0%)	8 (27.6%)

**n=29*

Note: This analysis compared only Tier 1 professionals and filtered out all others.

3.1 [cont.]

Figure 22. There was an increase in the percentage of professionals who reported they personally engaged any public audience in nano from before getting involved with NISE Net to their current role in Year 10. This is true for all tiers and organization types.

Tier 2 Professionals

Year 10 APS question #s: 22 & 23 (see Instrument Appendix for item format)

Q22: Before getting involved with NISE Net, did you personally engage any public audience in nano at any time of the year?

Q23: In your current role at your organization, do you personally engage any public audience in nano at any time of the year?

Test used: McNemar’s Test

Test result: $\chi^2 (1, n=194) = 92.860, p < .001$

Frequency table:

Q22 / Before	Q23 / Currently	
	No	Yes
No	29 (14.9%)	114 (58.8%)
Yes	7 (3.6%)	44 (22.7%)

**n=194*

Note: This analysis compared only Tier 2 professionals and filtered out all others.

3.1 [cont.]

Figure 22. There was an increase in the percentage of professionals who reported they personally engaged any public audience in nano from before getting involved with NISE Net to their current role in Year 10. This is true for all tiers and organization types.

Tier 3 Professionals

Year 10 APS question #s: 22 & 23 (see Instrument Appendix for item format)

Q22: Before getting involved with NISE Net, did you personally engage any public audience in nano at any time of the year?

Q23: In your current role at your organization, do you personally engage any public audience in nano at any time of the year?

Test used: McNemar’s Test

Test result: $\chi^2 (1, n=97) = 29.091, p < .001$

Frequency table:

Q22 / Before	Q23 / Currently	
	No	Yes
No	10 (10.3%)	48 (49.5%)
Yes	7 (7.2%)	32 (33.0%)

*n=97

Note: This analysis compared only Tier 3 professionals and filtered out all others.

3.1 [cont.]

Figure 22. There was an increase in the percentage of professionals who reported they personally engaged any public audience in nano from before getting involved with NISE Net to their current role in Year 10. This is true for all tiers and organization types.

I SE Professionals

Year 10 APS question #s: 22 & 23 (see Instrument Appendix for item format)

Q22: Before getting involved with NISE Net, did you personally engage any public audience in nano at any time of the year?

Q23: In your current role at your organization, do you personally engage any public audience in nano at any time of the year?

Test used: McNemar’s Test

Test result: $\chi^2 (1, n=209) = 120.852, p < .001$

Frequency table:

Q22 / Before	Q23 / Currently	
	No	Yes
No	36 (17.2%)	137 (65.6%)
Yes	5 (2.4%)	31 (14.8%)

**n=209*

Note: This analysis compared only ISE professionals and filtered out all others.

3.1 [cont.]

Figure 22. There was an increase in the percentage of professionals who reported they personally engaged any public audience in nano from before getting involved with NISE Net to their current role in Year 10. This is true for all tiers and organization types.

University Professionals

Year 10 APS question #s: 22 & 23 (see Instrument Appendix for item format)

Q22: Before getting involved with NISE Net, did you personally engage any public audience in nano at any time of the year?

Q23: In your current role at your organization, do you personally engage any public audience in nano at any time of the year?

Test used: McNemar’s Test

Test result: $\chi^2 (1, n=95) = 13.921, p < .001$

Frequency table:

Q22 / Before	Q23 / Currently	
	No	Yes
No	7 (7.4%)	31 (32.6%)
Yes	7 (7.4%)	50 (52.6%)

**n=95*

Note: This analysis compared only University professionals and filtered out all others.

3.2 As of Year 10, the majority of Tier 1-3 professionals engaged the public in nano throughout the year and used NISE Net cart demonstrations and hands-on activities, media, and classroom activities more than other types of products.

Figure 23. More than 50% of Year 10 respondents are using cart demonstrations/hands-on activities, print media, video media, or classroom activities.

Year 10 APS question #: 31 (see Instrument Appendix for item format)

- Q31: Over the past 12 months, to what extent have you personally implemented any of the following NISE Net educational products with the public?
- a. Cart demonstrations and hands-on activities
 - b. Stage presentations
 - c. Museum theater
 - d. Classroom activities
 - e. Forums
 - f. Science cafés
 - g. Media (videos, multimedia, images)
 - h. Media (print, posters)

Test used: N/A (descriptive data)

Frequency table:

(n=264)	No, I have NOT used this type of NISE Net product...		Yes, I HAVE used this type of NISE Net product...	
A.	42	(15.9%)	222	(84.1%)
B.	170	(64.4%)	94	(35.6%)
C.	220	(83.3%)	44	(16.7%)
D.	92	(34.8%)	172	(65.2%)
E.	228	(86.4%)	36	(13.6%)
F.	217	(82.2%)	47	(17.8%)
G.	91	(34.5%)	173	(65.5%)
H.	58	(22.0%)	206	(78.0%)

Note: Responses for “Yes, I HAVE used this type of product...” were consolidated across categories (“only during NanoDays”; “only outside of NanoDays”; “during and outside of NanoDays”) for presentation in Figure 23 of the report.

3.2 [cont.]

Figure 24. Of the Year 10 respondents who reported using these public engagement products, 50% or more report implementing them during and outside of NanoDays.

Year 10 APS question #: 31 (see Instrument Appendix for item format)

Q31: Over the past 12 months, to what extent have you personally implemented any of the following NISE Net educational products with the public?

- a. Cart demonstrations and hands-on activities
- b. Stage presentations
- c. Museum theater
- d. Classroom activities
- e. Forums
- f. Science cafés
- g. Media (videos, multimedia, images)
- h. Media (print, posters)

Test used: N/A (descriptive data)

Frequency table:

	Only during NanoDays		Only outside of NanoDays		During and outside of NanoDays	
A. (n=222)	16	(7.2%)	13	(5.9%)	193	(86.9%)
B. (n=94)	30	(31.9%)	11	(11.7%)	53	(56.4%)
C. (n=44)	17	(38.6%)	5	(11.4%)	22	(50.0%)
D. (n=172)	14	(8.1%)	29	(16.9%)	129	(75.0%)
E. (n=36)	9	(25.0%)	8	(22.2%)	19	(52.8%)
F. (n=47)	10	(21.3%)	12	(25.5%)	25	(53.2%)
G. (n=173)	25	(14.5%)	14	(8.1%)	134	(77.5%)
H. (n=206)	51	(24.8%)	8	(3.9%)	147	(71.4%)

Note: Percentages displayed include only those professionals responding “Yes, I HAVE used this type of NISE Net product...”, accounting for the differing group sizes for each product category.

3.2 [cont.]

Figure 25. Of the Tier 1-3 professionals using products throughout the year, the most frequent settings are brief table top activities, special events, and K-12 outreach.

Year 10 APS question #: 32 (see Instrument Appendix for item format)

Q32: In which of the following settings do you personally use NISE Net materials outside of NanoDays?

Test used: N/A (descriptive data)

Frequency table:

(n=227)	Yes	
A. Cart demonstrations / brief table top activities	191	(84.1%)
B. Longer museum programs (e.g., forums, classes, labs, science clubs)	108	(47.6%)
C. Longer term display of materials in public spaces (e.g., within exhibits, on the museum floor, on a table)	90	(39.6%)
D. K-12 School outreach activities (e.g., classes, after school programs, field trips, science fair)	165	(72.7%)
E. Lesson activities within college courses	35	(15.4%)
F. Science camps (daily, weekly, seasonal)	136	(59.9%)
G. Special events (e.g., family events, chemistry events, nano-related events other than NanoDays, family nights, festivals)	173	(76.2%)
H. Outreach activities with ongoing community partners (e.g., libraries, scouts, Boys & Girls clubs)	129	(56.8%)
I. Professional development (for museum staff, school teachers, college students)	100	(44.1%)

Note: Percentages displayed include only those professionals responding “Yes, I HAVE used this type of NISE Net product...” either “only outside of NanoDays” or “during and outside of NanoDays” to any of the 8 product categories presented in question 31 (n=227 unique individuals).

