Taking Stock of Oregon STEM Hubs: Accomplishments and Challenges

An Evaluation Report Prepared for the Oregon Department of
Education

Prepared by:
Nancy Staus
Kimberley Preston
Brianna Keys
Martin Storksdieck
Center for Research on Lifelong STEM Learning
Oregon State University
254 Gilbert Hall
Corvallis, OR 97331

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Executive Summary

Introduction. The Center for Research on Lifelong STEM Learning (Center) at Oregon State University (OSU) conducted a yearlong capacity-building research project in order to better understand the common and unique features and strengths of Oregon’s STEM Hubs. The goal for the study was to examine the continued growth and success of the STEM Hubs and their partners in establishing both local and statewide STEM learning ecosystems with the potential to systemically impact STEM education throughout Oregon. The study was designed to compare the state of the STEM Hubs in 2019 to the state of STEM Hubs in 2016-2017, when a similar evaluation was last conducted.

STEM Hubs are regionally-focused, multi-sector partnerships that unite schools, universities, non-profits, businesses, civic leaders and other members of communities in so-called local STEM (Science, Technology, Engineering, and Mathematics) learning ecosystems. STEM Hubs as organized local learning ecosystems have their origin in recent research on effective STEM programming which strongly recommends integrated approaches to teaching and learning that include not only all students, but also all assets for learning, and that build on the simple truth that learning does not only occur within classrooms. The purpose of creating these organized local STEM learning ecosystems called STEM Hubs, therefore, is to drive STEM innovation and evidence-based practices in teaching and learning at the systems level. Designing and curating connected learning across time and space by making use of local STEM assets, involvement of all community partners and resources in a local learning ecosystem, a focus on quality of life and economic opportunity and the development of more cohesive collaborations and partnerships within a STEM Hub region are underlying mechanisms through which STEM Hubs can create short- and long-term impacts. Investments in STEM Hubs are therefore investments into organizational infrastructure for improving the learning experiences and ultimately the learning success of students.

STEM Hubs are implementing strategies that include (amongst others) educator professional development on best practices in STEM instruction; in- and out-of-school, hands-on STEM learning experiences for students; and connections to fast-growing STEM employment opportunities in Oregon. But most importantly, STEM Hubs are creating connections between programs and organizations within a region, and in doing so they contribute not only the individual program and organizational success, but promote local collaboration towards collective impact. Hubs are meant to support each partner of the Hub, but moreover are designed to achieve common goals that otherwise and without the STEM Hub as a “collective impact organization” would be difficult to achieve.

Purpose. The main research goal for this study was to describe how continued investment into the Hubs is influencing local STEM communities; that is, how STEM Hubs have begun to create opportunities for partnerships, collaboration, connected programing, improved program development or delivery, or improved communication within and outside the STEM teaching and learning community. Based on these findings, the report provides recommendations for improvements and future investments. Ultimately, the study aimed at establishing whether and to what degree STEM Hubs are helping to improve opportunities for effective teaching and learning for all Oregon children.

Scope of final report. This report is based on data from surveys, focus groups and individual interviews with Hub directors and staff to provide insights into the STEM Hubs' developing STEM learning ecosystems at both the local and regional level and how Hubs are beginning to function as a larger network to create positive change across the state. The findings inform recommendations for investments into future capacity building for improved STEM learning opportunities.

Methods. Data were collected from STEM Hub backbone staff, leadership and partners using an online survey designed to assess the development and health of the local STEM communities. Focus groups and interviews with Hub directors and selected staff were conducted to assess the development of the Hubs as a statewide collaborative and their perceptions of accomplishments and needs.

Results. Data indicate that investments into backbone structures and programming by the state have been instrumental in creating local STEM Hubs as communities of practice focused on providing rich STEM learning opportunities for all. Across STEM Hubs, partners and backbone staff are reporting positive change as a direct result of Hub activity. In addition, Hubs are developing a collective identity with increased connection, communication and collaboration among Hubs since 2017.

