STEM LEARNING ECOSYSTEMS: EVALUATION AND ASSESSMENT FINDINGS

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SUMMARY

This is a report on findings from a survey of STEM Learning Ecosystems' thoughts about collaboration on evaluation and assessment. The survey had an impressive response rate of 100%, with very detailed comments, demonstrating the high level of importance placed on this topic by community leaders. Results revealed that half of the ecosystems are using at least one data collection tool to evaluate STEM learning, and the level of evaluation progress can be stratified as three groups: beginner, intermediate, and advanced. Leaders identified six goals for evaluation and assessment, including: to demonstrate value of programming to stakeholders; to use data to guide the process of implementing system- and program-level changes, to assess program impact on student outcomes; to ensure quality of student learning experiences; to use data to improve teaching effectiveness; and to increase STEM learning opportunities. However, ecosystem leaders felt that attainment of these goals would be less challenging with a common set of tools and strategy, a centralized data management/reporting system, more funding, less stringent data sharing/privacy policies in schools, and more cohesion among partners. Nevertheless, leaders remain positive and motivated to work toward strengthening partnerships, creating a common language for evaluation and assessment, and leveraging resources and support to strengthen the ecosystems as a whole. This report concludes with recommendations for advancing this high-priority issue.

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1. EXECUTIVE SUMMARY

STEM Learning Ecosystems aim to connect schools, out-of-school time programs, STEM expert institutions, the private sector, community-based organizations, youth and families so as to foster STEM-rich learning opportunities for all young people. At a recent meeting in Chicago, many STEM Learning Ecosystem leaders expressed a desire to learn more about other communities' strategies around evaluating STEM learning. The 2016 STEM Learning Ecosystem Leadership Survey on Evaluation and Assessment was developed in response to this growing national movement to use data to inform progress in STEM learning within and between ecosystems. The primary learning goals of this survey were the following:

1. What are the ecosystems' evaluation goals and challenges?
2. What do ecosystems hope to learn through the use of data-creating tools?
3. How much progress has each ecosystem made to gather evidence of STEM learning?
4. Have ecosystems hired formal evaluators, and which specific tools are ecosystems using?
5. Is the approach to evaluation separate or integrated in terms of ecosystem partners' involvement?
6. Are partners in the ecosystems willing to create a shared vision around data collection?
7. Do ecosystems have the capacity to leverage data long-term?

Survey findings revealed a high level of motivation among ecosystem leaders to tackle the challenge of evaluation and assessment, as evidenced by the 100% response rate and in-depth answers to open-ended questions including positive comments like: "This is an area of development that is important to our ecosystem." And "This is a hard but incredibly important project!" This outstanding response serves to underscore the high priority that the ecosystems place on this topic and the dedication of the leaders to address the issue. Importantly, the findings detailed in this report show that most ecosystems have given considerable thought to defining goals for evaluation and assessment, and nearly all indicated that data collection tools were useful.

There were six primary goals indicated by leaders: to demonstrate value of programming to stakeholders and potential partners; to use data to guide the process of implementing system- and program-level changes, to assess program impact on student outcomes; to ensure quality of student learning experiences; to use data to improve teaching effectiveness; and to increase STEM learning opportunities. Building upon these goals, the reasons leaders cited for wanting to use data collection tools were: to improve reach and scaling of ecosystem; to improve quality/impact, to foster collaborations to share support, resources, and strategies; and to learn about the long-term impact of ecosystem work. However, there were six main challenges

disclosed by ecosystem leaders, including: lack of necessary infrastructure like a common data system; limited resources including staff time and funding; need for common assessments, negative associations with high-stakes testing; stringent data sharing/privacy policies; and disconnect among ecosystem partners.

Despite the roadblocks to evaluation and assessment, leaders remained positive and endorsed the need to strengthen partnerships, to move toward a common language for evaluation and assessment, and to leverage resources and support to strengthen the ecosystems as a whole. As evidence of this, the majority of ecosystem leaders (89%) reported that they believed their partners would be somewhat willing or very willing to use common data collection tools across ecosystems. Ecosystems wanting a shared vision cited the need for standardized measures that can facilitate communication and learning among educational stakeholders (including businesses, teachers, parents, funders, etc.). Ecosystems that were hesitant about partners' willingness to adopt shared tools and evaluation plans cited lack of resources, difficulty obtaining alignment among schools/programs, and uncertainty about the reliability or validity of available tools. It will be important to provide guidance and support to these communities to help unify their various sectors.

Another impressive finding is that half of ecosystems have already used at least one data collection tool to understand STEM learning. As expected, some communities are further along – the data reveal three clusters: (1) an advanced group that is characterized as having a clear evaluation plan and an established battery of data collection tools, has chosen an evaluator or has own in-house data management process, and has been performing evaluations across sectors (i.e., in school and outside of school) for a number of years; (2) an intermediate group that is characterized as having defined goals and thinking actively about evaluation plans, as being in the process of vetting or piloting data collection tools, and has started performing at least small scale evaluations within the last year but with less cohesion among partners in the ecosystem than the advanced group; (3) a beginner group that is just starting to think about evaluations and assessments but is in the early stages of planning/goal setting, has not used data collection tools, and has not consulted with a formal evaluator, and does not have a system in place for storing or tracking data long-range. There is a solid foundation to build on the scope and complexity of the work that is already being initiated by ecosystems. Suffice it to conclude that the ecosystem leaders are largely motivated to enhance STEM learning in youth using data-driven tools: "We can do better; they can do better."

Given that a large number of programs are just beginning to establish evaluation and assessment protocols, now is the best opportunity to create a shared vision across ecosystems. As ecosystems begin to think about evaluations, there is a tendency to create tools from scratch. This is a concern because these tools are not

vetted using standard research practices (such as establishing psychometric properties) and the scale is too small to generate comparative data (against which success can be defined, measured, and compared). Many ecosystems are also using generic observation tools that are not sufficiently STEM-focused, and some partners within the ecosystem are using different tools to achieve the same end, which doubles the effort but does not allow for comparisons. The use of different tools by different partners creates an array of data that is too complex to draw meaningful conclusions on a larger scale. A common language within and between ecosystems is needed to communicate findings, to promote learning from others' strengths and challenges, and to increase overall cohesion among partners. Fortunately, the majority of ecosystems (nearly 90%) believe their partners are willing to use common data-creating tools across all ecosystems.

Moving Forward

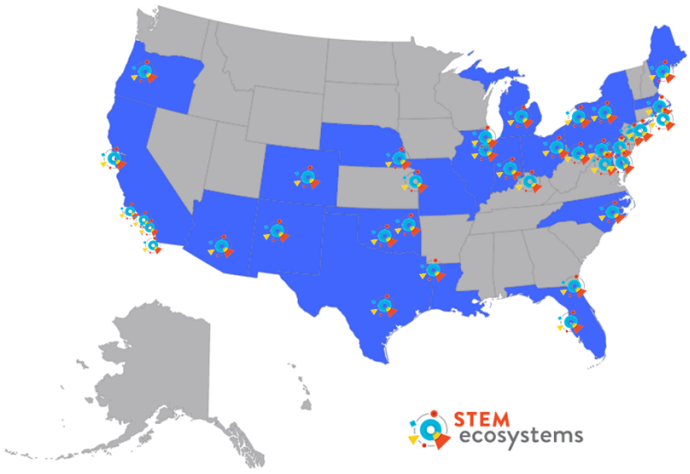
We believe that STEM Learning Ecosystems should drive the direction of a national evaluation and assessment strategy. A working group, formed by a subgroup of ecosystem leaders, is needed to address the high priority issue of creating a shared vision. There is a strong desire among ecosystem leaders to have a common set of data-creating tools that will allow for national comparisons and that will measure ecosystem progress. Once the subgroup comes to a consensus around national goals and strategy, we recommend adopting a common set of tools with strong psychometric properties and building upon existing tools to spare ecosystems the significant burden of tool development (in terms of time, effort, and funding). It is also important to recognize that ecosystems have a desire to use or create tools that are better tailored to their unique contexts and diverse partners. We believe that ecosystems should be flexible and continue to encourage partners to use tools that will gather the best evidence of STEM learning, but we recommend that there be a common thread (regarding a set of assessment tools) across the ecosystems to benchmark progress. It is also essential for ecosystems to identify a common national data management system that is accessible, affordable, and productive. Rapid analysis and reporting would allow for a paradigm shift in data usage – rather than examining results long after students are gone, educators could get to know each individual student to tailor the course of STEM learning. Lastly, as ecosystems become more advanced in this area, we recommend collecting multiple pieces of evidence of STEM learning. Converging measures, such as quality observations or change in attitudes or skills, will better tell the story of STEM learning than any one measure alone. The collective strength of the ecosystems to gather data on a large scale, combined with a multi-method approach, will provide a critical mass of evidence to convince practitioners, funders, and policymakers about the value of data and the direction of STEM education reform.

2. BACKGROUND

At the second national meeting of the STEM Learning Ecosystems in Chicago in March 2016, key stakeholders discussed the importance of STEM evaluation and assessment in schools, out-of-school time programs, cultural institutions, and other STEM expert institutions. The consensus was that evidence-creating tools will help identify and eliminate barriers to high-quality STEM, establish and sustain cross-sector partnerships, help educators to better facilitate learning with their students, and support youth in accessing pathways to further STEM learning and careers.

As a next step forward, leaders from the STEM Learning Ecosystems[1] (see Figure 1) were asked for their help in creating a shared vision across the communities regarding evidence sources, priority outcomes, common language, and supportive measurement. STEM Next at the University of San Diego partnered with The PEAR Institute: Partnerships in Education and Resilience (PEAR) at Harvard University and McLean Hospital, to design a brief survey asking the ecosystem leaders about their communities' experience, needs, and interest in using and collecting data in STEM programming. The final survey was comprised of 34 questions related to evaluation and assessment, such as whether the leader's community had an evaluator, if there were specific tools they were already using, if they partnered with their local school district, whether they use a data management system/portal, and whether they had defined goals for evaluation or if there were any challenges around evaluation and assessment (see Appendix A for full version of the survey).

Figure 1. Map of STEM Learning Ecosystems



In June 2016, there were a total of 37 STEM learning communities and a leader from each community was contacted by email to complete the evaluation and assessment survey. Survey data were collected between June 13, 2016 and August 4, 2016, and the response rate was an astounding 100% (at least one leader from 37 out of 37 communities completed the survey). There were two communities where two leaders responded (Chicago, East Syracuse). For data analysis/reporting, when more than one leader from a community responded to the survey, only the most conservative response to Likert-type questions

[1] Map displaying the nation-wide network of STEM Learning Ecosystems. At the time of this survey, there were a total of 37 participating communities. As of September 2016, there are 36 participating communities.

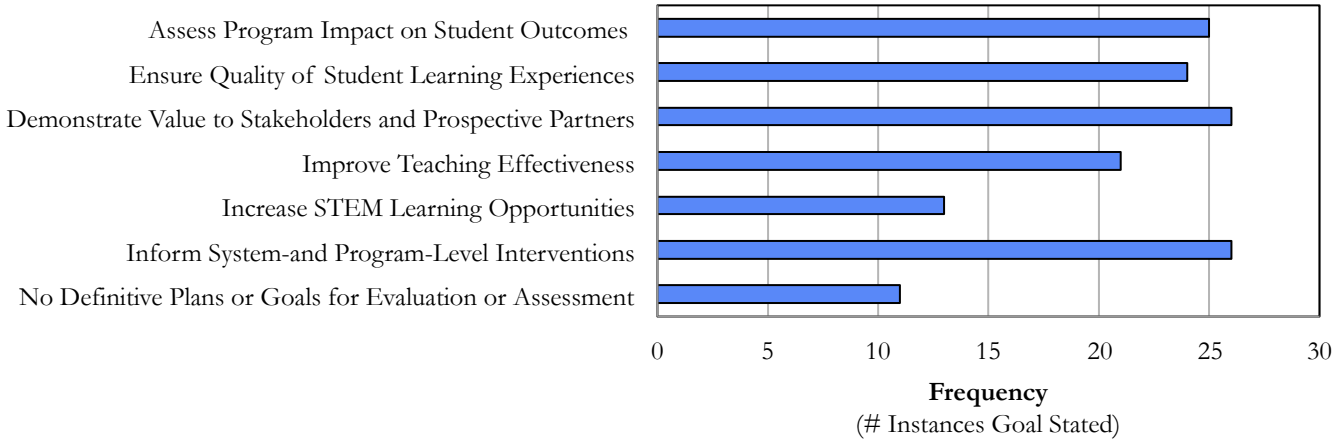
was used, but answers to open-ended questions from all leaders were included. One community opted to suspend their ecosystem's participation due to a potential grant-related conflict, but the results from this community (STEM Hub Downeast, Maine) are included in this report because the leader responded prior to ending their participation. The majority of respondents (65.7%) were Directors/Executive Directors of STEM or Education Programs. The sample also represented responses from CEOs/Vice Presidents/Presidents (10.5%), Program Managers/Coordinators (13.16%), an Educational Consultant (2.63%), a Senior Research Scientist (2.63%), an Educational Policy Advisor (2.63%), and a Superintendent of Schools (2.63%). For a full list of leaders and participating STEM Learning Ecosystems, please refer to Appendix B.

3. KEY FINDINGS

3.1. Evaluation Goals and Challenges

When leaders were asked about their ecosystem's goals for evaluation and assessment, six main themes[2] emerged (see Figure 2).