3.3 As of Year 10, although Tier 1-3 professionals were not using some product types as often (including museum theater and forums), Tier 1 and 2 professionals were still more aware of these products than their Tier 3 counterparts.

Figure 26. Of the respondents who are not using these product types, Tier 2 professionals are more aware than Tier 3 professionals of museum theater and forums.

Museum Theater

Year 10 APS question #: 31 (see Instrument Appendix for item format)

Q31: Over the past 12 months, to what extent have you personally implemented any of the following NISE Net educational products with the public?
 c. Museum Theater

Test used: Chi-square test

Test result: $\chi^2 = 9.567$, Fisher’s Exact 2-sided $p = .003$

Frequency table:

	Aware		Not aware	
Tier 2 (n=128)	108	(84.4%)	20	(15.6%)
Tier 3 (n=62)	40	(64.5%)	22	(35.5%)

Note: Only those Tiers 2 and 3 professionals selecting “No, I have NOT used this type of NISE Net product” were included in this analysis. Two response categories were consolidated to reflect awareness: “and I knew NISE Net offered this product, but have not seen it used in person” and “but I have seen this product used in person,” to provide comparisons to the category “and I did not know NISE Net offered this product.”

3.3 [cont.]

Figure 26. Of the respondents who are not using these product types, Tier 2 professionals are more aware than Tier 3 professionals of museum theater and forums.

Forums

Year 10 APS question #: 31 (see Instrument Appendix for item format)

Q31: Over the past 12 months, to what extent have you personally implemented any of the following NISE Net educational products with the public?

e. Forums

Test used: Chi-square test

Test result: $\chi^2 = 8.913$, Fisher’s exact 2-sided $p = .004$

Frequency table:

	Aware		Not aware	
Tier 2 (n=136)	117	(86.0%)	19	(14.0%)
Tier 3 (n=66)	45	(68.2%)	21	(31.8%)

Note: Only those Tiers 2 and 3 professionals selecting “No, I have NOT used this type of NISE Net product” were included in this analysis. Two response categories were consolidated to reflect awareness: “and I knew NISE Net offered this product, but have not seen it used in person” and “but I have seen this product used in person,” to provide comparisons to the category “and I did not know NISE Net offered this product.”

3.4 Since joining NISE Net, in order to integrate nano into their existing educational offerings, the majority of Tier 1-3 professionals reported adapting a NISE Net product and many reported developing a new nano educational product.

Figure 27. The majority of Year 10 survey Tier 1-3 respondents who engage the public in nano have made modifications to NISE Net products.

Year 10 APS question #: 34 (see Instrument Appendix for item format)

Q34: Please indicate if you have made any of the following modifications to any NISE Net product in the past 12 months.

Test used: N/A (descriptive data)

Frequency table:

(n=259)	Yes	
A. I have incorporated a NISE Net product into an existing program	192	(74.1%)
B. I have adapted a NISE Net product for a different audience (e.g., modified a product to engage younger or Spanish-speaking audiences)	131	(50.6%)
C. I have combined a few of the NISE Net products to make a longer program	140	(54.1%)
D. I have changed a NISE Net product's format (e.g., modified a stage presentation to be a cart demonstration)	80	(30.9%)
E. I have changed the educational messages of a NISE Net product	24	(9.3%)
F. I have NOT made any modifications to any NISE Net product	42	(16.2%)
G. I have made a modification not listed	14	(5.4%)

Note: (none)

3.4 [cont.]

Figure 28. The majority of Year 10 Tier 1-3 respondents agreed that they are confident in modifying programs.

Year 10 APS question #: 35 (see Instrument Appendix for item format)

Q35: Please rate the extent to which you agree: As part of my efforts to engage the public in nano, I feel confident in my ability to modify and adapt programs for my audiences.

Test used: N/A (descriptive data)

Frequency table:

<i>(n=259)</i>	
Completely Disagree	0 (0%)
Mostly Disagree	1 (0.4%)
Slightly Disagree	5 (1.9%)
Slightly Agree	15 (5.8%)
Mostly Agree	103 (39.8%)
Completely Agree	135 (52.1%)

Note: (none)

3.4 [cont.]

Figure 29. Over one-third of Year 10 Tier 1-3 respondents have developed a new nano educational product, many of whom started after joining NISE Net.

Year 10 APS questions #: 36 and 37 (see Instrument Appendix for item format)

Q36: (For new responders only) Have you developed any new nano educational products on your own?

Q37: (For repeat responders only) Have you developed any new nano educational products on your own in the last 12 months?

Test used: N/A (descriptive data)

Frequency table:

Q36 (n=94)	
No, I have not developed a new nano educational product	53 (56.4%)
Yes, I developed my own nano educational products before joining the NISE Network	10 (10.6%)
Yes, I have developed new nano educational products since joining the NISE Network	19 (20.2%)
Yes, I have developed new nano educational products both before and since joining the NISE Network	12 (12.8%)

Q37 (n=167)	
No	112 (67.1%)
Yes	55 (32.9%)

Note: Data from questions 36 and 37 were combined to reflect the overall picture in Year 10 consisting of first-time respondents to the Annual Partner Survey and repeat respondents. Due to the nature of the stem in question 37 asking specifically about “the last 12 months” to repeat respondents, the 55 professionals indicating “Yes” were combined with the “since joining the NISE Network category” (for a total of 74 responses) while the No’s were also combined (for a total of 165), with an updated overall N of 261.

3.5 Over Years 8-10, the types of public engagement products used by all individual professionals was fairly consistent, but the content being covered shifted for Tier 2 and ISE professionals.

Figure 30. Over Years 8-10, both Tier 2 and ISE professionals increased time spent covering a nano and society concept.

Tier 2 Professionals

Year 10 APS question #: 33h (see Instrument Appendix for item format)

Q33: Across all of your efforts to engage the public in nano, to what extent do you typically cover the following topic area?

h. How the future of nanotechnology may be influenced by political, economic, and personal values

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.923$, $p = .003$

Frequency table:

(n=138)		Pre		Post	
1	Never (I don't cover this content)	6	(4.3%)	2	(1.4%)
2	Rarely (less than 25% of the time)	44	(31.9%)	38	(27.5%)
3	Sometimes (between 25-50% of the time)	42	(30.4%)	33	(23.9%)
4	Often (between 51-75% of the time)	20	(14.5%)	31	(22.5%)
5	Very often (more than 75% of the time)	17	(12.3%)	18	(13.0%)
6	Always (all of my efforts cover this content)	9	(6.5%)	16	(11.6%)
	Mean	3.18		3.53	
	Median	3		3	
	Std. Deviation	1.30		1.36	

Note: This analysis compared professionals' first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

3.5 [cont.]

Figure 30. Over Years 8-10, both Tier 2 and ISE professionals increased time spent covering a nano and society concept.

ISE Professionals

Year 10 APS question #: 33h (see Instrument Appendix for item format)

Q33: Across all of your efforts to engage the public in nano, to what extent do you typically cover the following topic area?

h. How the future of nanotechnology may be influenced by political, economic, and personal values

Test used: Wilcoxon Signed Ranks Tests

Test result: Wilcoxon $z = -2.574, p = .010$

Frequency table:

(n=130)		Pre		Post	
1	Never (I don't cover this content)	4	(3.1%)	1	(0.8%)
2	Rarely (less than 25% of the time)	39	(30.0%)	38	(29.2%)
3	Sometimes (between 25-50% of the time)	42	(32.3%)	31	(23.8%)
4	Often (between 51-75% of the time)	21	(16.2%)	25	(19.2%)
5	Very often (more than 75% of the time)	19	(14.6%)	22	(16.9%)
6	Always (all of my efforts cover this content)	5	(3.8%)	13	(10.0%)
	Mean	3.21		3.52	
	Median	3		3	
	Std. Deviation	1.22		1.35	

Note: This analysis compared professionals' first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

4.1 As of Year 10, Tier 1-3 professionals were confident in their ability to engage the public, especially the practices of engaging young children, engaging adults, engaging audiences with nano and society content, and communicating nano research findings to the public.