Key Findings

Accomplishments

- Hubs continue to make **significant progress toward their goals**. Over 90% of staff, leadership, and highly engaged partners reported satisfactory to exemplary progress toward meeting the goals of the Hub.
- Overall, STEM Hub members are reporting **positive connections within Hubs**, and perceive their Hub to be healthy in terms of trust and respect among members, as well as their ability to influence the direction of and decision-making within the Hub.
- Hubs are **maturing and evolving**, moving from a focus on planning to an implementation phase. Partners are more aware of their own identity as part of the Hub and are beginning to become advocates for the Hub, rather than just participants.
- Partners continue to have **positive experiences** to share as a result of the Hubs' work and the responses indicate greater nuance and wider outreach than two years ago.
- Partners report a large increase in efforts to reach **underserved communities** and engagement in **diversity promotion** activities and programs.
- There is growing evidence for the **development of a functioning STEM ecosystem**. Hub directors report that they are developing a stronger collective identity and a sense that they succeed or fail together. Inter-Hub connections have increased since 2017 indicating that there is more communication across Hubs, including program development.

Challenges

- Some Hubs continue to struggle with creating or communicating their key areas of focus. Results indicate at times a lack of **consensus** among Hub members around what key foci of the Hubs are, indicating a need to improve communication efforts within Hubs, or continued need for strategic planning.
- Hubs remain **uncertain about ODE's governance and support** and would benefit from clearer communication and guidance on ODE's future expectations for the Hubs.
- **Geographic isolation** remains an issue for rural Hubs that find it more difficult to connect with other Hubs which could negatively affect the developing ecosystem.
- There is still some **perceived inequality** across the hubs that may be a detriment to the development of the collaborative if the issue goes unaddressed. Hubs may benefit from an **independent facilitator** to help broker relationships among Hubs and outside actors such as ODE and the Legislature.

Oregon STEM Hubs: An Introduction

The Chief Education Office, in collaboration with the Oregon Department of Education (ODE), directly or through partner education agencies, has funded several collaborative partnership programs focused on improving key education outcomes throughout Oregon. These collaborative partnerships include the Early Learning Hubs, Regional Achievement Collaboratives (RACs), and a statewide network of Regional STEM (Science, Technology, Engineering, and Mathematics) Hubs. Each collaborative is focused on coordinating regional communication and partnerships, improving key student outcomes, building capacity and sustainability for change, and encouraging and supporting local and statewide multisector engagement.

In 2013, the Oregon Legislature passed House Bill 3232, Strategic Investments: Connecting to the World of Work, as a means to provide significant funding to strengthen and expand Oregon's focus on the importance of developing strong programs in science, technology, engineering arts/design, and mathematics (STEM/STEAM). Connecting Oregon students to the world of work by expanding STEM and career and technical education (CTE) programs aligns Oregon with the national priority of keeping students competitive and preparing them for leadership roles within an increasingly globalized and technical workplace. There is an increasing demand for workers with the content knowledge and skills required to fill fast-growing and high-paying positions within the STEM fields. Oregon is striving to fill these positions locally by supporting schools and programs within their community that prepare students for a successful transition to certificate programs and/or college. Additionally, providing a talent pool of individuals with the skills desired by employers in the STEM occupations is meant to attract and retain STEM businesses and industries in Oregon, contributing to regional and statewide prosperity. Furthermore, students with a strong background in STEM will contribute to a more scientifically literate citizenry.

In a rapidly changing, technologically rich, global society, literacy in STEM is required to participate in, and drive, an innovation-based economy. Jobs in the 21st century require individuals with the knowledge, skills, and mindsets that will enable them to adapt to flexible workforce needs and to compete for high-wage, high-demand careers. Employment projections by the U.S. Department of Labor's Bureau of Labor Statistics show that more than 80% of the fastest-growing occupations projected over the next ten years require significant mathematics or science preparation.¹ It is widely recognized that high-quality, cross-disciplinary STEM education encourages skills such as critical thinking, problem solving, collaboration, and creativity.

The statewide network of regional STEM Hubs is an economic development strategy created in Oregon in order to meet two key goals set forth by the Chief Education Office's STEM Investment Council:

- Double the percentage of students in 4th and 8th grades who are proficient or advanced in mathematics and science.
- Double the number of students who earn postsecondary credentials requiring proficiency in high-wage, high-demand STEM fields.

¹ Jones, 2014

Cohort 1	Cohort 2	Cohort 3
<ul style="list-style-type: none"> Central Oregon STEM Hub Greater Oregon STEM Hub Oregon Coast STEM Hub Portland Metro STEM Partnership South Metro-Salem STEM Partnership Umpqua Valley STEAM Hub 	<ul style="list-style-type: none"> Columbia Gorge STEM Hub East Metro STEAM Partnership Frontier STEM Hub Lane County STEM Hub Southern Oregon STEM Hub 	<ul style="list-style-type: none"> Mid-Valley STEM-CTE Hub Northwest STEM Hub

To date, 13 STEM Hubs have received funding to establish multisector partnerships linking local educators, community members, and business/industry representatives in a collaborative move to transform the landscape of STEM teaching and learning. Figure 1 shows the geographic distribution of the STEM Hubs for the 2015–2017 biennium.