Figure 2. Commonly Stated Evaluation/Assessment Goals



The two most common themes were: (1) to demonstrate value of programming to stakeholders and potential partners (e.g., to secure funding to increase capacity, increase partnerships, and improve educational strategies), and (2) to use data to guide the process of implementing system- and program-level changes (e.g., use data to inform program- and system-level decision makers with realistic ideas for

[2] Figure 2 displays the relative frequencies of common themes found in leaders' responses to the question "What are your ecosystem's goals for evaluation and assessment?" Leaders often included more than one goal. The graph above shows the frequency in which a goal was mentioned (organized by theme).

intervention, to drive program standards and system-level decisions). The next two most frequently cited goals for evaluation and assessment were: (3) to assess program impact on student outcomes (e.g., measuring student attitudes, skills, career pathways), and (4) to ensure quality of student learning experiences (e.g., strong minds-on activities, exposure to STEM career options). Two additional goals that were important to ecosystem leaders were: (5) to use data to improve teaching effectiveness (e.g., increase teaching confidence, ensure quality professional development experiences), and (6) to increase STEM learning opportunities (e.g., create more opportunities for students and families; continually grow reach and impact). A relatively smaller proportion of ecosystem leaders (from six communities) reported that their organizations have not reached, or are working towards, a point at which they can agree upon definitive plans and goals for evaluation and assessment.

Ecosystem leaders were also asked what they hoped to learn using data collection tools. Four common learning goals emerged:

1. *Improve Reach/Scaling:* Community leaders indicated that they want to learn how to use data collection tools to better understand how the ecosystem generates value within a school network, so that there is an equitable distribution of opportunity and support for all youth. It is vital to ensure that they reach all student populations, especially those that are not typically exposed to STEM learning opportunities. Community leaders want to leverage data to understand how to best build out STEM learning pathways in areas with diverse communities, assets, needs, and supports.

2. *Improve Quality/Impact:* Community leaders reported that data collection allows the ecosystems to get a stronger sense of how efficiently and effectively the ecosystems are currently able to achieve their goals. Quantifiable and comparable data are necessary to assess whether or not an ecosystem, year after year, is increasing student awareness of STEM career pathways and interest in pursuing STEM academically or professionally. Emphasis was also placed on determining the extent to which curriculum "interventions" produce the desired student outcomes.

3. *Increase Collaboration:* Community leaders feel that data allows ecosystems to identify underperforming programs so that collaborators can share support, resources, and the best strategies to improve program performance among programs in need. Data can provide insight into what kinds of collaborative opportunities exist for ecosystems by learning from other programs' strengths and areas for growth. Community leaders also indicated that sharing data would generate more

involvement among stakeholders, particularly parents and funders, by demonstrating the value of both formal and informal STEM learning. Some leaders indicated that collaboration is key for obtaining additional philanthropic support for the development or expansion of a robust system of informal educational opportunities. Lastly, ecosystem leaders indicated that collaborations are necessary to help programs better leverage and understand data by providing assistance with data collection, analysis, reporting, and long-term tracking of student data to evaluate long-range results.

4. *Measure Long-term Outcomes*: Leaders reported that data collection tools would help them to learn about the long-term impact of ecosystem partners' effort to increase STEM learning and workforce preparation and keep students in the STEM pipeline. The hope is that data collection tools will help steer short-term decisions that will improve program quality ecosystem-wide, so that in the long-term the ecosystem can model expected trajectories of student outcomes and apply methods that will produce the greatest possible return on investment.

When asked about challenges faced and what would better enable their community to advance evaluation and assessment of STEM learning, six main themes emerged:

1. *Lack of Infrastructure:* Leaders emphasized a need a common, centralized database that automates analysis and reporting. An easily accessible portal would help to engage communities, allow for benchmarking progress, help refine evaluation metrics and goals for STEM learning, and inform ecosystems about national strategies. A centralized data system would reduce burden of data management and analysis on the ecosystems and allows program leaders to focus on youth and programming.

2. *Need for Common Assessments:* Leaders indicated that there are many tools currently in use, at least for some organizations, but that they are not effective for longitudinal tracking. There is a need for shared metrics and assessment tools and time to perform evaluations well. As one leader noted, "Currently, the primary STEM organizations utilized a variety of evaluation tools. There have been conversations around common language for STEM learning and a brief conversation about the need for evaluation." There is the general feeling that there are "no commonly defined...metrics for STEM learning."

3. *Limited Resources*: Leaders cited time and funding as two resources that would increase their ecosystem's ability to achieve their evaluation and assessment goals. One leader noted that they need

"dedicated staff and resources to ensure success" whereas another wrote "it takes a significant amount of time and effort to achieve goals; this can obstruct the formation of partnerships and development of relationships between programs and schools." Leaders also cited a need for affordable assessment tools that can be used from year to year that are shared across the ecosystems and better access to student data (both in school and outside of school). One leader noted that "securing funding is difficult in and of itself..." and another had a related thought that: "Systems such as databases, portals, and dashboards are expensive to create, and even more expensive to maintain; many funders are more interested in supporting programs made directly available to students as opposed to organizational capacities."

4. *Negative Perceptions of Assessment Tools:* Pressure on schools and programs to demonstrate student performance using statewide performance assessments makes it difficult to pursue or use other methods of evaluation. One leader captured the sentiment of the others well: "Within the K-12 education system, high stakes testing has soured many discussions related to assessment and evaluation. Parents, teachers and many community members have trouble understanding the role of assessment and evaluation in our work. We have tried to emphasize the need for 'multiple measures' and data to inform continuous improvement; however, conversations can very quickly disintegrate into a debate over state assessment linked to school performance." Another noted that there is a need to "work to mitigate the aversion many parents have towards standardized testing" and still another felt that it is "hard to ask for more assessments of students in a time of extreme scrutiny of burden of assessments of multiple kinds." One other leader wrote more frankly that there was "General and justified suspicion of current state-sponsored standardized test." Plausibly, reducing the number of assessments used while increasing awareness of other non-performance measures could help to mitigate the negative associations with assessment, but there would need to be a concerted effort on multiple-levels (academic and political). One leader came to this conclusion, writing that there is a need to "build an increased awareness, for both professionals and parents, of the value of evaluation systems and assessment tools." Related to this point, one leader noted that "Ensuring that our metrics are true measures of our work is always a challenge for any community," underscoring the importance of both raising awareness of the value of data-creating tools as well as choosing tools that have strong psychometric properties, including strong reliability and validity.

5. *Stringent Data Sharing/Privacy Policies:* Leaders have indicated that, due to existing privacy/confidentiality policies, it is very challenging for schools and programs to collect and share

student-level data. One leader wrote: "Data privacy issues are pervasive and recent policy makes it harder to collect student level data from districts." Some also noted that hesitancy to share data was also for superficial reasons – fear of failure in the eyes of the public. Regarding this data sharing challenge, one leader lamented: "There has been a fear among school districts to reveal data that they are not already required to share. Some of this fear is grounded in privacy concerns. Part of the fear stems from a desire to 'look good' in the eyes of the public." When resources are already limited, needing to overcome data hurdles are adding to the burden: "The current policies in education regarding evaluation provide challenges and consume resources that are needed for advancing this area of development."

6. *Strength of Ecosystem Partnerships:* Related to the above points, challenges to data sharing/privacy, lack of a clear/shared vision for evaluation and assessment, as well as limited resources and competition for funding reduces the strength of partnerships within ecosystems. One leader wrote that: "time and administrative burden that we ask of teachers and program staff to invest in surveying youth who participate...can be an obstruction to developing partnerships/relationships between programs and schools." Another added that "... it becomes increasingly difficult in ecosystems in which there are many layers of decision making, all of which are influenced by different stakeholders with varying visions." Leaders indicate that they can learn from the strengths and challenges of partners, as well as leverage support and resources within the ecosystem, to improve STEM learning for all. This requires shared goals and tools among schools, out-of-school time programs, cultural institutions, and other STEM expert institutions. In the words of one leader: "Useful assessment and evaluation always require a stable environment in which to assess, agreement on important goals, methods and techniques of assessment, carefully selected instruments upon which the various constituencies agree and approve, and the development of a common language/purpose of assessment."

3.2. Types of Data Collection Tools Used

While the majority of ecosystem leaders have thought about goals for evaluation and assessment, some are further along in terms of actualizing their plans. Approximately 20% to 50% of STEM Learning Ecosystems (n = 37 ecosystems) reported using one of seven types of data collection tools (see Figure 3). The two most commonly used tools in the ecosystems currently are STEM program quality observation tools (48.6%) and student surveys/assessments (48.6%). Table 1 provides a list of the most commonly reported tools used to

measure STEM program quality and student attitudes or content knowledge. Measures of day school teacher (40.5%) and out-of-school time (OST) facilitator (43.2%) attitudes or performance were also among the most commonly reported tools. The least commonly used measures across the ecosystems were parent surveys (24.3%), general non-STEM observation tools (35.1%), and focus groups/interviews (32.4%).

Figure 3. Percent of STEM Learning Ecosystems using Data Collection Tools

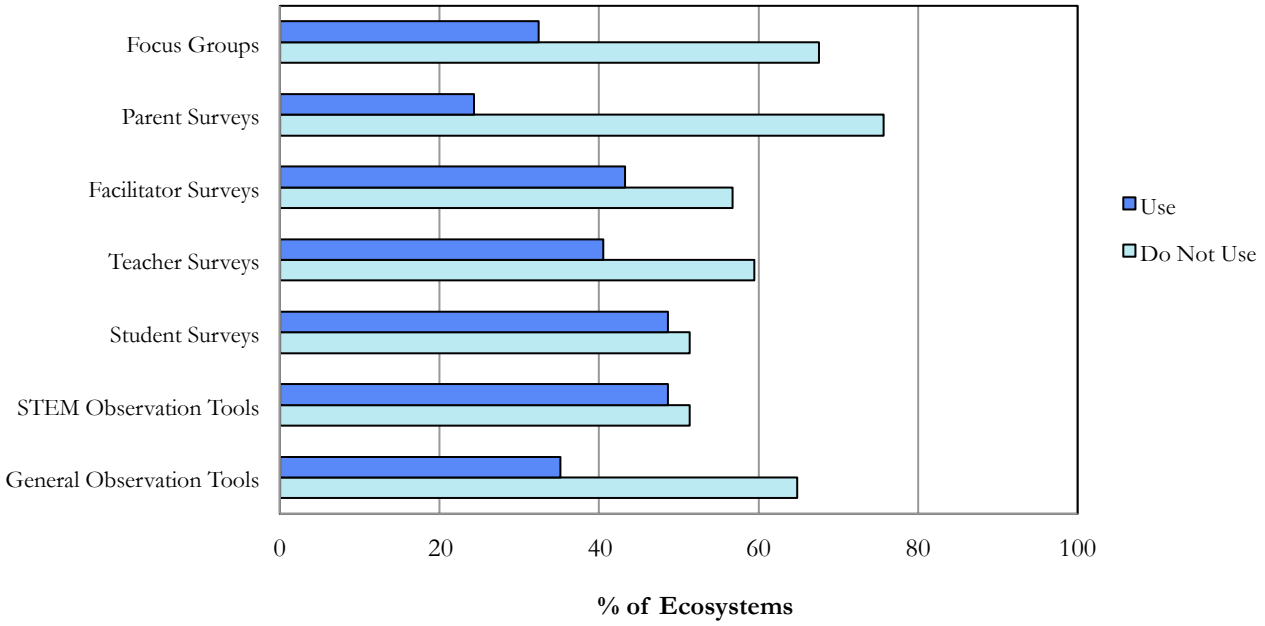


Table 1. List of most commonly used tools across STEM ecosystems.

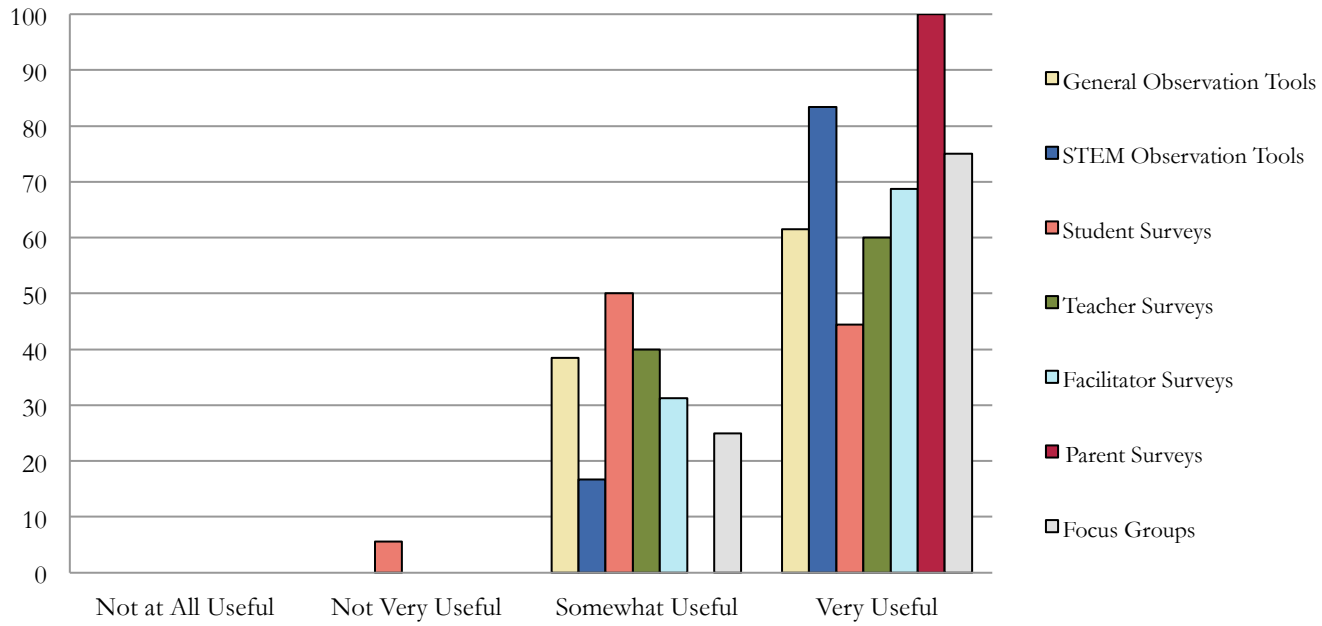
General Observation Tools	STEM Observation Tools	Student Assessment Tools	Teacher Assessment Tools	Facilitator Assessment Tools	Parent Assessment Tools	Other Assessment Tools
Youth Program Quality Assessment (YPQA)	Dimensions of Success (DoS)	Common Instrument	Teaching Rubrics (e.g., Project-Based Learning, PBL/Projected Based Teaching Rubric, State Rubrics)	PEAR Facilitator Survey	Interviews of families (e.g., to find out about learning from OST STEM resources)	Student achievement data/testing (e.g., state mandated testing)
Thoughtful Classroom Teacher Effectiveness Framework	Youth Program Quality Assessment (YPQA) for STEM	Common Instrument Suite	ExpandED Schools Educator Survey – Collaboration among Educators	ExpandED Schools Educator Survey	Homegrown/local (e.g., school-and district-created surveys, Google forms)	Network analysis