Figure 31. Tier 1-3 professionals reported high levels of confidence in all of the public engagement practices, especially engaging young children, engaging adult audiences, engaging audiences with nano and society content, and communicating to a public audience findings from the field of nano research.

Year 10 APS question #: 25a-g (see Instrument Appendix for item format)

- Q25: As part of my nano education efforts, I feel confident in my ability to:
- a. Engage young children.
 - b. Engage adult audiences.
 - c. Engage Spanish-speaking audiences.
 - d. Apply principles of universal design.
 - e. Engage audiences with nano and society content.
 - f. Use team-based inquiry to incorporate evaluation into my work.
 - g. Communicate to a public audience findings from the field of nano research.

Test used: N/A (descriptive data)

Frequency table:

	A (n=262)	B (n=260)	C (n=259)	D (n=258)
Completely Disagree	2 (0.8%)	1 (0.4%)	51 (19.7%)	11 (4.3%)
Mostly Disagree	0 --	0 --	34 (13.1%)	10 (3.9%)
Slightly Disagree	3 (1.1%)	2 (0.8%)	22 (8.5%)	18 (7.0%)
Slightly Agree	15 (5.7%)	19 (7.3%)	44 (17.0%)	81 (31.4%)
Mostly Agree	77 (29.4%)	72 (27.7%)	20 (7.7%)	72 (27.9%)
Completely Agree	158 (60.3%)	165 (63.5%)	26 (10.0%)	42 (16.3%)
Not Applicable	7 (2.7%)	1 (0.4%)	62 (23.9%)	24 (9.3%)

	E (n=260)		F (n=259)		G (n=259)	
Completely Disagree	2	(0.8%)	11	(4.2%)	4	(1.5%)
Mostly Disagree	1	(0.4%)	8	(3.1%)	4	(1.5%)
Slightly Disagree	12	(4.6%)	31	(12.0%)	4	(1.5%)
Slightly Agree	45	(17.3%)	66	(25.5%)	50	(19.3%)
Mostly Agree	91	(35.0%)	75	(29.0%)	97	(37.5%)
Completely Agree	105	(40.4%)	53	(20.5%)	94	(36.3%)
Not Applicable	4	(1.5%)	15	(5.8%)	6	(2.3%)

Note: All “Not Applicable” responses were removed from analysis, resulting in adjusted sample sizes and percentages as displayed in the report:

	A (n=255)		B (n=259)		C (n=197)		D (n=234)	
Completely Disagree	2	(0.8%)	1	(0.4%)	51	(25.9%)	11	(4.7%)
Mostly Disagree	0	--	0	--	34	(17.3%)	10	(4.3%)
Slightly Disagree	3	(1.2%)	2	(0.8%)	22	(11.2%)	18	(7.7%)
Slightly Agree	15	(5.9%)	19	(7.3%)	44	(22.3%)	81	(34.6%)
Mostly Agree	77	(30.2%)	72	(27.8%)	20	(10.2%)	72	(30.8%)
Completely Agree	158	(62.0%)	165	(63.7%)	26	(13.2%)	42	(17.9%)

	E (n=256)		F (n=244)		G (n=253)	
Completely Disagree	2	(0.8%)	11	(4.5%)	4	(1.6%)
Mostly Disagree	1	(0.4%)	8	(3.3%)	4	(1.6%)
Slightly Disagree	12	(4.7%)	31	(12.7%)	4	(1.6%)
Slightly Agree	45	(17.6%)	66	(27.0%)	50	(19.8%)
Mostly Agree	91	(35.5%)	75	(30.7%)	97	(38.3%)
Completely Agree	105	(41.0%)	53	(21.7%)	94	(37.2%)

4.1 [cont.]

Figure 32. University respondents were more likely than ISE respondents to completely or mostly disagree that they were confident in their ability to apply principles of Universal Design.

Year 10 APS question #: 25d (see Instrument Appendix for item format)

Q25: Please rate the extent to which you agree with the following:
 d. Apply principles of universal design.

Test used: Chi-square test

Test result: $\chi^2 = 6.800, p = .033$

Frequency table:

	ISE (n=159)		University (n=67)	
Completely or Mostly Disagree	9	(5.7%)	11	(16.4%)
Slightly Disagree or Slightly Agree	70	(44.0%)	27	(40.3%)
Mostly or Completely Agree	80	(50.3%)	29	(43.3%)

Note: The cell including University professionals responding “Completely Disagree” or “Mostly Disagree” (n=11, 16.4%) had a standardized residual of 2.1, indicating that the observed number of respondents in this category was significantly higher than expected. All other standardized residuals were less than 2.0.

This analysis compared only ISE and University professionals and filtered out all others.

4.1 [cont.]

Figure 33. University respondents were more likely than ISE to agree that they were confident in their ability to communicate to a public audience findings from the field of nano research.

Year 10 APS question #: 25g (see Instrument Appendix for item format)

Q25: Please rate the extent to which you agree with the following:
 g. Communicate to a public audience findings from the field of nano research.

Test used: Chi-square test

Test result: $\chi^2 = 10.377, p = .006$

Frequency table:

	ISE (n=164)		University (n=78)	
Completely or Mostly Disagree	5	(3.0%)	2	(2.6%)
Slightly Disagree or Slightly Agree	44	(26.8%)	7	(9.0%)
Mostly or Completely Agree	115	(70.1%)	69	(88.5%)

Note: The cell including University professionals responding “Slightly Disagree” or “Slightly Agree” (n=7, 9.0%) had a standardized residual of -2.3, indicating that the observed number of respondents in this category was significantly lower than expected. All other standardized residuals were less than 2.0.

This analysis compared only ISE and University professionals and filtered out all others.

4.2 As of Year 10, Tier 1-3 professionals were using NISE Net resources to implement many public engagement practices, especially engaging young children, engaging adults, conveying nano and society content, and communicating nano research findings to the public.

Figure 34. Tier 1-3 professionals reported implementing all of the public engagement practices, especially engaging young children, engaging adult audiences, engaging audiences with nano and society content, and communicating to a public audience findings from the field of nano research.

Year 10 APS question #: 26a-g (see Instrument Appendix for item format)

- Q26: As part of your nano education efforts, have you done any of the following?
- a. Engaged young children.
 - b. Engaged adult audiences.
 - c. Engaged Spanish-speaking audiences.
 - d. Applied principles of universal design.
 - e. Engaged audiences with nano and society content.
 - f. Used team-based inquiry to incorporate evaluation into my work.
 - g. Communicated to a public audience findings from the field of nano research.

Test used: N/A (descriptive data)

Frequency table:

	A (n=261)	B (n=259)	C (n=261)	D (n=258)
No	6 (2.3%)	8 (3.1%)	131 (50.2%)	88 (34.1%)
Yes	240 (92.0%)	241 (93.1%)	75 (28.7%)	128 (49.6%)
Not Applicable	15 (5.7%)	10 (3.9%)	55 (21.1%)	42 (16.3%)

	E (n=261)	F (n=259)	G (n=261)
No	41 (15.7%)	111 (42.9%)	49 (18.8%)
Yes	205 (78.5%)	116 (44.8%)	195 (74.7%)
Not Applicable	15 (5.7%)	32 (12.4%)	17 (6.5%)

Note: All “Not Applicable” responses were removed from analysis, resulting in adjusted sample sizes and percentages as displayed in the report:

	A (n=246)	B (n=249)	C (n=206)	D (n=216)
No	6 (2.4%)	8 (3.2%)	131 (63.6%)	88 (40.7%)
Yes	240 (97.6%)	241 (96.8%)	75 (36.4%)	128 (59.3%)

	E (n=246)	F (n=227)	G (n=244)
No	41 (16.7%)	111 (48.9%)	49 (20.1%)
Yes	205 (83.3%)	116 (51.1%)	195 (79.9%)

4.2 [cont.]