Figure 1. Geographic distribution of Oregon's STEM Hubs (2019).

STEM Hubs as Facilitators of STEM Learning Ecosystems

Creating learning ecosystems for STEM education constitutes a shift from an institutional focus to a learner focus. This approach to improving STEM education, which is the principle behind the creation of the STEM Hubs, is research-based and has been detailed in two recent reports by the

National Academy of Sciences, Engineering and Medicine^{2 3} as well as in two working papers for a consortium of private foundations and corporate funders who pursue a common goal of creating systemic positive change in STEM education nationwide.^{4 5} The key idea that emerged from the research literature on how best to support learning was to build on, nurture, support, expand, and actively manage a STEM learning ecosystem that is learner-centered, with the needs and interests of learners being supported by a variety of STEM rich opportunities including school, digital and other media such as websites or magazines, STEM activities at home such as building things or outdoor exploration, STEM rich institutions in the community such as science centers, and organized out-of-school STEM organizations like 4H or science clubs. Instead of asking what individual organizations can or should do in isolation of others to support a STEM learner, the focus lies on collective impact of all organizations that support learning of individuals within their local contexts (see Figure 2).

In STEM Hubs, the principles of local STEM learning ecosystems are operationalized based on three well-established theories: that of communities of practice,⁶ of professional learning networks,⁷ and principles of collective impact.⁸ A “community of practice” (CoP)^{9 10} is where individuals with common goals and common professional practices form supportive communities that influence individuals via shared norms, customs, practices and various layers of communication and engagement. A very specific application of this idea can be found in so-called networked improvement communities, or NICs,¹¹ which have been used successfully to improve school culture. Networks enable individuals from many different contexts to participate according to their interests and expertise while sustaining collective attention on progress toward common goals. Since these communities strive toward common goals, the principles of collective impact (CI) might help accelerate progress and lead to agreement on common measures of success. Collective impact organizations are defined by five characteristics: (1) a common agenda, (2) shared outcome measurement, (3) continuous communication among partners, (4) mutually reinforcing activities, and (5) “backbone” support from committed staff.¹² STEM Hubs are encouraged to use the elements of collective impact to form and sustain networked improvement communities of practice that allow for productive participation at any level. In this way, STEM Hubs represent the designed STEM Learning Ecosystem for a community.

“GO-STEM is extremely helpful. . . We routinely cross-pollinate our program information. . . We are excited to embark on a new chapter of our relationship by brainstorming K-12 outreach events that we can bring to the community collectively.”
–Greater Oregon STEM Partner

² National Research Council, 2014

³ National Research Council, 2015

⁴ Traphagen & Traill, 2014

⁵ Traill & Traphagen, 2015

⁶ Wenger, 1998

⁷ Bryk et al., 2011

⁸ Kania & Kramer, 2011

⁹ Lave & Wenger, 1991

¹⁰ Wenger, 1998

¹¹ Bryk, Gomez, & Grunow, 2011

¹² Kania & Kramer, 2011

Although each STEM Hub has developed its own unique identity with associated priorities, activities, and outcomes, all the collaboratives share a commitment to improving key student outcomes in their regions through a variety of actions including the direct deployment of programming activities for students and educators, as well as the support of programming activities already engaged in by partner organizations. The collaboratives have also been seeking ways in which to elevate and expand their current work through connections with other STEM Hubs around the state and identifying ways in which they can share resources that will increase efficiency and effectiveness.

Figure 2. STEM learning ecosystem for a community.