General Observation Tools	STEM Observation Tools	Student Assessment Tools	Teacher Assessment Tools	Facilitator Assessment Tools	Parent Assessment Tools	Other Assessment Tools
Assessment of Program Practices Tool (APT)	Thoughtful Classroom Teacher Effectiveness Framework	Holistic Student Assessment	Teacher Efficacy and Attitudes toward STEM Survey (T-STEM) - Friday Institute	Easy CBM (Benchmarking and Progress Monitoring System) - Fluency and Comprehension	Non-specific (e.g. parent survey, varies widely)	Group and individual interview (e.g., focus groups)
University of Cincinnati Evaluation Services Center Observation Tool	University of Cincinnati Evaluation Services Center Observation Tool	National Assessment of Educational Progress (NAEP)	Survey of Academic and Youth Outcomes-Teacher Version (SAYO-T)	Homegrown/local (e.g., District-created survey tools, SciTech Festival collaboratory survey, VC STEM 3D)		Local/Home Grown: OST - Indiana Quality Program Self-Assessment
Onsite visits by a Program Evaluator	Homegrown/local (VC STEM 3D under development)	Student Attitudes toward STEM Surveys (S-STEM): MISO/ North Carolina State/Friday Institute	Science Teaching Efficacy Belief Instrument (STEBI) - STELAR - EDC	Non-specific (e.g., staff reflections, customized self-report forms).		Landscape Survey – examining needs and wants for STEM programming in community at large
Policy Studies Association, Inc. (PSA) OST Observation Instrument		Survey of Academic and Youth Outcomes Youth Survey (SAYO Y)	Federal Annual Performance Report - Teacher Survey			District preparedness surveys (e.g., Carnegie Science Center STEM Pathways Assessment tool (STEM learning progress).
The Danielson Group Observation Template (modified)		State-wide knowledge-based assessments (e.g., M-STEP in Michigan)	Pedagogical Content Knowledge (PCK) Assessment			Pre-screen check-lists (administered prior to program observation tools to determine if full observation needed)
		STEM Readiness Self-Assessment	Home grown/local: VC STEM 3D, OC STEM			VC STEM 3D (under development)
		University of Cincinnati Evaluation Services Center - Student STEM Survey	Non-specific responses (Google forms)			
		Homegrown (e.g., SciTech Festival Visitor Evaluation Survey, Explore STEM Survey				
		Non-specific (e.g. attitudinal surveys, rating scales)				

3.3. Usefulness of Data Collection Tools

When asked how "useful" each type of data collection tool has been for informing each leader's ecosystem about STEM education strategies, approximately 44% to 100% of respondents endorsed "Very Useful" (highest possible rating) with responses depending on the type of tool in question (Figure 4). Ecosystem leaders were unanimous in their beliefs that all data collection tools were useful (when combining ratings for "Somewhat Useful" and "Very Useful"). Among the tools that received the highest endorsement ("Very Useful") were parent surveys and STEM observation tools, followed by focus groups/interviews, facilitator surveys, general observation tools, and student surveys, respectively. STEM observation tools were rated both the most used and the most useful. Surprisingly, two tools that were reported as being the least used were rated among the most useful (focus groups/interviews and parent surveys).

Figure 4. Usefulness of STEM Data Collection Tools



3.4. Evaluation and Assessment Strategies

Ecosystem leaders were asked a series of questions about their community's preliminary evaluation and assessment strategies, such as hiring an evaluator and partnering with school districts. Respondents answered these questions on a scale of "No, and not considered," "No, but considering," or "Yes" (see Table 2).

Table 2. Ecosystem leaders' preliminary thinking around evaluation and assessment.

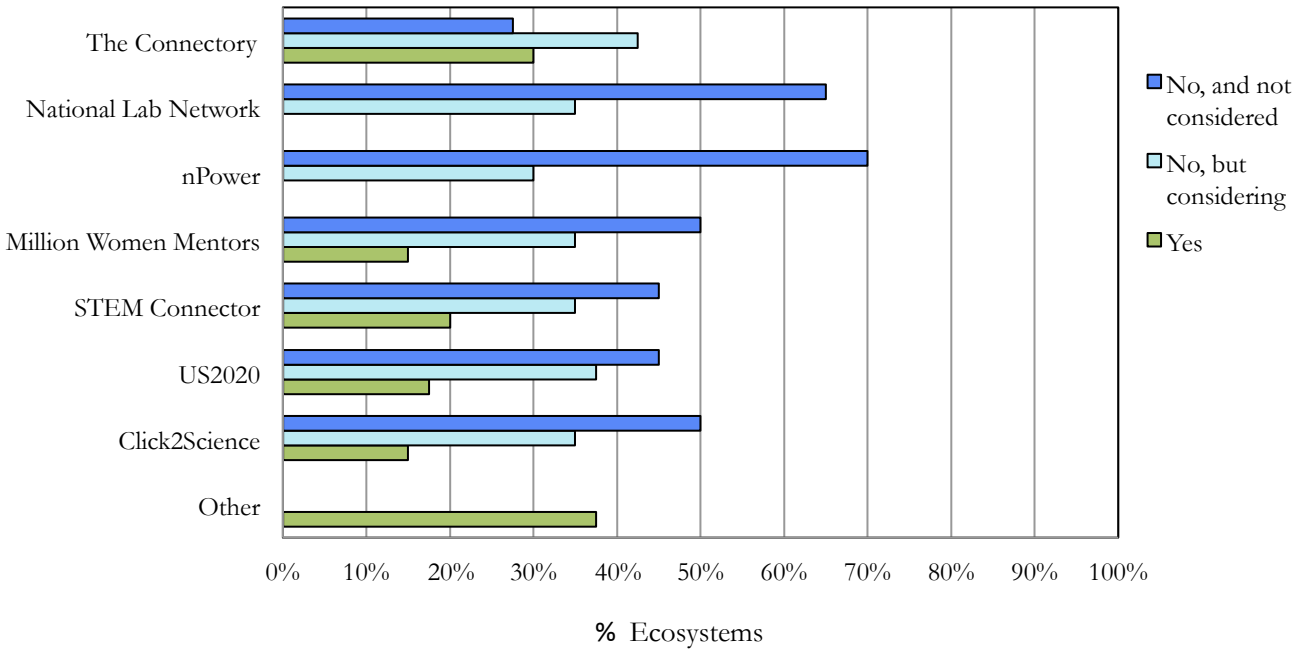
Question	No, and not considered	No, but considering	Yes
Has your ecosystem hired an evaluator to help you measure STEM program quality or student outcomes?	8 (21.62%)	13 (35.14%)	16 (43.24%)
Have you partnered with your local school district to conduct evaluations of STEM learning?	8 (21.62%)	15 (40.54%)	14 (37.84%)
Does your STEM ecosystem use a data management system/portal?	13 (35.14%)	20 (54.10%)	4 (10.81%)
Has your ecosystem or its partners developed data collection tools of its own?	10 (27.02%)	11 (29.73%)	16 (43.24%)
Does your ecosystem use a website/portal to connect students, educators, and/or volunteers with STEM opportunities?	3 (8.12%)	14 (37.84%)	20 (54.10%)

Although many ecosystems reported actively using some kind of website technology to connect members of the ecosystem, few ecosystems have established a data management system/portal to store results from the data collection tools used by the ecosystems (10.8%) – though the majority of the leaders are considering this possibility (54.1%). Among the minority of ecosystems with an established data management system, leaders report using: Qualtrics, City Span, The Connectory, CAYEN, Pivitol Tracker, and Youth Services among a few other home grown varieties. Leaders noted some challenges related to their current data management systems, such as limited scope of use within the ecosystem (e.g., "Currently the Afterschool sector is using City Span. There is a huge potential for a city wide use of city span."), licensing expense (e.g., "I use Qualtrics for...evaluation projects. The site license is $5,000 per year), untapped potential (e.g., "we use Salesforce to enter in all contact info. It is not used to its full potential. Just a matter of people and time."). As with data collection tools described below, some of the systems are homegrown (e.g., "We have custom-designed systems for data management, using various formats and tools."). Many ecosystems are seriously considering their own data management portal, with some actively planning (e.g., "We do not have a portal today but have created an initial plan to create one as part of a NSF grant proposal..." and "Working on a grant to develop a digital dashboard - incorporating evaluation research and asset mapping projects.) Nevertheless, the majority is just beginning to think about how to store and track data (e.g., "We are just in the beginning stages." and "we're very early in figuring out what our evaluation processes will be and how the data will be collected and filed." and "Under consideration.")

Regarding website use, the majority of respondents reported that they have already established a website to connect students, educators, and volunteers with STEM opportunities (54.1%), whereas a small minority had not considered this possibility (8.1%). Among those who were using websites/portals to increase

interactions among STEM community members, there was significant diversity in the response to the website being used. From a pre-determined list of commonly used websites (see Figure 5), it was found that the majority of ecosystems were currently using The Connectory (and a large percentage of ecosystems – 42.5% - indicated that they were actively considering using The Connectory). The STEM Connector (20.0%) and US2020 (17.5%) were the next two most commonly used websites to connect individuals within the ecosystems. However, a large share of ecosystems (38%) reported using a website/portal other than one of the names presented to the leader by The PEAR Institute.

Figure 5. Percentage of Ecosystems Using Various Websites/Portals



When asked about seeking partners to help build out evaluation strategies, somewhat less than half (43.2%) have hired a formal evaluator to measure STEM program quality or student outcomes but another one third of the ecosystems are considering evaluator options (35.1%). Among those who listed a formal evaluator, the majority were university partners such as Harvard University (The PEAR Institute), Loyola University, Miami University of Ohio, and North Carolina State University (Friday Institute). However, there was some diversity in the evaluator pool; one ecosystem reported having a business partner with expertise in the area of evaluation (Hezel Associates, Syracuse, NY), while another reported working with a local public-private partnership that aligns the city government with local community organizations (Boston After School & Beyond, Boston, MA).

Additionally, about one third of ecosystems (37.8%) have partnered with their local school district to conduct evaluations of STEM learning, with many others considering this possibility (40.5%). This is an area of great interest to ecosystems, as many have indicated the desire to strengthen the connection between the regular school day and outside of school. However, many ecosystems find it difficult to articulate the goals or plans for an in-school/out-of-school partnership or what evaluation/assessment could look like. One leader wrote: "We're still in the early stages of figuring out how we will work with several school districts around the state. Certainly, evaluation will be an element of those relationships, but it's too early to define what exactly those practices will be." Similarly, another wrote: Currently, there are 2 districts with whom we are in discussion as partners...However, our work with those districts is still in the early stages, and we have not yet had detailed conversations about assessment." Another simply stated: "Will be working with them [school district partners] in the future. Too early to have anything evaluated."

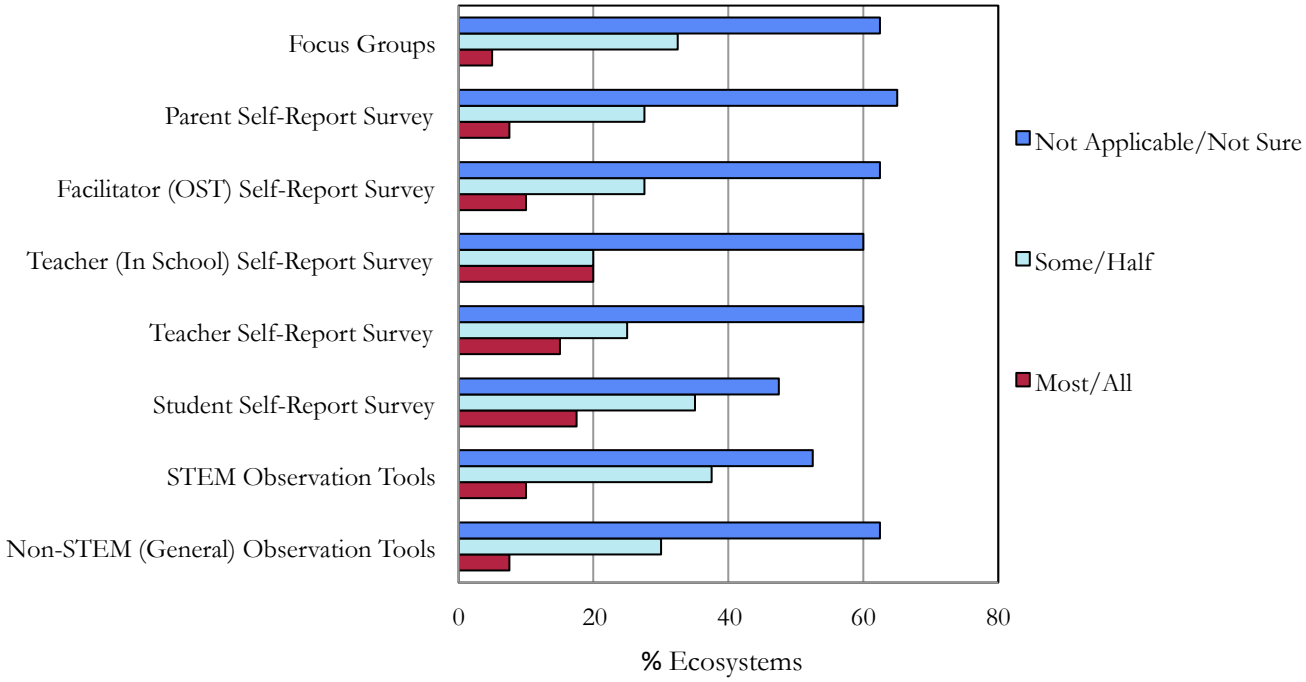
Finally, when asked about local data collection tools, less than half (43.2%) reported that they had developed some kind of data collection tool to evaluate STEM programming, and another third were considering the possibility of developing their own tools (29.7%). A list of commonly cited tools can be found below (see Table 2). The wide range of tools being used to achieve the same end will continue to make it difficult to compare progress within and between ecosystems, a goal that was strongly endorsed by many ecosystem leaders. This challenge was expressed directly by some ecosystem leaders: "pilot communities vary widely with respect to focus, composition, experience, and setting. They are local. To create a meaningful, shared vision would be challenging." Of equal concern, a large number of tools listed by ecosystem leaders do not have well-established psychometric properties, and there exist no comparison data to establish benchmarks for success. However, there is a clear desire by many to identify and adopt tools that meet the standards of educators and researchers, and a jointly developed "STEM Tool Kit" that fits well across communities would help to bring a shared vision to fruition. Supporting this willingness to move away from local tools, one leader wrote: "it would be value added to be able to use a single tool that meets the needs of both the Ecosystem and state."