Figure 35. Of the respondents who are implementing the public engagement practices, over 75% of professionals are using a NISE Net resource for each of the below practices.

Year 10 APS question #: 27a-g (see Instrument Appendix for item format)

Q27: You answered that you have done the following item(s) as a part of your nano education efforts over the past 12 months. Did you use a NISE Net resource about this topic?

- a. Engage young children.
- b. Engage adult audiences.
- c. Engage Spanish-speaking audiences.
- d. Apply principles of universal design.
- e. Engage audiences with nano and society content.
- f. Use team-based inquiry to incorporate evaluation into my work.
- g. Communicate to a public audience findings from the field of nano research.

Test used: N/A (descriptive data)

Frequency table:

	A (n=240)		B (n=240)		C (n=74)		D (n=127)	
No	19	(7.9%)	27	(11.3%)	9	(12.2%)	29	(22.8%)
Yes	221	(92.1%)	213	(88.8%)	65	(87.8%)	98	(77.2%)

	E (n=204)		F (n=116)		G (n=193)	
No	12	(5.9%)	24	(20.7%)	38	(19.7%)
Yes	192	(94.1%)	92	(79.3%)	155	(80.3%)

Note: Responses include only those professionals who selected “Yes” to the corresponding practice on question 26 (see previous table). Missing responses account for differing n’s between tables.

4.3 As of Year 10, although some practices were not being used as broadly by Tier 1-3 professionals (including using team-based inquiry, applying universal design, and engaging Spanish-speaking audiences), Tier 2 professionals were still more aware of the NISE Net resources related to these practices than their Tier 3 counterparts.

In-text finding (page 70 of report, above Figure 36).

Organization Type

Year 10 APS question #: 28c (see Instrument Appendix for item format)

Q28: You answered that you have not done the following item(s) as a part of your nano education efforts over the past 12 months. Are you aware of NISE Net’s resources about this topic?

- c. Engage Spanish-speaking audiences.

Test used: Chi-square test

Test result: $\chi^2 = 12.711$, Fisher’s Exact 2-sided $p = .001$

Frequency table:

	ISE (n=83)	University (n=43)
No	10 (12.0%)	17 (39.5%)
Yes	73 (88.0%)	26 (60.5%)

Note: This analysis compared only ISE and University professionals and filtered out all others.

4.3 [cont.]

Figure 36. Of those Tier 1-3 professionals who are not implementing the practice, Tier 2 respondents are more aware of NISE Net resources about these topics than Tier 3 respondents.

Tiers 2 and 3

Year 10 APS question #: 28c,d,f,g (see Instrument Appendix for item format)

Q28: You answered that you have not done the following item(s) as a part of your nano education efforts over the past 12 months. Are you aware of NISE Net’s resources about this topic?

- c. Engage Spanish-speaking audiences.
- d. Apply principles of universal design.
- f. Use team-based inquiry to incorporate evaluation into my work.
- g. Communicate to a public audience findings from the field of nano research.

Tests used: Chi-square tests

Test result: $\chi^2 = 17.975$, Fisher’s Exact 2-sided $p < .001$

Frequency table:

28c	Tier 2 (n=79)	Tier 3 (n=42)
No	10 (12.7%)	20 (47.6%)
Yes	69 (87.3%)	22 (52.4%)

Test result: $\chi^2 = 10.154$, Fisher’s Exact 2-sided $p = .002$

Frequency table:

28d	Tier 2 (n=48)	Tier 3 (n=37)
No	17 (35.4%)	26 (70.3%)
Yes	31 (64.6%)	11 (29.7%)

Test result: $\chi^2 = 20.925$, Fisher's Exact 2-sided $p < .001$

Frequency table:

28f	Tier 2 (n=66)	Tier 3 (n=42)
No	19 (28.8%)	31 (73.8%)
Yes	47 (71.2%)	11 (26.2%)

Test result: $\chi^2 = 5.622$, Fisher's Exact 2-sided $p = .026$

Frequency table:

28g	Tier 2 (n=26)	Tier 3 (n=17)
No	6 (23.1%)	10 (58.8%)
Yes	20 (76.9%)	7 (41.2%)

Note: This analysis compared only Tier 2 and Tier 3 professionals and filtered out all others.

4.4 Over Years 8-10, Tier 2 professionals and ISE professionals became more confident in engaging adult audiences and engaging Spanish-speaking audiences.

Figure 37. Over Years 8-10, Tier 2 professionals’ and ISE professionals’ mean confidence in engaging adult audiences and engaging Spanish-speaking audiences increased.

ISE Professionals

Year 10 APS question #: 25b,c (see Instrument Appendix for item format)

Q25: As part of my nano education efforts, I feel confident in my ability to:

- b. Engage adult audiences.
- c. Engage Spanish-speaking audiences.

Test used: Wilcoxon Signed Ranks Test

Test result: Wilcoxon $z = -1.962, p = .050$

Frequency table:

25b (n=142)		Pre		Post	
1	Completely Disagree	0	(0%)	1	(0.7%)
2	Mostly Disagree	0	(0%)	1	(0.7%)
3	Slightly Disagree	2	(1.4%)	0	(0%)
4	Slightly Agree	14	(9.9%)	10	(7.0%)
5	Mostly Agree	49	(34.5%)	34	(23.9%)
6	Completely Agree	77	(54.2%)	96	(67.6%)
	Mean	5.42		5.56	
	Median	6		6	
	Std. Deviation	0.73		0.79	

Test result: Wilcoxon $z = -3.164$, $p = .002$

Frequency table:

25c (n=90)		Pre		Post	
1	Completely Disagree	18	(20.0%)	17	(18.9%)
2	Mostly Disagree	21	(23.3%)	12	(13.3%)
3	Slightly Disagree	19	(21.1%)	16	(17.8%)
4	Slightly Agree	20	(22.2%)	22	(24.4%)
5	Mostly Agree	6	(6.7%)	12	(13.3%)
6	Completely Agree	6	(6.7%)	11	(12.2%)
Mean		2.92		3.37	
Median		3		3.5	
Std. Deviation		1.46		1.63	

Note: These analyses compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

4.4 [cont.]

Figure 37. Over Years 8-10, Tier 2 professionals’ and ISE professionals’ mean confidence in engaging adult audiences and engaging Spanish-speaking audiences increased.

Tier 2 Professionals

Year 10 APS question #: 25b,c (see Instrument Appendix for item format)

- Q25: As part of my nano education efforts, I feel confident in my ability to:
- b. Engage adult audiences.
 - c. Engage Spanish-speaking audiences.

Test used: Wilcoxon Signed Ranks Test

Test result: Wilcoxon $z = -2.404$, $p = .016$

Frequency table:

25b (n=148)		Pre		Post	
1	Completely Disagree	0	(0%)	0	(0%)
2	Mostly Disagree	1	(0.7%)	1	(0.7%)
3	Slightly Disagree	2	(1.4%)	0	(0%)
4	Slightly Agree	13	(8.8%)	8	(5.4%)
5	Mostly Agree	50	(33.8%)	39	(26.4%)
6	Completely Agree	82	(55.4%)	100	(67.6%)
	Mean	5.42		5.60	
	Median	6		6	
	Std. Deviation	0.77		0.66	

Test result: Wilcoxon $z = -3.721, p < .001$

Frequency table:

25b (n=92)		Pre		Post	
1	Completely Disagree	22	(23.9%)	18	(19.6%)
2	Mostly Disagree	23	(25.0%)	14	(15.2%)
3	Slightly Disagree	19	(20.7%)	15	(16.3%)
4	Slightly Agree	18	(19.6%)	24	(26.1%)
5	Mostly Agree	6	(6.5%)	11	(12.0%)
6	Completely Agree	4	(4.3%)	10	(10.9%)
	Mean	2.73		3.28	
	Median	3		3	
	Std. Deviation	1.42		1.61	

Note: These analyses compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

4.4 [cont.]