Scope of the Report

In this project we examined multiple layers of collaboration between publicly funded STEM-focused organizations, partner organizations, and their broader communities in order to provide data-driven recommendations that will help to strengthen and sustain the regional partnerships among STEM Hubs and their communities as they work together to promote positive STEM outcomes across Oregon. This report is intended to provide insights into the nature of the collaborative relationships within Hubs as well as the nature of the developing network among the Hubs across the state. Specifically, we explore the following questions:

How do STEM Hub backbone staff, leadership, and partner organizations view the following?:

- a) The Hub's progress toward its goals
- b) The nature of partners' contributions to the Hub's collaborative efforts
- c) The perceived accomplishments of the STEM Hubs to date
- d) The development of a local STEM ecosystem identity
- e) The development of a statewide collaborative of the Hubs

Results of the Study

Progress Toward STEM Hub Goals

Figure 3 shows that most (90% or more) STEM Hub leaders/backbone staff and their partner organizations report that the STEM Hubs are making satisfactory or exemplary progress toward their goals. Partners as a whole are slightly less positive about progress towards goals than STEM Hub staff: 27% of partners, but 36% of leaders/backbone staff, think that progress so far has been exemplary, and 46% of partners, but 58% of staff judged progress to be satisfactory. However, this difference is being driven by low engaged partners who may be less aware of the progress Hubs are making. High engaged partners who interact with the Hub on a regular basis do not differ from Hub staff and leadership on this measure.

“[The Hub] is **DOING** more than ever before and practicing new and innovative ways of moving STEM education and community partnerships forward.”
–Central Oregon STEM Partner

Figure 3. To what extent are STEM Hubs progressing toward their goals? (% of respondents by role in 2019)

Nature of the Partners' Collaborative Efforts in Hubs

Each of the Hub partners was asked to choose any of the seven item(s) that best described the nature of their relationship with the Hub (Figure 4 below). In other words, these findings represent the areas of expertise that partners perceive they are bringing to the table and

“I’ve observed [the Hub] improve the cohesiveness of STEM-related opportunities. . . I value our connection with the STEM hub to stay connected with STEM initiatives in the Gorge.”
–Columbia Gorge STEM Hub Partner

contributing to the successful functioning of the Hub. The results indicate a much wider range of partnerships in 2019 than 2017 with major increases in all areas, particularly Diversity Promotion. While some of these differences could be attributable to the much larger number of respondents, interviews and focus groups with Hub directors and staff indicated that some increases were due to a recent focus on certain areas such as diversity and equity in which a number of programs have been created to address issues related to race and gender. Some examples include county-wide PD days for equity, translation of materials into multiple languages, intentional outreach to diverse school districts, and programs for girls in which gender disparity is explicitly addressed. Another positive trend is the

fact that a third of partners perceive themselves to be advocates for the Hub who promote and champion the activities of the Hub to others within the community. This finding is an indicator of a healthy, functioning ecosystem in which partners feel an identity with and pride about their involvement within the larger group.

Figure 4. Nature of partnership with the STEM Hubs (% of respondents). For descriptions of each of the codes, see the Technical Appendix.

Accomplishments of the STEM Hubs

In order to better understand how STEM Hub members perceive the accomplishments of the Hub, we asked several open-ended questions that allowed each respondent to identify the specific programs or actions that they identified as significant indicators of positive outcomes attributable to the work of the STEM Hubs, as well as those that could be improved.

Figure 5. One positive change as a direct result of the work of the STEM Hub (% of respondents).

These answers were then analyzed to identify broader themes and coded into categories to facilitate across-year comparison (see Table A2 for code descriptions). When asked what one positive change respondents could identify as a result of the STEM Hub, the majority of respondents identified **specific student programs** such as Chief Science Officers, a variety of after school STEM clubs and camps and community events such as STEM nights at local schools. Another major theme was a greater **implementation of existing programs** including greater sharing of physical or monetary resources (see Figure 5 above). We interpret this finding as an **indicator of maturation among Hubs** that are beginning to be perceived as brokers among existing program providers rather than program or PD providers themselves. While the decrease in communication being perceived as a positive change may seem alarming, we interpret this as a positive indication that communication within the Hub is now taken for granted and therefore may not be perceived as the most important, salient or top-of-mind “value-added” of the Hub.

“We are excited to have the opportunity to offer high quality STEAM programming for our students and help inspire students as they build their own unique STEAM identity.”
–East Metro STEAM Partner

Next, participants were asked to identify the one thing, other than additional funding, that would make their respective STEM Hub more successful. Over a third of respondents described changes that we identified as **Partnership Improvement** to enhance cooperation among existing partners as well as to develop additional partnerships that would help Hubs better meet their goals in the future (Figure 6). For example, several respondents talked about **reaching out to local businesses and industry** while others suggested working with school administrators to **encourage teachers to connect with STEM Hub resources and staff**. Others noted the need to **address diversity and equity issues within partnerships** such as increasing the diversity of the steering committee and engaging with the Latinx community and other communities of color within the Hub. In addition, one in five respondents mentioned strategic planning as an area that Hubs should focus on in order to provide a clearer focus for Hub activities going forward.