3.5. Cohesiveness among Ecosystem Partners

After leaders were asked about which tools, if any, their ecosystems were using to evaluate STEM learning, they were asked to estimate how many of the partners within the ecosystems were using the data collection tools they specified earlier in the survey (see Figure 6). Between 7.0-17.5% of ecosystems reported most or all of their partners were using the same tools, whereas between 20.0-37.5% of ecosystems reported that

some or half of their partners were using the same data collection tools. The majority (47.5-62.5%) was not sure if partners were using the same or different tools - or did not use the tools in question. Based on this information, it is evident that there needs to be more communication among partners in the ecosystems to promote cohesion in evaluation strategy. Now is an optimal time to advocate for unity in goal setting, tool selecting, and evaluation planning.

Figure 6. Percentage of partners in ecosystems using various data collection tools



3.6. Willingness to Create Shared Vision

Lastly, ecosystem leaders were asked: "*How willing do you think your partners would be to use data collection tools that are common across ecosystems (to look at ecosystem development, program effects, and youth impact)?*" and answered on a four-point Likert scale from "Very Unwilling" to "Very Willing." The majority of ecosystem leaders (89%) reported that they believed their partners would be somewhat willing (21 ecosystems) or very willing (12 ecosystems) to use common data collection tools across ecosystems. On the other hand, 11% of ecosystems felt that their partners would be somewhat unwilling (3 ecosystems) or very unwilling (1 ecosystem) to use the same tools that are used by others across ecosystems.

Figure 7. Willingness to Use Shared Tools Across Ecosystems

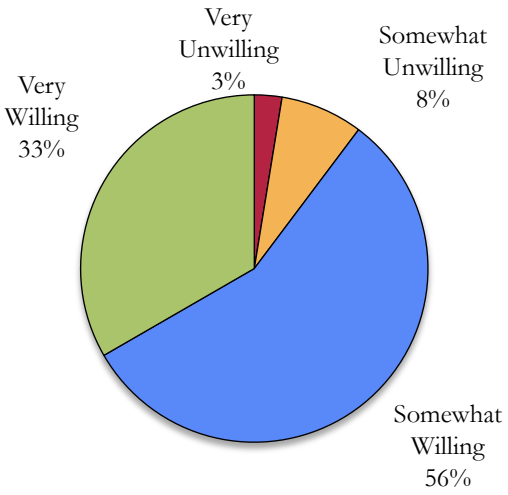


Table 3 below provides brief summaries of the common reasons for why ecosystem leaders believe their partners would be willing or unwilling to use common tools across ecosystems. The most common reasons for being somewhat willing or very willing pertain to wanting standardized measures that can communicate between ecosystems and to funders and having a common metric that will cultivate cross-sector and regional partnerships to support STEM pathways and create STEM opportunities for youth. The most common explanations for why ecosystem leaders think their partners would hesitate to adopt shared tools relate to a lack of resources, difficulty obtaining alignment among schools/programs, commitment to current tools in use, and uncertainty about the reliability or validity of available tools.

Table 3. Partners' willingness to use data collection tools that are common across ecosystems.

Rating	Reasons for Willingness or Unwillingness
Very Willing	• Partners have a desire to standardize evaluation tools to better collect data and share metrics with stakeholders. • Some funders have pre-existing research requirements that may interfere with introducing a new tool. • Partners have a strong commitment to implementing common data collection tools. • Many partners are eager and excited to be able to track and measure progress. • Ecosystems have a vision and desire to cultivate cross-sector and regional partnerships to support youth pathways and generate opportunities for growth
Somewhat Willing	
Somewhat Unwilling	• There are concerns about the time and energy it takes to attain alignment across all schools. • The quality and type of tools would have to be better than the established suite of tools already being used by some ecosystems. • Ecosystems feel it is challenging to convince people who are resistant to change to get on board. • Limited resources and a lack of information about return on investment impedes implementation
Very Unwilling	

4. RECOMMENDATIONS

The 2016 STEM Learning Ecosystem Evaluation and Assessment Survey achieved the goal of gathering a great variety of perspectives from the ecosystem leaders across the U.S. While many different insights on evaluation strategy and data collection tools were shared with us, there were several clear patterns that were captured in this report that make it possible to introduce a number of significant recommendations. We are focusing here on five key recommendations: (1) to decide on a common framework for ecosystems and choose common metrics of STEM learning across ecosystems (with flexibility); (2) to increase accessibility and ease of data collection and analysis with a common national database; (3) to shift the way STEM practitioners think about and use data to a more proactive approach; (4) to connect multiple pieces of evidence to affect policy changes; (5) to form a national working group of interested ecosystem leaders to further research this high priority topic and propose a reasonable action plan.

1. **Decide on common framework, goals, and tools within ecosystems:** Ecosystem leaders report a great deal of interest in having a common assessment across ecosystems, however they also have shown that there needs to be more cohesion among ecosystem partners in terms of their current evaluation plans and data collection tools. This is not surprising because, within each ecosystem, there are many ideas about values and practices for STEM learning. For instance, museums have different ways of teaching STEM than a school or an afterschool program, and so it is logical that different kinds of evaluation plans and measurement tools would be used. However, identifying a unifying framework, or a common language to communicate STEM learning goals, within each ecosystem will sharpen the focus on which data collection tools to use to measure the progress of each ecosystem as a whole. A standard set of reliable and valid data collection tools are necessary to establish benchmarks that measure success. Though it is critical to identify a common metric across partners in an ecosystem, we also strongly encourage flexibility if there are partners that want to continue to collect data quantitatively and qualitatively using their own methods. Nevertheless, each ecosystem will need a leader who can synthesize the diverse STEM learning experiences across various settings to draw conclusions about the outcomes of the ecosystem as a whole. If there continues to be separate measurements for each context (i.e., one measure for museums, one measure for company mentoring program, etc.), there will not be a way to communicate between partners.

We recommend that each ecosystem have a goal to bring up every member (to "lift all boats"), which will require a common framework and common language to understand quality and outcomes across all contexts. For instance, it is possible to measure engagement, inquiry, relevance, and interest regardless of the STEM learning setting. Assessment is as much of an art as it is a science; we must have tools that are sensitive to the environment so that the nuances of each setting are captured, but we must have tools that are generalizable enough so that strengths and needs are easily communicated across all partners.

Related to the above, ecosystems should be provided with training and assistance to make use of what tools already exist rather than starting from scratch. The development of assessments is a multi-year process, and much of this work has already been done. We believe that ecosystems should be protected, except if they want to, from a long and expensive process of research, development, piloting, and validating, when the field has already come a long way in evaluation and assessment. There is significant risk in using homegrown tools that have no basis for comparison and are not psychometrically sound.

We strongly recommend, as much as possible, that ecosystems choose psychometrically sound tools that already exist rather than to start from scratch to save on effort, time, and money. This does not mean that it is not possible to adjust, refine, or add to existing tools so that they meet the needs of each ecosystem. There should be customization, but it should be based on established tools whenever possible.

2. **Establish a national data management system to track ecosystem progress and advocate for change:** The large majority of ecosystem leaders believe that their partners are willing to create a shared vision around evaluation and assessment across ecosystems. We can make similar arguments for common assessments across the ecologies as we did within the ecologies. However, there is an important difference, which is that ecosystems can be very different (e.g., regionally, culturally, economically, and politically) and there are different motives for data collection (i.e., field building, development of best practices, and policy support), which can make this task especially challenging. However, there are at least three reasons for ecosystems to unite on evaluation and assessment: (1) ecosystems can learn from the strengths and needs of other ecosystems, (2) ecosystems can be motivated by the progress made by others, and (3) big data has become an incredible new opportunity

to advocate for policy changes. If all of the ecosystems work together on evaluation and assessment, there would be significant power to inform on national trends of STEM learning.

To facilitate a cross-ecosystem approach to evaluation and assessment, we recommend that there is a centralized data system that makes participation in evaluation easy and cost-effective and that also serves as a type of virtual community to engage ecosystem partners. This means that outcome measures are relatively short, the time commitment for collecting and inputting data is minimal, the turn-around for results is fast, tracking over time is possible, and comparisons to a national database are immediately made available. Such systems now exist and we recommend that they be made available to all members of the initiative.

3. **Shift the paradigm for data collection and use**: The results of this survey point to a need to shift thinking around the usage of data to increase its value and to better serve youth. Data collection often is accompanied by a sense of *quid pro quo*. For instance, STEM practitioners often feel compelled to assist with data collection for important reasons like grant funding, but this can easily lead to an estranged and abstract relationship with assessment tools and data. We need to change thinking from "we're doing this because we have to" to "we're doing this because it will help us understand and educate our students."

   To be fair to those who hold an ambivalent view, data collection is usually not very timely – results are often reported back to programs long after youth have moved on, and STEM practitioners are not given a deal of guidance on how to use the data to their advantage to facilitate youth development and learning.

   Thus, we strongly recommend a different use of data collection – to take a proactive approach to help practitioners better understand and help the students that they are currently serving, rather than using data to reflect on what happened after the fact.

   Rapid analysis and reporting of data at the start of programming (using a common database, mentioned above) would provide STEM educators with information about students that could lead to changes in STEM activity planning or execution. As an example, it would be helpful to know if girls in a classroom or afterschool program feel less engaged with science than boys, or if more than half of the students are not interested in getting a STEM career when they grow up.

Another outcome from the present survey of ecosystem leaders serves to exemplify this point, which is that student surveys were among the most commonly used tools but were viewed as the least useful, particularly compared to STEM program quality observations (though the majority of leaders viewed all tools as somewhat useful or very useful, including self-report surveys). In the context of an ecosystem, students and parents should be viewed as active participants and there needs to be a way to leverage their valuable input. Self-report surveys promote youth voice in the educational system by giving students the opportunity to really represent themselves and express their views about STEM learning. Their voice is as important as any other partners within the ecosystem. However, from the perspective of ecosystem leaders, there is a sense that student self-reports are performed and filed away at the end of each school year and not used in a meaningful way. Using self-report tools to get to know students at the beginning and middle of the school year would allow educators to consider their students' interest levels and skills in real-time. Likewise, performing STEM program quality observations and giving feedback at the beginning of STEM programming would help to improve the quality of activities that students participate in.

Our recommendation is to shift the paradigm for the collection and use of data from a reactive to a proactive approach; obtain measures of STEM quality and student interest at the outset to engage STEM practitioners and to address thoughts and feelings voiced by students.

4. **Link multiple pieces of evidence of STEM learning:** About half of the ecosystem leaders report their partners are using at least one data collection tool, which is an excellent start. However, connecting multiple pieces of evidence, such as STEM program quality observations with student attitudes or skills will better tell the story of STEM learning than any one measure alone. Importantly, it will not be sufficient to use one tool alone, such as self-reported outcomes, to convince policymakers and funders about changes that would better support STEM learning in the ecosystems.

We recommend a triangulation method, which means that self-report of youth is combined with reports from teachers and facilitators, as well as observations of the quality of the settings.

The majority of the ecosystems are very early in the process of selecting and using data collection tools, but the combined power of the ecosystems can have a big impact on the selection of methods. It is

important to note that most ecosystems will not have the capacity implement multiple data collection tools with every program and every child, but starting with a small subset of students, adults, and programs/schools in combination would create a very substantial sample across ecosystems. The numbers that would be generated could be very convincing to funders, practitioners, and policymakers. This approach would create the foundation of longitudinal work and fundable studies, but the positive is that even without those ambitious goals, that one could have a relatively low cost system that produces usable results for each ecology and for this important initiative together.