In-text finding (pages 71-72 of report, following Figure 37).

Tier 2 Professionals

Year 10 APS question #: 25g (see Instrument Appendix for item format)

- Q25: As part of my nano education efforts, I feel confident in my ability to:
- g. Communicate to a public audience findings from the field of nano research.

Test used: Wilcoxon Signed Ranks Test

Test result: Wilcoxon $z = -2.067$, $p = .039$

Frequency table:

25g (n=143)		Pre		Post	
1	Completely Disagree	2	(1.4%)	1	(0.7%)
2	Mostly Disagree	5	(3.5%)	2	(1.4%)
3	Slightly Disagree	3	(2.1%)	1	(0.7%)
4	Slightly Agree	30	(21.0%)	22	(15.4%)
5	Mostly Agree	59	(41.3%)	68	(47.6%)
6	Completely Agree	44	(30.8%)	49	(34.3%)
	Mean	4.90		5.10	
	Median	5		5	
	Std. Deviation	1.07		0.87	

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

4.4 [cont.]

In-text finding (pages 71-72 of report, following Figure 37).

ISE Professionals

Year 10 APS question #: 25d (see Instrument Appendix for item format)

Q25: As part of my nano education efforts, I feel confident in my ability to:
 d. Apply principles of universal design.

Test used: Wilcoxon Signed Ranks Test

Test result: Wilcoxon $z = -2.067$, $p = .039$

Frequency table:

25d (n=120)		Pre		Post	
1	Completely Disagree	4	(3.3%)	3	(2.5%)
2	Mostly Disagree	12	(10.0%)	5	(4.2%)
3	Slightly Disagree	12	(10.0%)	3	(2.5%)
4	Slightly Agree	25	(20.8%)	43	(35.8%)
5	Mostly Agree	50	(41.7%)	43	(35.8%)
6	Completely Agree	17	(14.2%)	23	(19.2%)
	Mean	4.30		4.56	
	Median	5		5	
	Std. Deviation	1.31		1.11	

Note: This analysis compared professionals' first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

4.5 Over Years 8-10, Tier 2 professionals and ISE professionals increased their audience engagement around nano and society content.

Figure 38. Over Years 8-10, there was an increase in the percentage of Tier 2 professionals and ISE professionals engaging audiences with nano and society content.

Tier 2 Professionals

Year 10 APS question #: 26e (see Instrument Appendix for item format)

Q26: As part of your nano education efforts, have you done any of the following?
 e. Engaged audiences with nano and society content.

Test used: McNemar’s Test

Test result: $\chi^2 (1, n=136) = 17.333, p < .001$

Frequency table:

Pre / First survey response	Post / Last survey response	
	No	Yes
No	10 (7.4%)	33 (24.3%)
Yes	6 (4.4%)	87 (64.0%)

**n=136*

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only Tier 2 professionals and filtered out all others.

4.5 [cont.]

Figure 38. [cont.]

ISE Professionals

Year 10 APS question #: 26e (see Instrument Appendix for item format)

Q26: As part of your nano education efforts, have you done any of the following?
 e. Engaged audiences with nano and society content.

Test used: McNemar Test

Test result: $\chi^2 (1, n=134) = 10.256, p = .001$

Frequency table:

Pre / First survey response	Post / Last survey response	
	No	Yes
No	10 (7.5%)	30 (22.4%)
Yes	9 (6.7%)	85 (63.4%)

**n=134*

Note: This analysis compared professionals’ first responses – whether in Year 8 or Year 9 – with their final response in either Year 9 or Year 10. See the “note on comparisons over time” in the introduction to the Technical Appendix for more information.

This analysis compared only ISE professionals and filtered out all others.

5.1 Tier 1-3 professionals reported that NISE Net has been valuable to their organizations and to themselves because the materials are models they can emulate.

Figure 39. As of Year 10, the majority of all Tier 1-3 professionals reported that NISE Net has been valuable to their organization.

Year 10 APS question #: 41 (see Instrument Appendix for item format)

Q41: How valuable has the NISE Network been to your organization?

Test used: N/A (descriptive data)

Frequency table:

	(n=319)
Not at all	1 (0.3%)
Very little	6 (1.9%)
A little	14 (4.4%)
Somewhat	46 (14.4%)
A lot	77 (24.1%)
A great deal	175 (54.9%)

Note: (none)

5.1 [cont.]

Figure 40. As of Year 10, the majority of all Tier 1-3 professionals reported that NISE Net has been valuable to themselves.

Year 10 APS question #: 42 (see Instrument Appendix for item format)

Q42: How valuable has the NISE Network been to you individually?

Test used: N/A (descriptive data)

Frequency table:

	(n=321)
Not at all	2 (0.6%)
Very little	10 (3.1%)
A little	17 (5.3%)
Somewhat	45 (14.0%)
A lot	73 (22.7%)
A great deal	174 (54.2%)

Note: (none)

5.1 [cont.]

Figure 41. In Year 10, when asked to rate how valuable NISE Net has been to their organization, Tier 1 and 2 professionals were more likely to respond more positively than Tier 3 professionals. ISE professionals were more likely to respond higher than University professionals.

Tier Analysis

Year 10 APS question #: 41 (see Instrument Appendix for item format)

Q41: How valuable has the NISE Network been to your organization?

Test used: Chi-square test

Test result: $\chi^2 = 37.004, p < .001$

Frequency table:

	Tier 1 (n=30)	Tier 2 (n=193)	Tier 3 (n=96)
1 Not at all	0 (0%)	1 (0.5%)	0 (0%)
2 Very little	0 (0%)	1 (0.5%)	5 (5.2%)
3 A little	0 (0%)	6 (3.1%)	8 (8.3%)
4 Somewhat	1 (3.3%)	24 (12.4%)	21 (21.9%)
5 A lot	4 (13.3%)	44 (22.8%)	29 (30.2%)
6 A great deal	25 (83.3%)	117 (60.6%)	33 (34.4%)
Mean	5.80	5.38	4.80
Median	6	6	5
Std. Deviation	0.48	0.92	1.16

Note: The cell including Tier 3 professionals responding “Very Little” (n=5, 5.2%) had a standardized residual of 2.4, indicating that the observed number of Tier 3 respondents in this category was significantly higher than expected; similarly, the cell including Tier 3 professionals responding “A Great Deal” (n=33, 34.4%) had a standardized residual of -2.7, indicating that the observed number of Tier 3 respondents in this category was significantly lower than expected. Moreover, the proportion of Tier 1 professionals responding “A Great Deal” (n=25, 83.3%) was much higher than expected. All other standardized residuals were less than 2.0.

5.1 [cont.]

Figure 41. [cont.]

Organization Type Analysis

Year 10 APS question #: 41 (see Instrument Appendix for item format)

Q41: How valuable has the NISE Network been to your organization?

Test used: Chi-square test

Test result: $\chi^2 = 21.985, p = .001$

Frequency table:

		ISE (n=209)		University (n=95)	
1	Not at all	1	(0.5%)	0	(0%)
2	Very little	0	(0%)	2	(2.1%)
3	A little	4	(1.9%)	9	(9.5%)
4	Somewhat	24	(11.5%)	21	(22.1%)
5	A lot	54	(25.8%)	21	(22.1%)
6	A great deal	126	(60.3%)	42	(44.2%)
Mean		5.43		4.97	
Median		6		5	
Std. Deviation		0.83		1.12	

Note: The cell including University professionals responding “A Little” (n=9, 9.5%) had a standardized residual of 2.4, indicating that the observed number of respondents in this category was significantly higher than expected. All other standardized residuals were less than 2.0.