Figure 6. One change that would make the STEM Hub more successful (% of respondents). For descriptions of each of the codes, see the Technical Appendix.

There was also a call for **more coherent and consistent direction from ODE** including more consistent and long-term support by the state. These responses indicate that while the Hubs feel

they are making progress toward their goals, the current funding structure creates an atmosphere of uncertainty that may make it difficult to engage in long-term planning in a meaningful way.

Finally, when respondents were asked what excited them most about working with the Hub, the majority answered **engaging students** and experiencing more generally the **overall impact of the Hub** (Figure 7). Respondents felt that **Hubs have the potential to create some really positive changes in their communities** by facilitating community building, sharing resources/information, and creating better strategies for students.

“The Hub has a strong, diverse advisory board as well as connections with partners and educators. They are filling gaps in STEM education that existed prior.”
–Frontier STEM Hub Partner

Figure 7. What makes you most excited about being engaged in the STEM Hub (% of respondents)? For descriptions of each of the codes, see the Technical Appendix.

Development of a Local STEM Ecosystem Identity as a Result of STEM Hubs

Effective communication among backbone staff and partners is critical for ecosystems’ success as this helps build identity among partners as part of a larger collaborative entity. One measure of successful identity formation within local STEM learning ecosystems as a result of STEM Hubs is the level of agreement amongst STEM Hub staff and partners of what each STEM Hub “is all about” (i.e., the perceived focus of each Hub as described by those most involved in it). Results from this analysis allow Hubs to determine whether the perception of their Hub is aligned with their strategic goals, provide the state with a potential gap analysis that can focus future investments or guidance to the Hubs, and provide policymakers with a simple “narrative” of what their investment in STEM Hubs is trying to accomplish regionally and across the state.

Respondents were asked “what their STEM Hub was all about” by choosing from a variety of statements which represented potential priorities for their Hubs. Figure 8 (below) summarizes the percent of Hubs whose staff and partners agreed that the given item is a focus of their Hub. In 2019, 11 STEM Hubs participated in survey data collection in and in 2017, 7 Hubs participated.

Across all Hubs, improving K–12 STEM Education, preparing students for STEM careers, and providing teacher/educator professional development ranked high as key aspects for Hubs. Reaching underserved populations and improving out-of-school learning rated slightly lower, but

were identified across all hubs as relevant. Overall, Hubs were not perceived to be providers of early learning experiences or instrumental in increasing graduation rates.

As seen in Figure 8, there appeared to be more agreement on areas of focus in 2017 than in 2019 which could be interpreted as an indicator of a decrease in feelings of identity among Hub members. However, interviews with Hub directors and staff suggest a different interpretation. While a few directors did identify better communication among partners as a challenge to be addressed in the future, there were a number of other explanations for this pattern. First, in 2017 survey participants were almost exclusively members of the backbone staff, leadership, and some close partners while in 2019 there were significantly more partners who were less engaged in the Hub who participated in the survey. Therefore, we would expect a bit less agreement by those who are less involved in the day to day operations and activities of the Hub.

“[I am excited about] the ability to increase programming and reach underrepresented and underserved audiences in the community through this collaborative partnership.”
–Umpqua Valley STEAM Hub Partner

Figure 8. What is your STEM Hub all about? (% of Hubs whose partners agreed each item is a focus of the Hub; 2019 had data from 11 hubs, 2017 had data from 7 hubs) (Additional details see Table A3)

Second, since 2017 many Hubs have begun to shift focus in response to leadership changes and/or community needs and these changes may not have been communicated yet to all partners. Similarly, some Hubs have decreased the number of areas they focus on so that numbers in 2019 more closely reflect what the Hub is actually doing now.

For Hubs in which there was confusion among partners regarding the main foci of the Hub, directors recognized the need for better communication to share what they are doing. For example, one director has already decided to hire a communications coordinator to help increase the sense of connection among Hub members in the future. Others acknowledged that they could do a better job of

“It takes time to accomplish those sort of long-term goals and it takes time for information about STEM Hub resources, programs,... to spread throughout our community. I see more involvement and awareness each year.”
–Central Oregon STEM Partner

explicitly discussing the Hub's foci and goals with partners. Finally, one director realized that the perceived foci of the Hub do not match the job opportunities within the community suggesting that the Hub revisit their goals and possibly revise their areas of focus in the future.