5. **Form a national working group to drive a national evaluation and assessment strategy.**

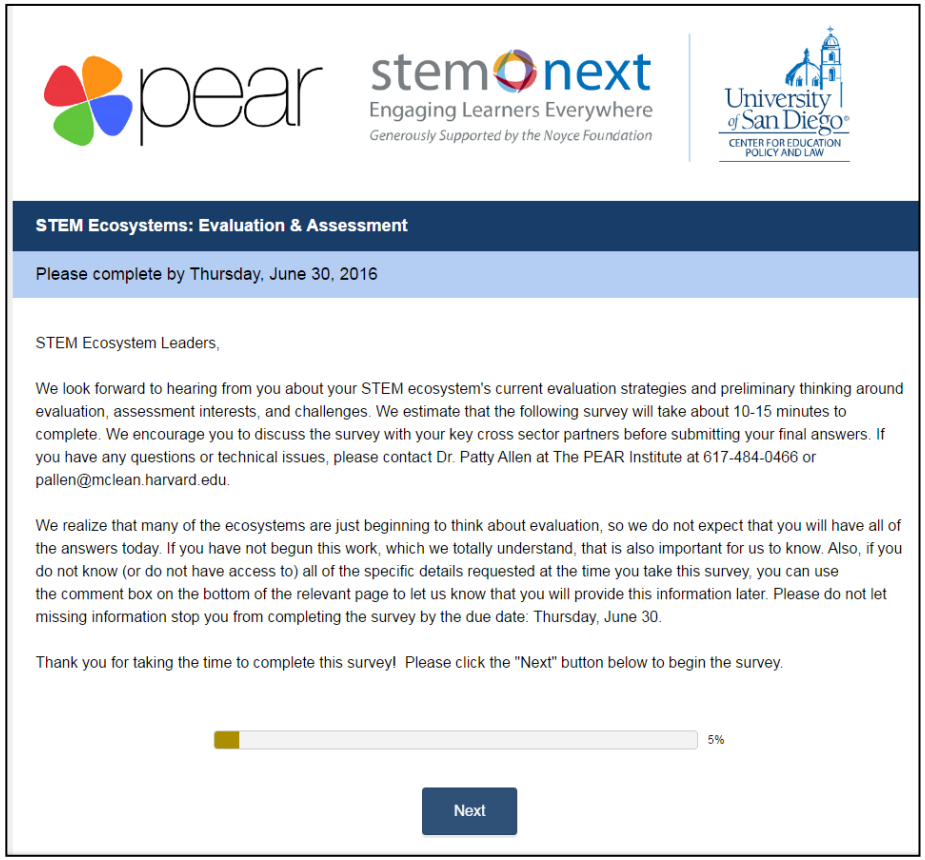
We recommend a subgroup of ecosystems interested in this topic to join the discussion by forming a national working group that focuses on STEM evaluation and assessment.

This group should be informed by STEM researchers and experts, and the goal of this group should be to consider the above recommendations and to create a reasonable action plan aimed at developing a shared vision for evaluation and assessment strategies across ecosystems. This group should continue to remain flexible and encourage creative thinking around evaluation and assessment within each ecosystem. The collective whole can learn from lessons that are unique to each ecosystem. The context, efforts, resources, and lessons of each ecosystem should be communicated to this group, with the hope that local efforts will complement a common national plan to benchmark ecosystem progress and impact. Together, the ecosystems can and should leverage their strength and innovation to benefit youth and to transform STEM education in the U.S.

LIST OF APPENDICES

A. Images of STEM Ecosystem Survey – Evaluation & Assessment (online only)

(Survey Images: Page 1 of 11)



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STEM Ecosystems: Evaluation & Assessment

Please complete by Thursday, June 30, 2016

STEM Ecosystem Leaders,

We look forward to hearing from you about your STEM ecosystem's current evaluation strategies and preliminary thinking around evaluation, assessment interests, and challenges. We estimate that the following survey will take about 10-15 minutes to complete. We encourage you to discuss the survey with your key cross sector partners before submitting your final answers. If you have any questions or technical issues, please contact Dr. Patty Allen at The PEAR Institute at 617-484-0466 or pallen@mclean.harvard.edu.

We realize that many of the ecosystems are just beginning to think about evaluation, so we do not expect that you will have all of the answers today. If you have not begun this work, which we totally understand, that is also important for us to know. Also, if you do not know (or do not have access to) all of the specific details requested at the time you take this survey, you can use the comment box on the bottom of the relevant page to let us know that you will provide this information later. Please do not let missing information stop you from completing the survey by the due date: Thursday, June 30.

Thank you for taking the time to complete this survey! Please click the "Next" button below to begin the survey.

5%

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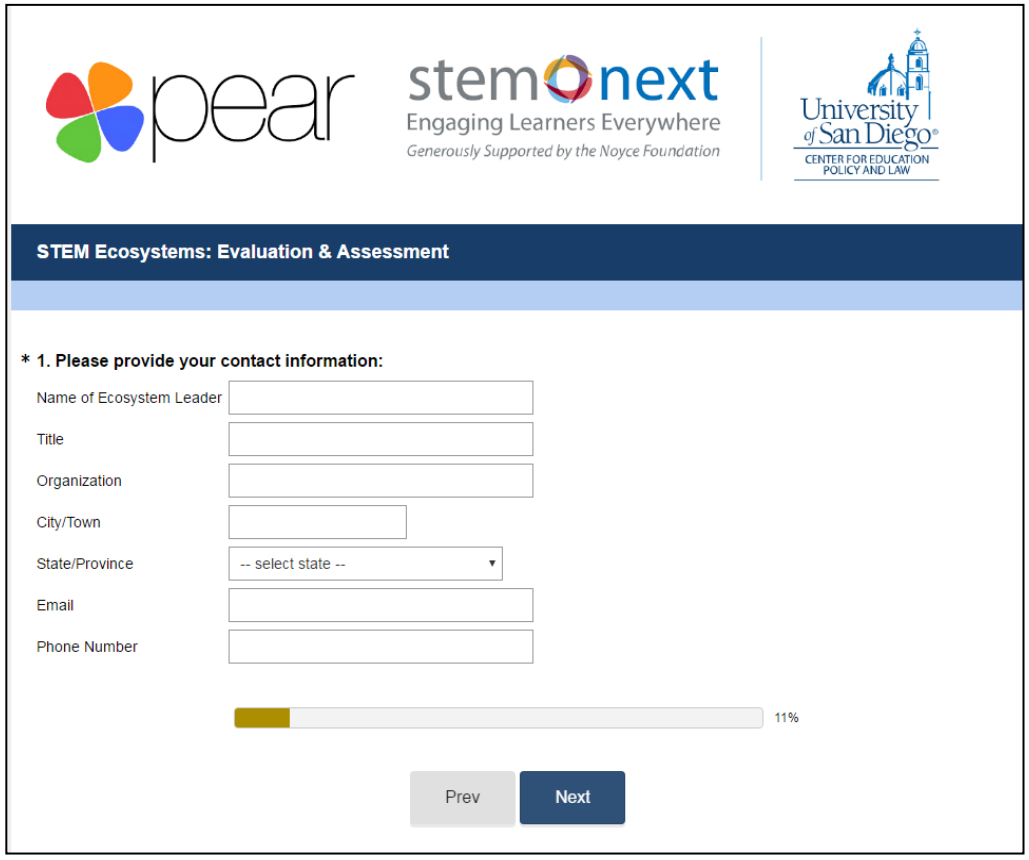

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STEM Ecosystems: Evaluation & Assessment

*** 1. Please provide your contact information:**

Name of Ecosystem Leader
Title
Organization
City/Town
State/Province -- select state --
Email
Phone Number

11%

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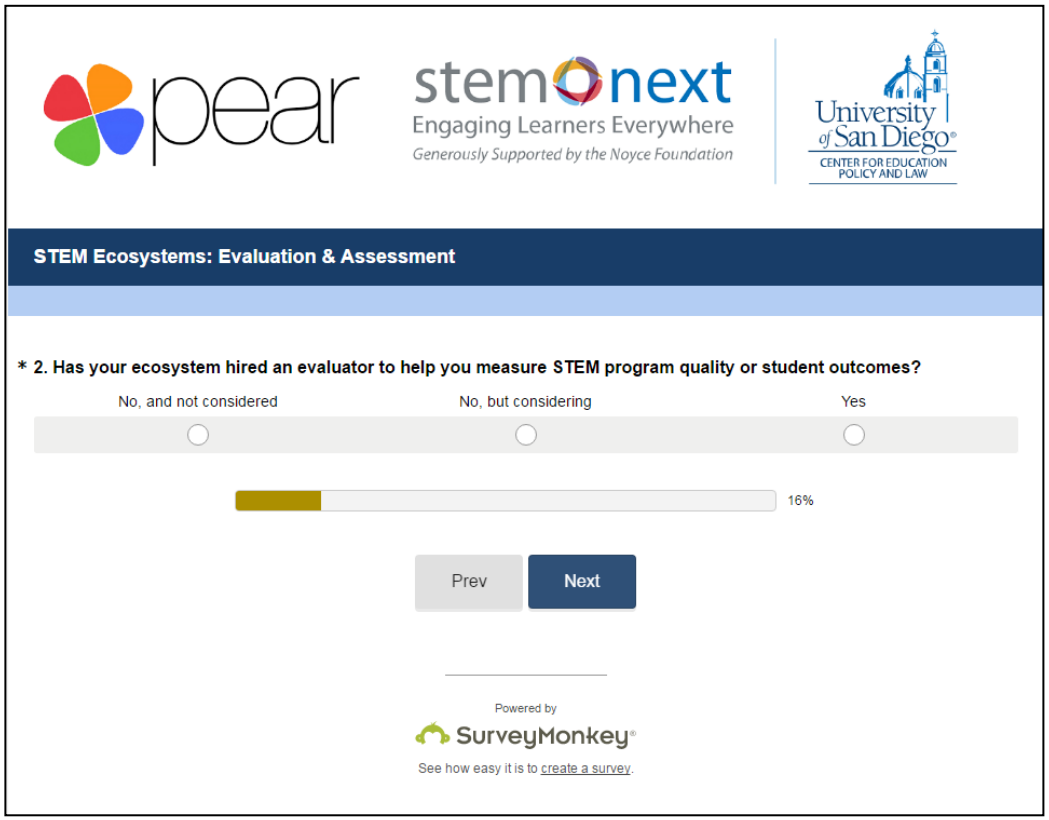
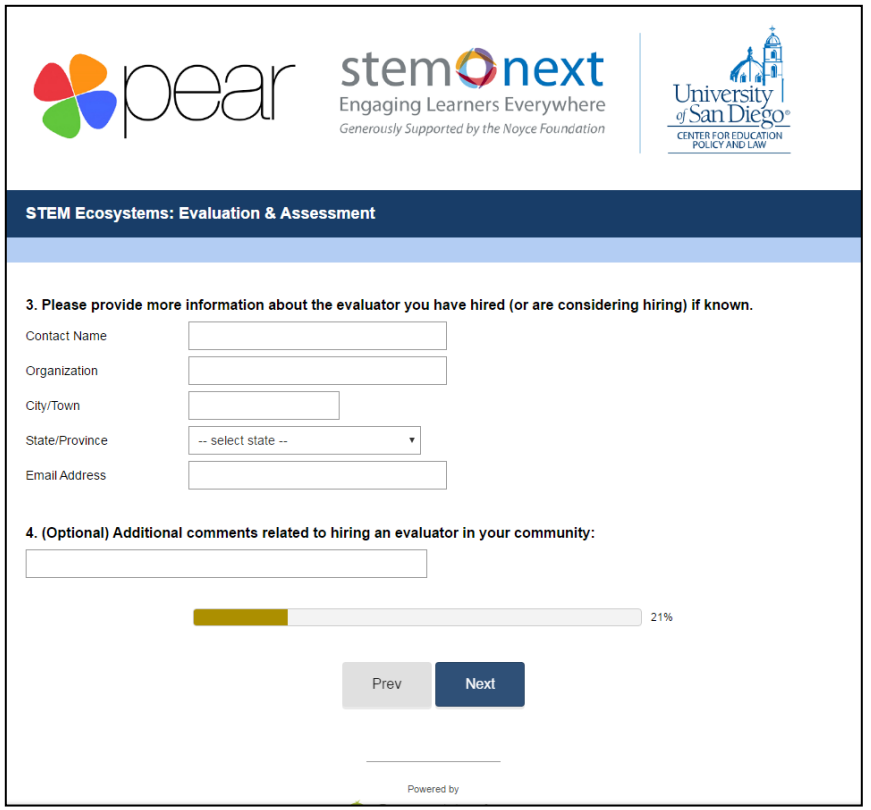
(Survey Images: Page 2 of 11)





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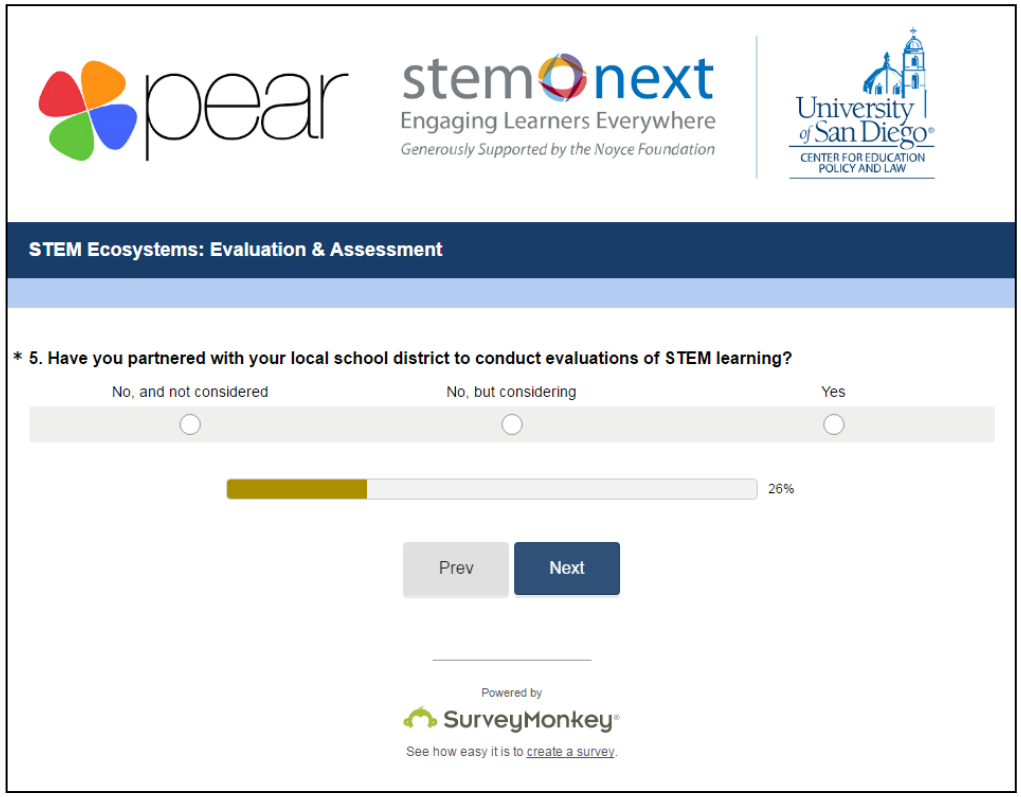