This analysis compared only ISE and University professionals and filtered out all others.

5.2 Tier 1-3 professionals reported that, as of Year 10, NISE Net has increased their organization’s amount of partnerships on any topic, nano or otherwise.

Figure 42. The majority of Tier 1-3 professionals report that NISE Net has increased their organization’s amount of partnerships and collaborations on any topic.

Year 10 APS question #: 19 (see Instrument Appendix for item format)

Q19: To what extent has NISE Net increased the amount of ANY partnerships or collaborations between your organization and another?

Test used: N/A (descriptive data)

Frequency table:

	<i>(n=248)</i>	
Not at all	4	(1.6%)
Very little	9	(3.6%)
A little	29	(11.7%)
Somewhat	89	(35.9%)
A lot	77	(31.0%)
A great deal	40	(16.1%)

Note: If respondents selected *No* (*n=46*) or *I don’t know* (*n=26*) to question 16 (“Has your organization partnered or collaborated with another around engaging the public in nano?”), they were not asked question 19.

5.3 Professionals, especially those in Tier 2 ISE, reported that NISE Net helped them communicate other STEM topics to the public.

Figure 43. On the Year 10 survey, the majority of Tier 1-3 professionals reported that NISE Net has helped them communicate other STEM topics.

Year 10 APS question #: 30 (see Instrument Appendix for item format)

Q30: To what extent has NISE Net helped you communicate any science, technology, engineering, and math with the public?

Test used: N/A (descriptive data)

Frequency table:

	<i>(n=274)</i>	
Not at all	2	(0.7%)
Very little	8	(2.9%)
A little	16	(5.8%)
Somewhat	43	(15.7%)
A lot	112	(40.9%)
A great deal	93	(33.9%)

Note: If respondents selected *No* to question 23 (“In your current role at your organization, do you personally engage any public audience in nano at any time of the year?”), they were not asked question 30, unless they were affiliated with a college or university; of the 59 individuals who responded *No*, 14 were college or university professionals who were asked question 30, while the remaining 45 were not.

5.3 [cont.]

Figure 44. When asked to rate the extent to which NISE Net helped them communicate STEM, in Year 10, some groups responded the extent to which NISE Net helped them was higher than other groups. Tier 2 responded higher than Tier 3 and ISE professionals responded higher than University professionals.

Tier Analysis

Year 10 APS question #: 30 (see Instrument Appendix for item format)

Q30: To what extent has NISE Net helped you communicate any science, technology, engineering, and math with the public?

Test used: Chi-square test

Test result: $\chi^2 = 15.522, p = .008$

Frequency table:

		Tier 2 (n=164)		Tier 3 (n=87)	
1	Not at all	1	(0.6%)	1	(1.1%)
2	Very little	1	(0.6%)	6	(6.9%)
3	A little	7	(4.3%)	8	(9.2%)
4	Somewhat	27	(16.5%)	14	(16.1%)
5	A lot	61	(37.2%)	37	(42.5%)
6	A great deal	67	(40.9%)	21	(24.1%)
Mean		5.12		4.64	
Median		5		5	
Std. Deviation		0.94		1.21	

Note: The cell including Tier 3 professionals responding “Very Little” (n=6, 6.9%) had a standardized residual of 2.3, indicating that the observed number of respondents in this category was significantly higher than expected. All other standardized residuals were less than 2.0.

This analysis compared only Tier 2 and Tier 3 professionals and filtered out all others.

5.3 [cont.]

Figure 44. [cont.]

Organization Type Analysis

Year 10 APS question #: 30 (see Instrument Appendix for item format)

Q30: To what extent has NISE Net helped you communicate any science, technology, engineering, and math with the public?

Test used: Chi-square test

Test result: $\chi^2 = 20.206, p = .001$

Frequency table:

	ISE (n=167)		University (n=95)	
1 Not at all	0	(0%)	2	(2.1%)
2 Very little	1	(0.6%)	5	(5.3%)
3 A little	5	(3.0%)	11	(11.6%)
4 Somewhat	25	(15.0%)	15	(15.8%)
5 A lot	79	(47.3%)	30	(31.6%)
6 A great deal	57	(34.1%)	32	(33.7%)
Mean	5.11		4.71	
Median	5		5	
Std. Deviation	0.81		1.30	

Note: The cell including University professionals responding “A Little” (n=11, 11.6%) had a standardized residual of 2.2, indicating that the observed number of respondents in this category was significantly higher than expected. All other standardized residuals were less than 2.0.

This analysis compared only ISE and University professionals and filtered out all others.

5.4 While Tier 1-3 professionals reported drawing on NISE Net information to implement public engagement practices with content other than nano, ISE professionals were more likely than University professionals to do so for four practices: engaging young children, engaging adults, applying principles of universal design, or using team-based inquiry.

Figure 45. As of Year 10, Tier 1-3 professionals reported drawing on NISE Net information to implement the public engagement practices with content other than nano.

Year 10 APS question #: 29a-g (see Instrument Appendix for item format)

- Q29: In the past 12 months, have you drawn on NISE Net information to do any of the following with content areas other than nano?
- a. Engage young children.
 - b. Engage adult audiences.
 - c. Engage Spanish-speaking audiences.
 - d. Apply principles of universal design.
 - e. Engage audiences with nano and society content.
 - f. Use team-based inquiry to incorporate evaluation into my work.
 - g. Communicate to a public audience findings from the field of nano research.

Test used: N/A (descriptive data)

Frequency table:

	A (n=258)	B (n=258)	C (n=257)	D (n=256)
No	81 (31.4%)	105 (40.7%)	147 (57.2%)	141 (55.1%)
Yes	153 (59.3%)	135 (52.3%)	41 (16.0%)	81 (31.6%)
Not Applicable	24 (9.3%)	18 (7.0%)	69 (26.8%)	34 (13.3%)

	E (n=258)	F (n=257)	G (n=257)
No	118 (45.7%)	140 (54.5%)	123 (47.9%)
Yes	119 (46.1%)	86 (33.5%)	116 (45.1%)
Not Applicable	21 (8.1%)	31 (12.1%)	18 (7.0%)

Note: All “Not Applicable” responses were removed from analysis, resulting in adjusted sample sizes and percentages as displayed in the report:

	A (n=234)	B (n=240)	C (n=188)	D (n=222)
No	81 (34.6%)	105 (43.8%)	147 (78.2%)	141 (63.5%)
Yes	153 (65.4%)	135 (56.3%)	41 (21.8%)	81 (36.5%)

	E (n=237)	F (n=226)	G (n=239)
No	118 (49.8%)	140 (61.9%)	123 (51.5%)
Yes	119 (50.2%)	86 (38.1%)	116 (48.5%)

5.4 [cont.]

Figure 46. ISE professionals are more likely than University professionals to draw on NISE Net information when engaging young children, engaging adults, applying principles of universal design, or using team-based inquiry with content areas other than nano.

Year 10 APS question #: 29a,b,d,f (see Instrument Appendix for item format)

Q29: In the past 12 months, have you drawn on NISE Net information to do any of the following with content areas other than nano?

- a. Engage young children.
- b. Engage adult audiences.
- d. Apply principles of universal design.
- f. Use team-based inquiry to incorporate evaluation into my work.

Tests used: Chi-square tests.