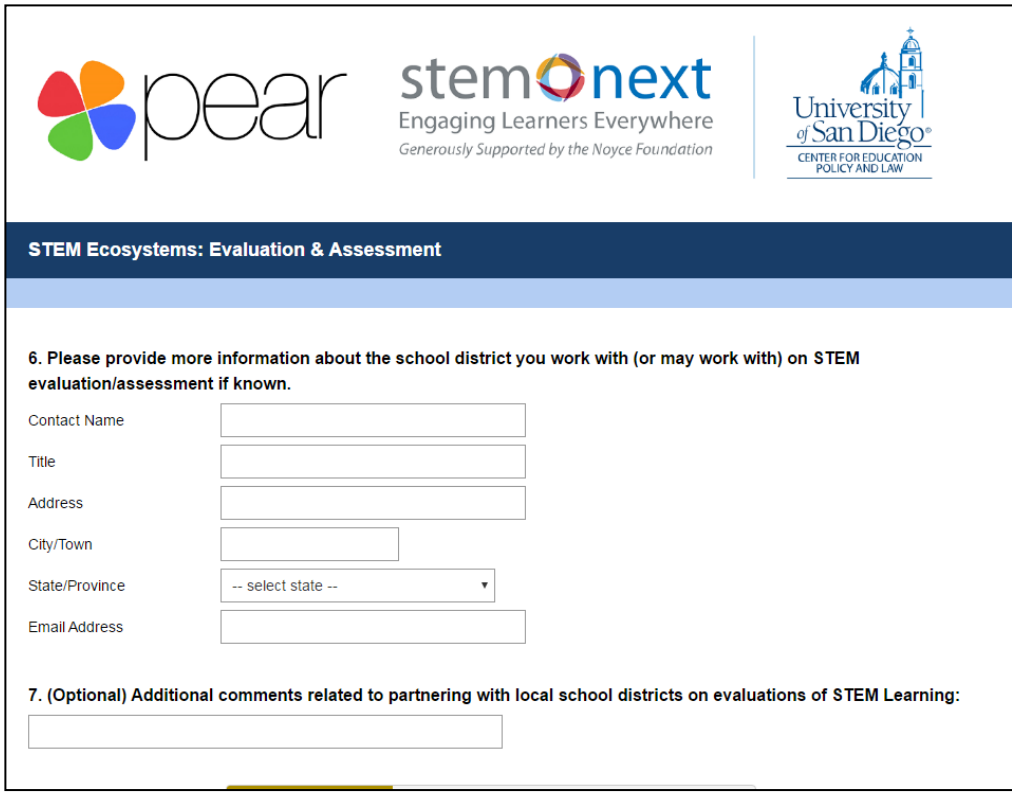

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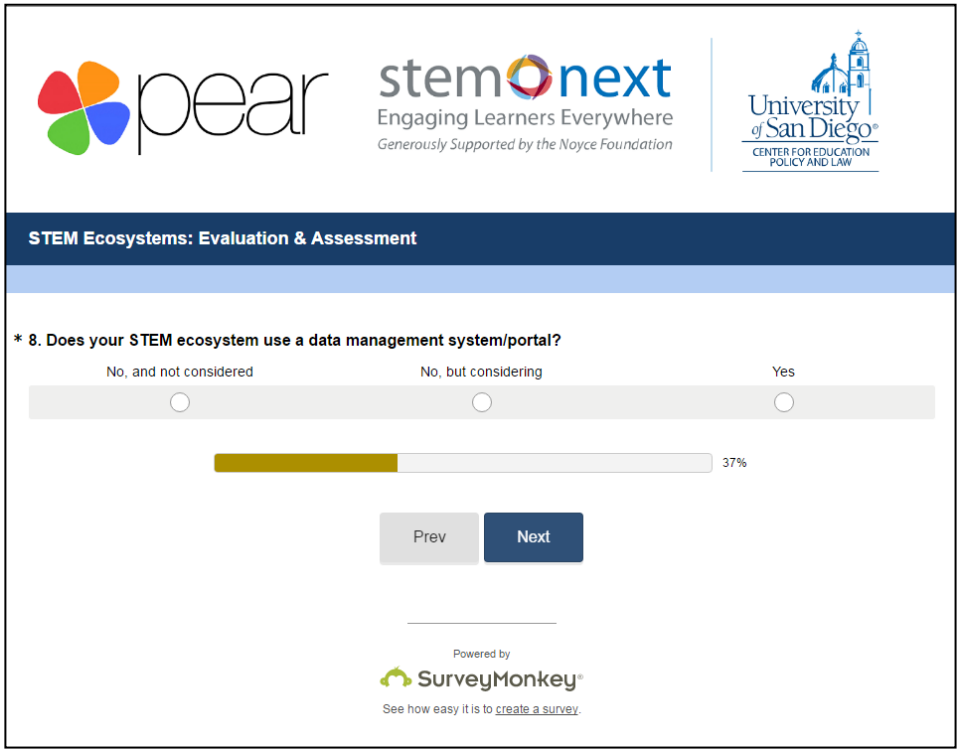

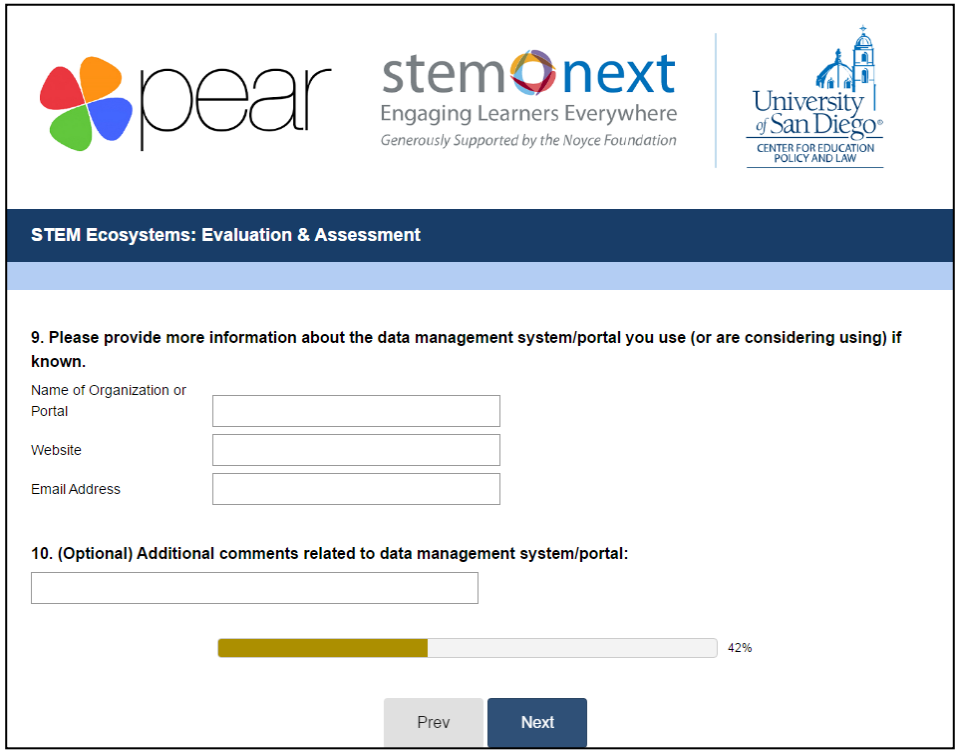

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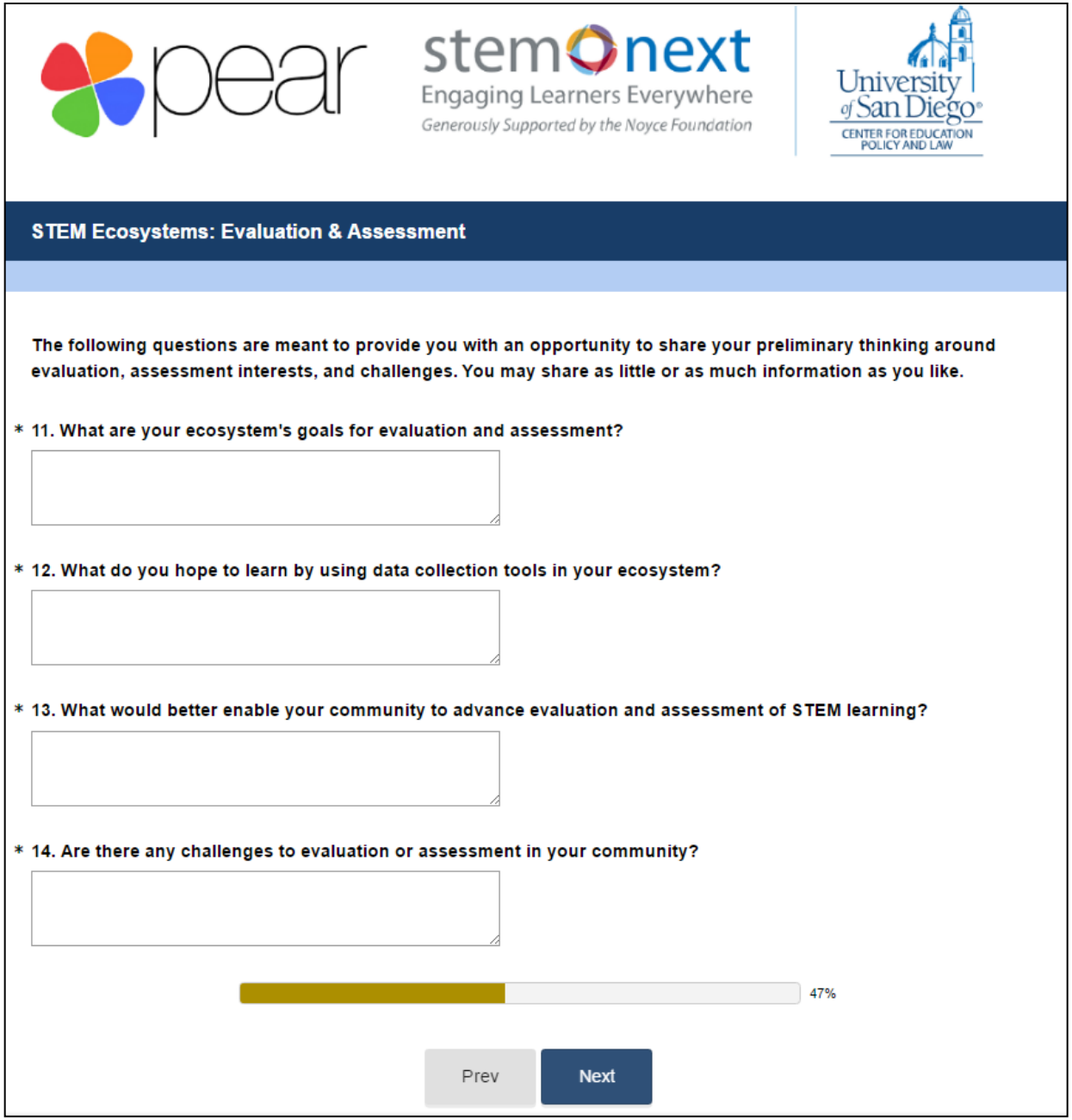

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STEM Ecosystems: Evaluation & Assessment

The following questions are meant to provide you with an opportunity to share your preliminary thinking around evaluation, assessment interests, and challenges. You may share as little or as much information as you like.

*** 11. What are your ecosystem's goals for evaluation and assessment?**

*** 12. What do you hope to learn by using data collection tools in your ecosystem?**

*** 13. What would better enable your community to advance evaluation and assessment of STEM learning?**

*** 14. Are there any challenges to evaluation or assessment in your community?**

47%

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(Survey Images:

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Please tell us the names of the data collection tool(s) you are CURRENTLY using (within the last 2 years) to evaluate STEM learning in your community.

If you haven't used any yet - this is not a problem! Please write N/A or None to move on to the next question.
If you are not sure what the tool is called, please provide what information you know or comment that you can provide later.

* **15. Name of observation tool(s) with a GENERAL EDUCATION focus:**
(If more than one answer, please list all from most commonly used to least commonly used.)

* **16. Name of observation tool(s) with a STEM EDUCATION focus:**
(If more than one answer, please list all from most commonly used to least commonly used.)

* **17. Name of survey tool(s) completed by STUDENTS:**
(If more than one answer, please list all from most commonly used to least commonly used.)

* **18. Name of survey tool(s) completed by TEACHERS during the school day.**
(If more than one answer, please list all from most commonly used to least commonly used.)

* **19. Name of survey tool(s) completed by FACILITATORS outside of school:**
(If more than one answer, please list all from most commonly used to least commonly used.)