Test result: $\chi^2 = 4.283$, Fisher's Exact 2-sided $p = .049$

Frequency table:

29a	ISE (n=160)	University (n=68)
No	50 (31.3%)	31 (45.6%)
Yes	110 (68.8%)	37 (54.4%)

Test result: $\chi^2 = 5.692$, Fisher's Exact 2-sided $p = .022$

Frequency table:

29b	ISE (n=160)	University (n=72)
No	62 (38.8%)	40 (55.6%)
Yes	98 (61.3%)	32 (44.4%)

Test result: $\chi^2 = 6.942$, Fisher's Exact 2-sided $p = .009$

Frequency table:

29d	ISE (n=151)		University (n=64)	
No	87	(57.6%)	49	(76.6%)
Yes	64	(42.4%)	15	(23.4%)

Test result: $\chi^2 = 14.348$, Fisher's Exact 2-sided $p < .001$

Frequency table:

29f	ISE (n=154)		University (n=64)	
No	83	(53.9%)	52	(81.3%)
Yes	71	(46.1%)	12	(18.8%)

Note: This analysis compared only ISE and University professionals and filtered out all others.

Tier 2 Focused Analyses

Involvement with NanoDays, mini-grants, and face-to-face meetings corresponded with higher ratings of NISE Net's value.

Figure A.1 How valuable has the NISE Network been to you individually?

Year 10 APS question #: 42 (see Instrument Appendix for item format)

Tests used: Chi-square tests.

Test result: $\chi^2 = 41.920, p < .001$

Frequency table:

Meetings	0 occurrences (n=64)		1+ occurrence (n=130)	
Not at all	2	(3.1%)	0	(0%)
Very little	4	(6.3%)	1	(0.8%)
A little	7	(10.9%)	1	(0.8%)
Somewhat	18	(28.1%)	11	(8.5%)
A lot	11	(17.2%)	21	(16.2%)
A great deal	22	(34.4%)	96	(73.8%)

Test result: $\chi^2 = 16.761, p = .005$

Frequency table:

Mini-grants	0 occurrences (n=141)		1+ occurrence (n=53)	
Not at all	2	(1.4%)	0	(0%)
Very little	5	(3.5%)	0	(0%)
A little	8	(5.7%)	0	(0%)
Somewhat	27	(19.1%)	2	(3.8%)
A lot	24	(17.0%)	8	(15.1%)
A great deal	75	(53.2%)	43	(81.1%)

Test result: $\chi^2 = 51.366, p < .001$

Frequency table:

NanoDays	0 occurrences (n=90)		1+ occurrence (n=104)	
Not at all	2	(2.2%)	0	(0%)
Very little	5	(5.6%)	0	(0%)
A little	7	(7.8%)	1	(1.0%)
Somewhat	27	(30.0%)	2	(1.9%)
A lot	13	(14.4%)	19	(18.3%)
A great deal	36	(40.0%)	82	(78.8%)

Note: Analyses compared 0 to 1+ occurrences (of meetings, mini-grants, and NanoDays, respectively) across all 6 categories, even though the charts in the report show clustered responses of Not at all/Very little, A little/Somewhat, and A lot/A great deal.

Involvement with NanoDays corresponded with a stronger identification with the NISE Net community.

Figure A.2 Now that you are involved with NISE Net, to what extent do you identify with a broader community that includes both scientists and museum professionals?

Year 10 APS question #: 12 (see Instrument Appendix for item format)

Test used: Chi-square test.

Test result: $\chi^2 = 19.690, p = .001$

Frequency table:

NanoDays	0 occurrences (n=90)		1+ occurrence (n=105)	
Not at all	1	(1.1%)	0	(0%)
Very little	0	(0%)	1	(1.0%)
A little	4	(4.4%)	0	(0%)
Somewhat	21	(23.3%)	8	(7.6%)
A lot	37	(41.1%)	43	(41.0%)
A great deal	27	(30.0%)	53	(50.5%)

Note: (see previous note)

Individuals involved with NanoDays, mini-grants, and face-to-face meetings were more likely to feel confident in their understanding of nano concepts and attribute that confidence to NISE Net.

Figure A.3 I feel confident in my ability to explain to another adult nano concepts.

Year 10 APS question #: 20 index (see Technical Appendix p. E 22-25 for more info)

Tests used: Mann-Whitney *U* tests.

Test result: $U = 3201.0, p < .001$

Frequency table:

NanoDays	0 occurrences ($n=90$)		1+ occurrence ($n=105$)	
Index of 31 or lower	10	(11.1%)	1	(1.0%)
Index of 32 or above	80	(88.9%)	104	(99.0%)

Test result: $U = 3018.5, p = .032$

Frequency table:

Mini-grant	0 occurrences ($n=142$)		1+ occurrence ($n=53$)	
Index of 31 or lower	11	(7.7%)	0	(0%)
Index of 32 or above	131	(92.3%)	53	(100%)

Test result: $U = 2945.5, p = .001$

Frequency table:

Meetings	0 occurrences ($n=65$)		1+ occurrence ($n=130$)	
Index of 31 or lower	7	(10.8%)	4	(3.1%)
Index of 32 or above	58	(89.2%)	126	(96.9%)

Note: (none)

[cont.]

Figure A.4 How much has NISE Net affected your confidence in explaining to another adult nano concepts?

Year 10 APS question #: 21 index (see Technical Appendix p. E 22-25 for more info)

Tests used: Mann-Whitney *U* tests.

Test result: $U = 2892.0, p < .001$

Frequency table:

NanoDays	0 occurrences ($n=89$)		1+ occurrence ($n=105$)	
Index of 31 or lower	23	(25.8%)	6	(5.7%)
Index of 32 or above	66	(74.2%)	99	(94.3%)

Test result: $U = 2302.5, p < .001$

Frequency table:

Mini-grant	0 occurrences ($n=141$)		1+ occurrence ($n=53$)	
Index of 31 or lower	27	(19.1%)	2	(3.8%)
Index of 32 or above	114	(80.9%)	51	(96.2%)

Test result: $U = 2397.5, p < .001$

Frequency table:

Meetings	0 occurrences ($n=65$)		1+ occurrence ($n=129$)	
Index of 31 or lower	19	(29.2%)	10	(7.8%)
Index of 32 or above	46	(70.8%)	119	(92.2%)

Note: (none)

Involvement with NanoDays or face-to-face meetings corresponded with higher confidence ratings about applying principles of universal design, while involvement with NanoDays also corresponded with higher confidence in one’s ability to initiate a partnership.

Figure A.5 As part of my nano education efforts, I feel confident in my ability to...
(d) Apply principles of universal design.

Year 10 APS question #: 25d (see Instrument Appendix for item format)

Tests used: Chi-square tests.

Test result: $\chi^2 = 16.962, p = .005$

Frequency table:

Meetings	0 occurrences (n=37)		1+ occurrence (n=105)	
Completely Disagree	5	(13.5%)	0	(0%)
Mostly Disagree	1	(2.7%)	4	(3.8%)
Slightly Disagree	3	(8.1%)	9	(8.6%)
Slightly Agree	13	(35.1%)	39	(37.1%)
Mostly Agree	12	(32.4%)	31	(29.5%)
Completely Agree	3	(8.1%)	22	(21.0%)

Test result: $\chi^2 = 11.115, p = .049$

Frequency table:

NanoDays	0 occurrences (n=56)		1+ occurrence (n=86)	
Completely Disagree	5	(8.9%)	0	(0%)
Mostly Disagree	1	(1.8%)	4	(4.7%)
Slightly Disagree	7	(12.5%)	5	(5.8%)
Slightly Agree	19	(33.9%)	33	(38.4%)
Mostly Agree	16	(28.6%)	27	(31.4%)
Completely Agree	8	(14.3%)	17	(19.8%)

Note: All “Not Applicable” responses were removed prior to analysis.

[cont.]

Figure A.6 As part of my nano education efforts, I feel confident in my ability to...
 (h) Initiate a partnership with an informal learning or research organization.