* **20. Name of survey tool(s) completed by PARENTS:**
(If more than one answer, please list all from most commonly used to least commonly used).

21. (Optional) Are there other data collection methods that you use which are not covered above?

22. (Optional) Is there anything else you would like us to know about data collection methods in your ecosystem?

53%

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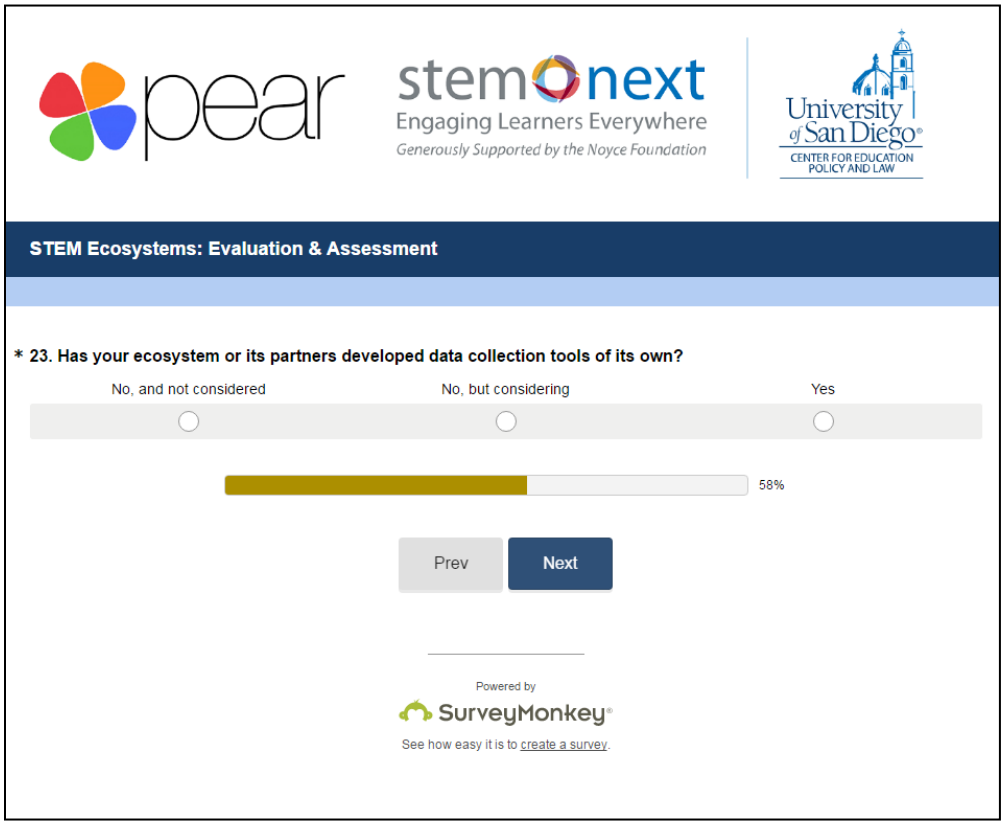

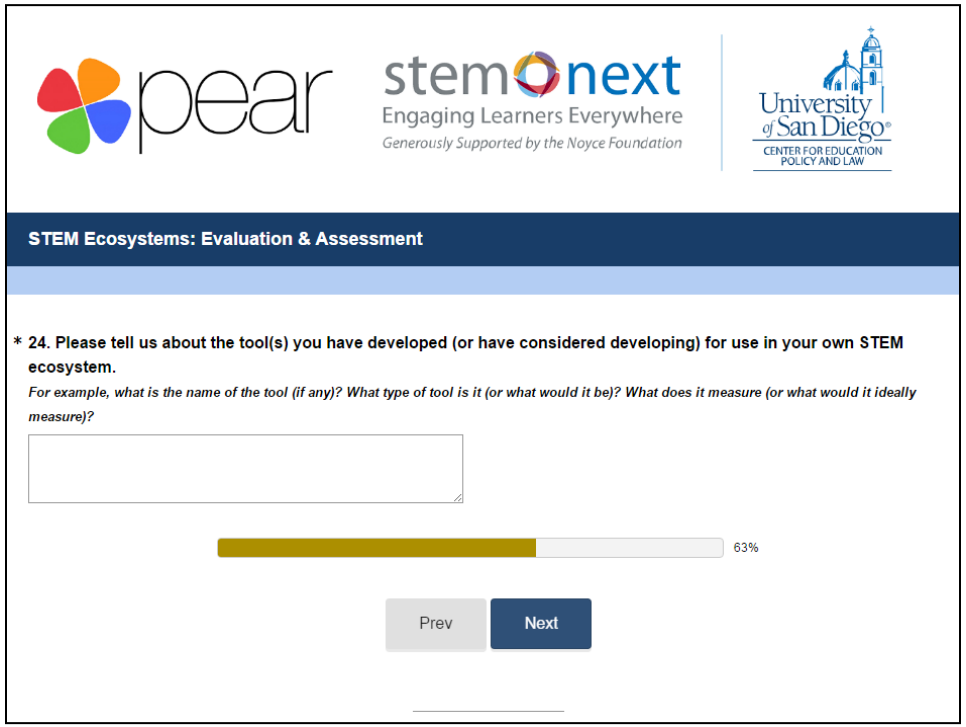

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However, if you answered yes or considering, this answer is require.)

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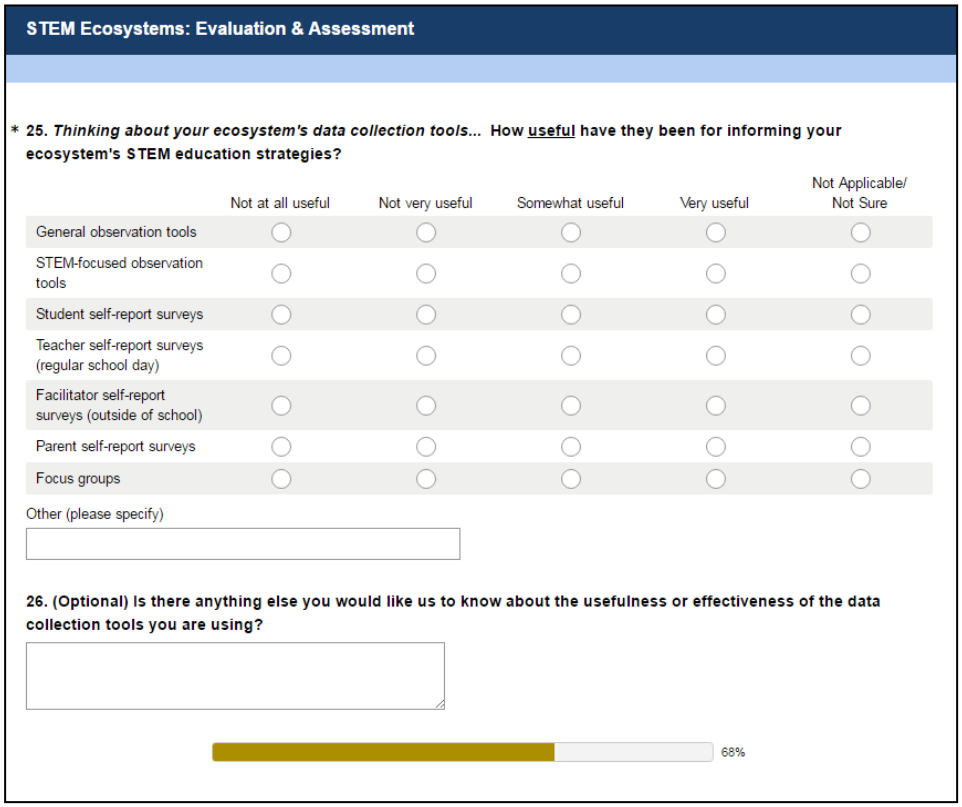


STEM Ecosystems: Evaluation & Assessment

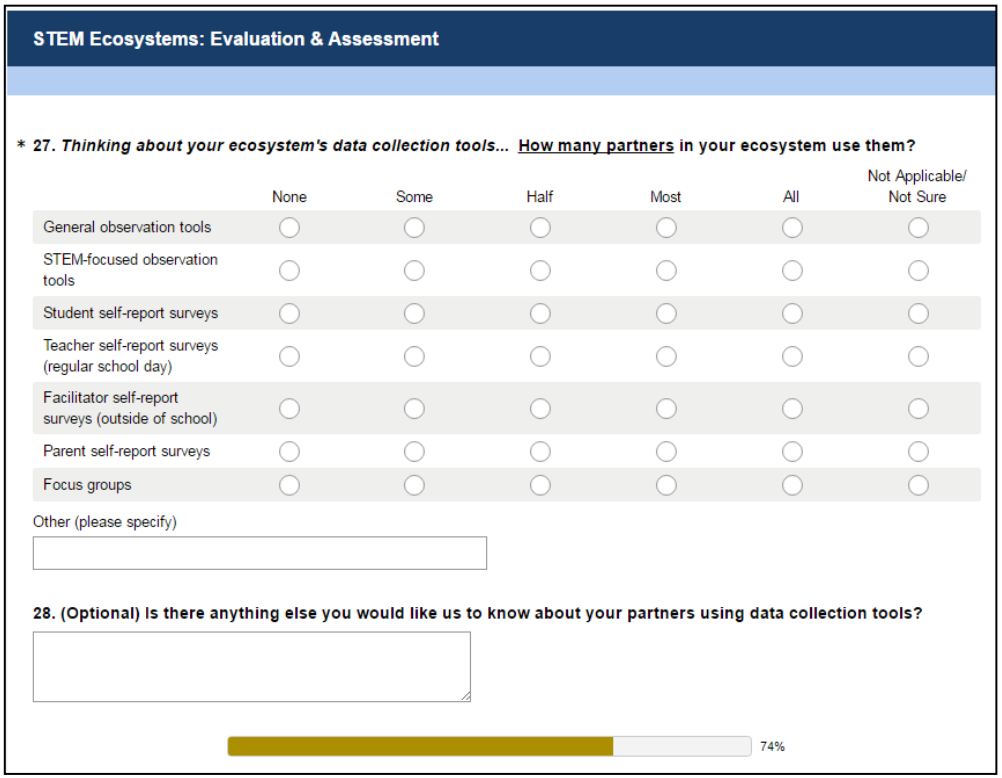
* **25. *Thinking about your ecosystem's data collection tools...* How <u>useful</u> have they been for informing your ecosystem's STEM education strategies?**

	Not at all useful	Not very useful	Somewhat useful	Very useful	Not Applicable/ Not Sure
General observation tools	○	○	○	○	○
STEM-focused observation tools	○	○	○	○	○
Student self-report surveys	○	○	○	○	○
Teacher self-report surveys (regular school day)	○	○	○	○	○
Facilitator self-report surveys (outside of school)	○	○	○	○	○
Parent self-report surveys	○	○	○	○	○
Focus groups	○	○	○	○	○

Other (please specify)

26. (Optional) Is there anything else you would like us to know about the usefulness or effectiveness of the data collection tools you are using?

68%



STEM Ecosystems: Evaluation & Assessment

* **27. *Thinking about your ecosystem's data collection tools...* <u>How many partners</u> in your ecosystem use them?**

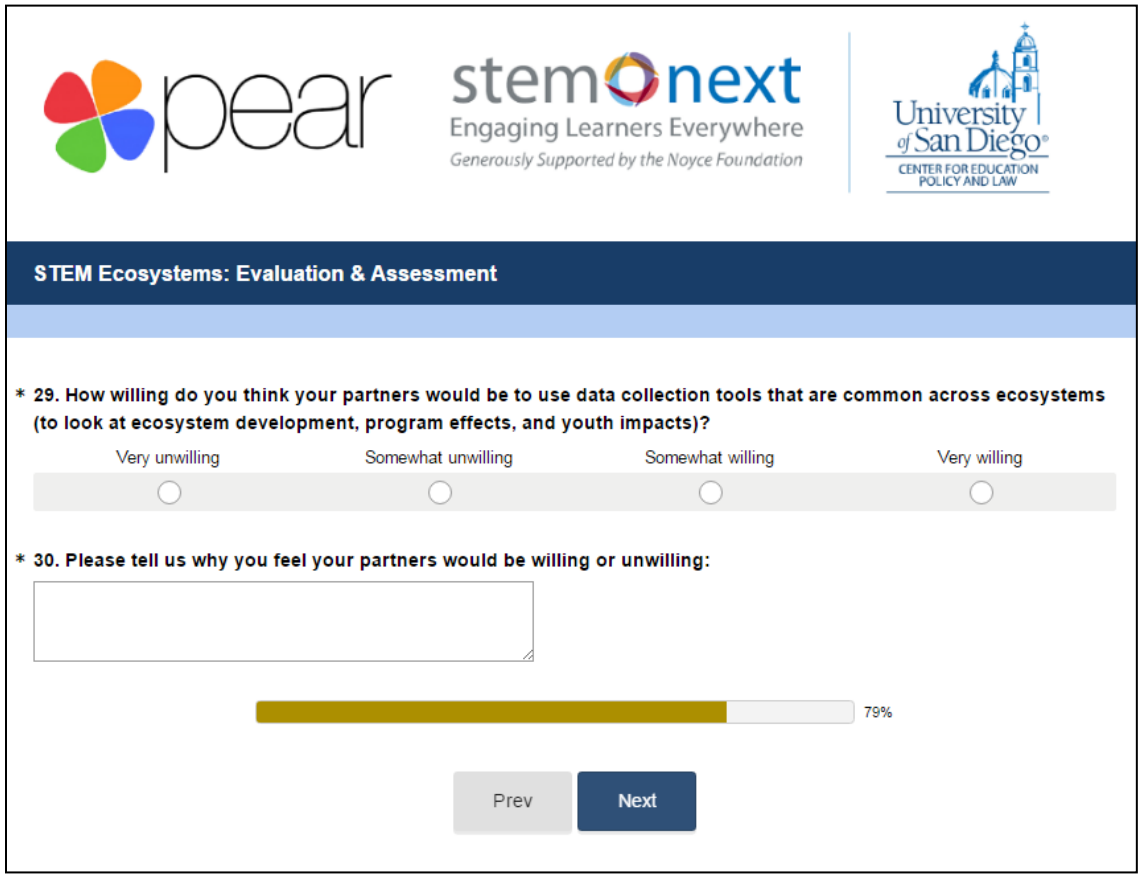
	None	Some	Half	Most	All	Not Applicable/ Not Sure
General observation tools	○	○	○	○	○	○
STEM-focused observation tools	○	○	○	○	○	○
Student self-report surveys	○	○	○	○	○	○
Teacher self-report surveys (regular school day)	○	○	○	○	○	○
Facilitator self-report surveys (outside of school)	○	○	○	○	○	○
Parent self-report surveys	○	○	○	○	○	○
Focus groups	○	○	○	○	○	○

Other (please specify)

28. (Optional) Is there anything else you would like us to know about your partners using data collection tools?

74%

(Survey Images: Page 9 of 11)



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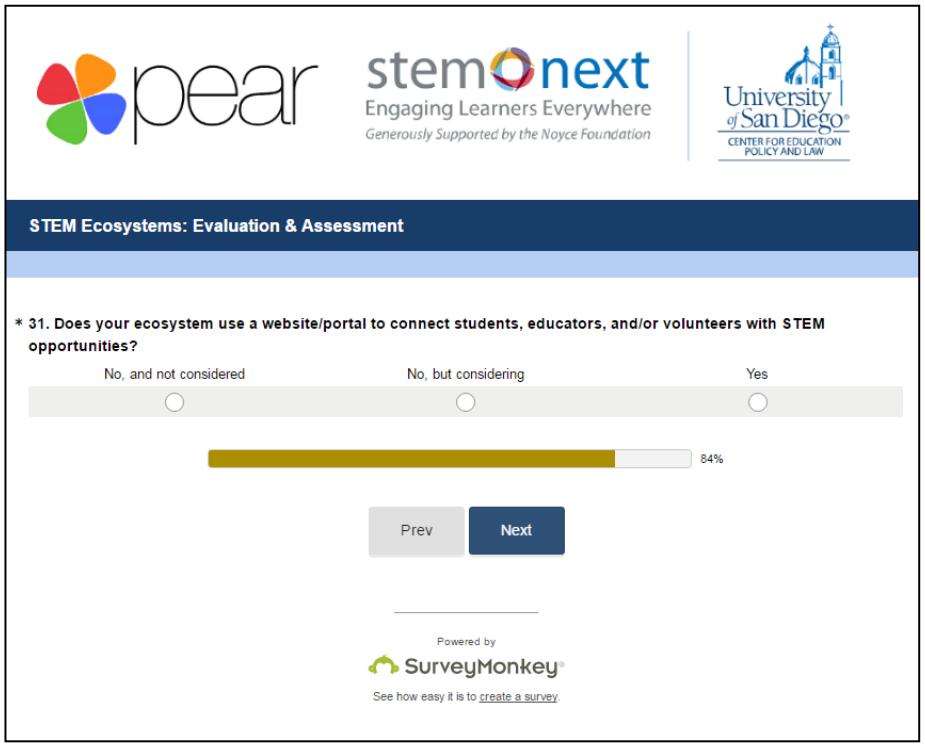

STEM Ecosystems: Evaluation & Assessment

* 31. Does your ecosystem use a website/portal to connect students, educators, and/or volunteers with STEM opportunities?

No, and not considered	No, but considering	Yes
○	○	○

84%

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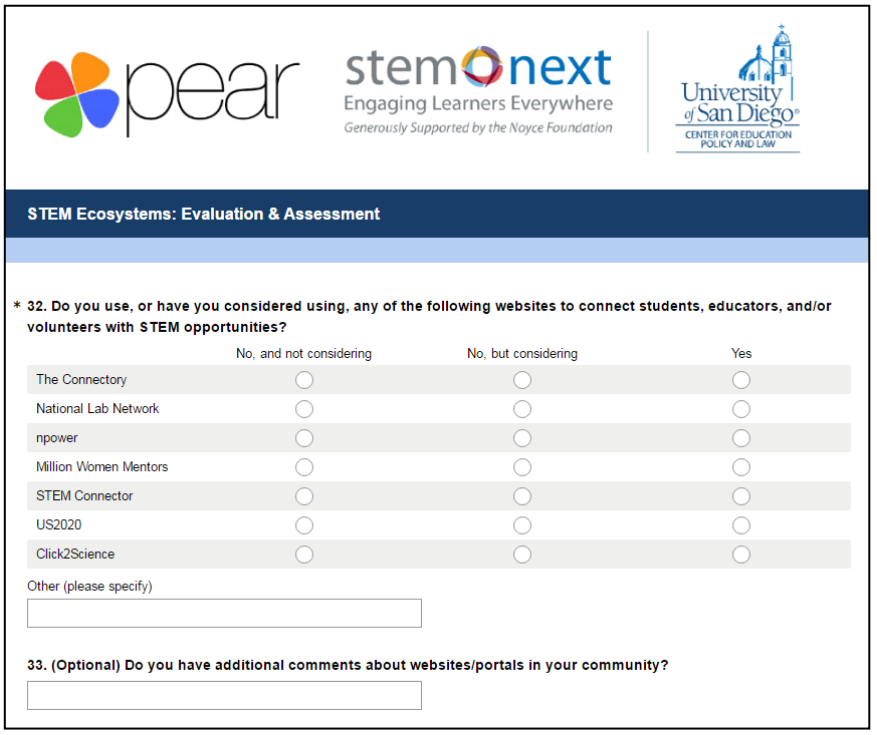
Powered by SurveyMonkey

See how easy it is to create a survey.



STEM Ecosystems: Evaluation & Assessment

* 32. Do you use, or have you considered using, any of the following websites to connect students, educators, and/or volunteers with STEM opportunities?

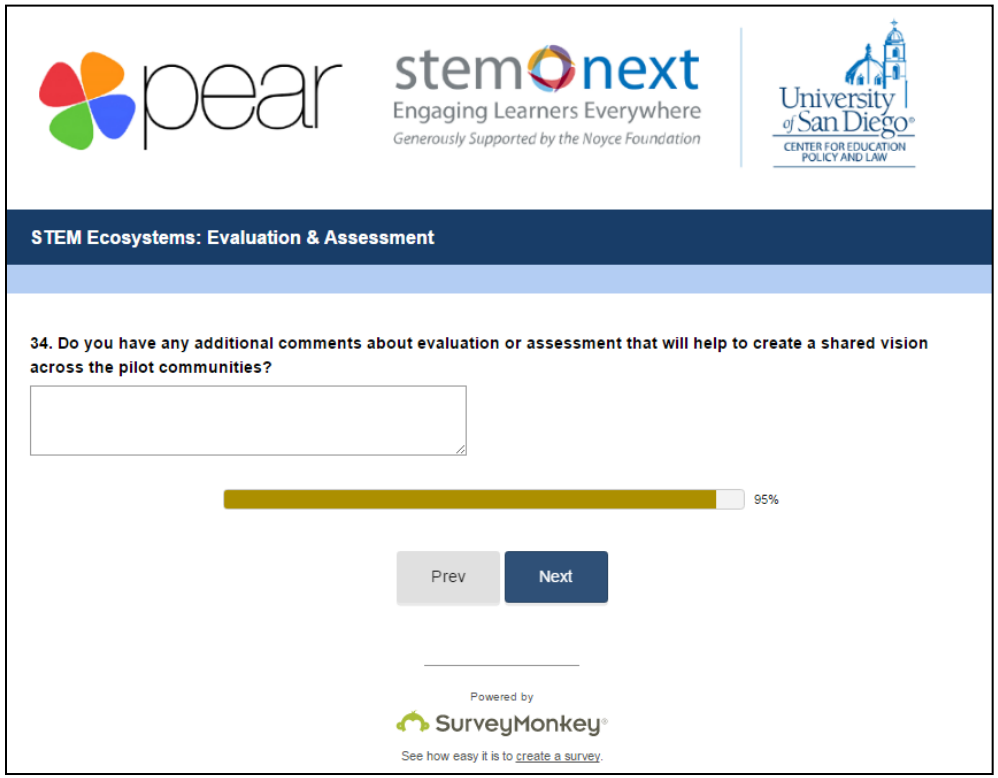
	No, and not considering	No, but considering	Yes
The Connectory	○	○	○
National Lab Network	○	○	○
npower	○	○	○
Million Women Mentors	○	○	○
STEM Connector	○	○	○
US2020	○	○	○
Click2Science	○	○	○

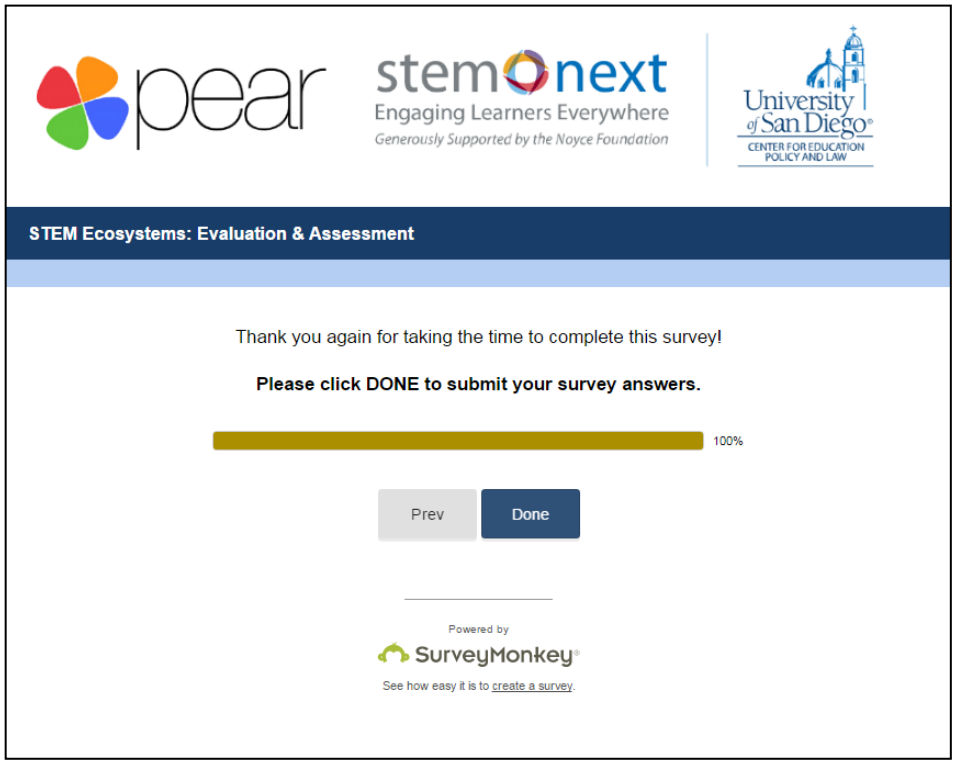
Other (please specify)

33. (Optional) Do you have additional comments about websites/portals in your community?

(If you answered **no** to #31, then you will skip the above info section)

(Survey Images: Page 11 of 11)





(You are officially finished once you click the "DONE" button!

Thanks for your participation!!)

B. List of STEM Learning Ecosystems that Completed Survey (June-August 2016)

Ecosystem	City/Town	State
Arizona SciTech Ecosystem	Phoenix	AZ
Bay Area STEM Ecosystem	San Franciscso	CA
Bmore STEM	Baltimore	MD
BoSTEM	Boston	MA
Carbon/Schuylkill/Lucerne Counties Ecosystem	Carbon County	PA
Central NM STEM-H Education Hub	Albuquerque	NM
Central Oklahoma Regional STEM Alliance	Oklahoma City	OK
Chicago STEM Pathways Cooperative	Chicago	IL
Colorado STEM	Denver	CO
DC STEM Network	Washington	DC
East Syracuse Minoa Central School District STEM Learning Ecosystem	East Syracuse	NY
ecosySTEM KC	Kansas City	MO
EvanSTEM	Evanston	IL
Great Lakes bay Regional STEM Initiative	Saginaw	MI
Greater Austin STEM Ecosystem	Austin	TX
Greater Cincinnati STEM Collaborative	Cincinnati	OH
Indiana STEM Ecosystem Initiative	Indianapolis	IN
Interdisciplinary Science and Engineering Partnership in Western New York	Buffalo	NY
Lancaster County STEM Alliance	Lancaster	PA
Los Angeles Regional STEM Hub	Los Angeles	CA
NC STEM Ecosystem: Driving the Future (Research Triangle Park, NC)	Greenville	NC
North Louisiana STEM Alliance	Shreveport	LA
Northeast Florida Regional STEM2 Hub	Jacksonville	FL
Northeast Ohio STEM Learning Ecosystem	Canfield	OH
NYC STEM Education Network	New York	NY
Omaha STEM Ecosystem	Omaha	NE
Orange County STEM Initiative	Corina Del Mar	CA
Oregon's Statewide Regional STEM Hub Network	Salem	OR
Pittsburg Regional STEM Ecosystem	Pittsburg	PA
Providence After School Alliance (PASA)	Providence	RI
Queens 2020	Corona	NY
San Diego EcosySTEM	San Diego	CA
STEM Hub Downeast	Augusta	ME
STEMCityPHL Regional Network	Philadelphia	PA
Tampa Bay STEM Network	Tampa	FL
Tulsa Regional STEM Alliance	Tulsa	OK
Ventura County STEM Regional Network	Camarillo	CA