Year 10 APS question #: 25h (see Instrument Appendix for item format)

Test used: Chi-square test.

Test result: $\chi^2 = 13.540$, $p = .009$

Frequency table:

NanoDays	0 occurrences (n=60)		1+ occurrence (n=94)	
Completely Disagree	0	(0%)	0	(0%)
Mostly Disagree	0	(0%)	1	(1.1%)
Slightly Disagree	6	(10.0%)	2	(2.1%)
Slightly Agree	14	(23.3%)	16	(17.0%)
Mostly Agree	22	(36.7%)	22	(23.4%)
Completely Agree	18	(30.0%)	53	(56.4%)

Note: All “Not Applicable” responses were removed prior to analysis.

Involvement with NanoDays and face-to-face meetings corresponded with a higher rating of how much NISE Net helped an individual communicate any science, technology, engineering, and math.

Figure A.7 To what extent has NISE Net helped you communicate any science, technology, engineering, and math with the public?

Year 10 APS question #: 30 (see Instrument Appendix for item format)

Tests used: Chi-square tests.

Test result: $\chi^2 = 23.220, p < .001$

Frequency table:

Meetings	0 occurrences (n=45)		1+ occurrence (n=119)	
Not at all	1	(2.2%)	0	(0%)
Very little	0	(0%)	1	(0.8%)
A little	6	(13.3%)	1	(0.8%)
Somewhat	12	(26.7%)	15	(12.6%)
A lot	15	(33.3%)	46	(38.7%)
A great deal	11	(24.4%)	56	(47.1%)

Test result: $\chi^2 = 15.334, p = .009$

Frequency table:

NanoDays	0 occurrences (n=67)		1+ occurrence (n=97)	
Not at all	1	(1.5%)	0	(0%)
Very little	1	(1.5%)	0	(0%)
A little	6	(9.0%)	1	(1.0%)
Somewhat	16	(23.9%)	11	(11.3%)
A lot	20	(29.9%)	41	(42.3%)
A great deal	23	(34.3%)	44	(45.4%)

Note: (none)

Multiple Comparisons

As noted in the preface to this Technical Appendix, the procedure of conducting multiple comparisons in exploratory analyses leads to an inflated error rate, in which statistical significance is detected more often than is true. One method of accounting for this phenomenon of “data-dredging” or “p-hacking” is to rank-order all the obtained p-values less than our cutoff level ($\alpha = .05$) and then establish a secondary criterion to determine which among these values may be most susceptible to error. As recommended by Benjamini and Hochberg (1995), this method of controlling for the false-discovery rate increases the statistical power of the family of tests when compared to other controlling procedures (e.g., Bonferroni adjustment, etc.). The Benjamini-Hochberg procedure is used here to account for the multitude of tests that were performed to find patterns among the data.

Limiting the familywise false-discovery rate (FDR) to 10% - that is, understanding that the procedure of repeated statistical testing is improving the odds of incorrectly finding a difference when none exists, and trying to limit these false positives to 10% of the total number of statistically significant findings – we can calculate a new threshold at which to evaluate the *p*-values:

$$p_{adj} \leq \frac{i \cdot q}{m}$$

Here, *i* is the rank order of the *p*-value, and thus this adjustment hinges on the rank of the *p*-value being evaluated. Based on tracking during analysis, it is estimated that approximately 500 separate tests were conducted ($m=500$) using data from the Annual Partner Survey, and using an FDR of 10% ($q=.10$), the table on the next page displays the results. Evidenced below, it is possible that as many as 24 of the 47 statistical tests presented in the report and detailed in this appendix are false positives (of which 8 are in-text references not displayed in the figures throughout the report).

Rank	p-value		p _{adj}	Test Information			
				Figure	Tech. App. page	Test statistic	Notes
1	<.000000	<	.000200	3	E 7	-11.349	---
2	<.000000	<	.000400	22	E 41	92.860	22/23 T2
3	<.000000	<	.000600	22	E 42	29.091	22/23 T3
4	<.000000	<	.000800	22	E 43	120.852	22/23 ISE
5	<.000000	<	.001000	17	E 27	31.285	---
6	.000009	<	.001200	36	E 64	20.925	28f T2/T3
7	.000031	<	.001400	38	E 71	17.333	26e T2
8	.000045	<	.001600	36	E 63	17.975	28c T2/T3
9	.000057	<	.001800	41	E 75	37.004	41 Tier
10	.000061	<	.002000	22	E 40	15.000	22/23 T1
11	.000123	<	.002200	46	E 84	14.348	29f ISE/Uni
12	.000191	<	.002400	22	E 44	13.921	22/23 Uni
13	.000199	<	.002600	37	E 68	-3.721	25c T2
14	.000527	<	.002800	41	E 76	21.985	41 org
15	.001005	<	.003000	in-text	E 62	12.711	28c Org
16	.001143	<	.003200	44	E 80	20.206	30 Org
17	.001362	<	.003400	38	E 72	10.256	26e ISE
18	.001558	<	.003600	37	E 66	-3.164	25c ISE
19	.002094	<	.003800	36	E 63	10.154	28d T2/T3
20	.002807	<	.004000	26	E 48	9.567	31c T2/3
21	.003471	<	.004200	30	E 53	-2.923	33h T2
22	.004305	<	.004400	16	E 26	10.896	---
23	.004414	<	.004600	26	E 49	8.913	31e T2/3
24	.005579	>	.004800	33	E 58	10.377	25g ISE/Uni
25	.006028	>	.005000	in-text	E 37	-2.746	20c ISE
26	.008349	>	.005200	44	E 79	15.522	30 Tier
27	.008753	>	.005400	46	E 84	6.942	29d ISE/Uni
28	.010048	>	.005600	30	E 54	-2.574	33h ISE
29	.011338	>	.005800	in-text	E 35	-2.532	21b T2
30	.015146	>	.006000	in-text	E 34	-2.429	20b ISE
31	.016201	>	.006200	37	E 67	-2.404	25b T2
32	.020939	>	.006400	in-text	E 33	-2.309	20b T2
33	.021984	>	.006600	46	E 83	5.692	29b ISE/Uni
34	.022141	>	.006800	10	E 16	-2.288	---
35	.022471	>	.007000	in-text	E 38	-2.282	20a ISE
36	.025796	>	.007200	36	E 64	5.622	28g T2/T3
37	.026458	>	.007400	20	E 31	-2.219	21g T2
38	.027826	>	.007600	19	E 29	-2.200	20g T2
39	.033378	>	.007800	32	E 57	6.800	25d ISE/Uni
40	.036155	>	.008000	19	E 30	-2.095	20g ISE
41	.038731	>	.008200	in-text	E 70	-2.067	25d ISE
42	.038762	>	.008400	in-text	E 69	-2.067	25g T2
43	.047938	>	.008600	in-text	E 36	-1.978	20c T2
44	.049042	>	.008800	11	E 17	4.765	---
45	.049058	>	.009000	46	E 83	4.283	29a ISE/Uni
46	.049187	>	.009200	20	E 32	-1.967	21h ISE
47	.049747	>	.009400	37	E 65	-1.962	25b ISE

References

- Benjamini, Y., & Hochberg, Y. (1995). "Controlling the false discovery rate: A practical and powerful approach to multiple testing." *Journal of the Royal Statistical Society, Series B*, 57(1): 289-300. URL: <http://www.jstor.org/stable/2346101>.
- Goss, J., Auster, R., Beyer, M., Mesiti, L.A., & Kollmann, E.K. (2016). *NISE Network Professional Impacts Summative Evaluation*. Boston, MA: NISE Network.
- Kirkham, J., Dwan, K., Altman, D., Gamble, C., Dodd, S., Smyth, R., & Williamson, P. (2010). "The impact of outcome reporting bias in randomised controlled trials on a cohort of systematic reviews." *BMJ* 340: c365. doi: 10.1136/bmj.c365.