Development of STEM Hubs as Connected and Healthy Communities

For the purpose of this study, we developed a measure that captured in various ways how much respondents felt they could or were contributing to their respective STEM Hub and how much they saw their STEM Hub and its partner organizations (and members) as trustworthy and productive partners.

Table 1. Items associated with each emergent factor in the Connectedness scale.

Factor and Items	
Respect/Trust	$\alpha = .93$
<ul style="list-style-type: none"> • I feel respected by other partners in the Hub/Partnership • I work well with the other partners of the Hub/Partnership • I respect the other partners in the Hub/Partnership • I can ask other partners for help and advice • I have open and honest exchanges with other partners in the Hub/Partnership • I can trust the partners in the Hub/Partnership • Even in difficult situations, partners in the Hub/Partnership can depend on each other • The way the Hub/Partnership is organized provides appropriate opportunities for sharing amongst partners • I am being supported by other partners in the Hub/Partnership 	
Agency/Influence	$\alpha = .89$
<ul style="list-style-type: none"> • I have influence over the direction of the Hub/Partnership • I have influence over decision-making within the Hub/Partnership • I am able to make productive contributions to the Hub/Partnership • I feel recognized for my contributions to the Hub/Partnership • My voice is being heard in the Hub/Partnership 	

Our measure was based on an existing formative assessment tool known as a “pulse check” of project health^{13 14}. As a diagnostic tool, a “pulse check” creates a simple and longitudinal measure of project progress and the “health” of the collaboration, or the degree to which team science is being conducted¹⁵. Our measure was based on a 14-item scale, measuring two constructs related to Hub health (Table 1 above).

¹³ Koepfler & Koepfler, 2011

¹⁴ Taylor-Powell et al., 1998

¹⁵ NRC, 2015

The Respect/Trust construct measured the degree to which partners felt that they had productive working relationships based on trust and respect. The Agency/Influence construct assessed the degree to which partners felt they had a voice and were able to actively contribute to the activities of the Hub. Together, we interpret these measures as an indicator of the health and connectedness of the community that underlies a STEM Hub (see Appendix Table A5 for details of factor analysis). Figures 9 and 10 show the mean percentage of responses (from strongly disagree to strongly agree) for each construct for partners and backbone staff. The majority of partners and backbone staff agreed or strongly agreed that they felt respected by others in the Hub and trusted them to be open and honest. However, in terms of being able to influence the Hub, partners were more likely than backbone staff to be neutral or disagree. Although this outcome is not unexpected, it does provide an opportunity for Hubs to develop mechanisms that allow partners to feel more in control of the activities and outcomes of the Hub.

“We have worked with SMSP to train teachers K-12 in best practices and curriculum development. Our relationship helped us develop our STEM vision in 2016. We have since exceeded our vision and are in process of revising/expanding it.”
–South Metro-Salem STEM Hub

Figure 9. Do you feel respected/trusted by your Hub? Do you feel respect/trust for your Hub? (% respondents by role).

Figure 10. Do you feel that you have influence in the Hub? (% of respondents by role).

Development of a Statewide Collaborative of the Hubs

Ultimately, the goal of the Hubs is to engage in the elements of collective impact in order to form and sustain networked communities of practice to elevate and expand the efforts of the individual Hubs. One measure of network development is the extent of interactions that exist between individuals of each Hub. Figures 11 and 12 provide a summary of inter-hub interactions among partners and backbone staff. (See Appendix Table A4 for specific interactions between Hubs).

Figure 11. Inter-hub connectedness: how many other Hubs did each partner interact with over the course of the last year (% of respondents)? (Partners 2017 n=185; Partners 2019 n= 146)

Overall, 76% of partners and 94% of backbone staff reported interacting with individuals from at least one other Hub, and these numbers were significantly higher than in 2017 indicating an increase in communication and potential collaboration among Hubs statewide. These findings indicate that Hubs are beginning to function as a larger collaborative network rather than as a

collection of individual entities. There were clear differences in numbers based on geography as rural Hubs are more isolated and reported greater difficulties in engaging with other Hubs. Several directors expressed interest in engaging in more collaboration while others cited lack of time to devote to more meetings with other Hubs.

Figure 12. Inter-hub connectedness: how many other Hubs did each backbone staff interact with over the course of the last year (% of respondents)? (Backbone Staff 2017 n=39; Backbone Staff 2019 n=66)

Not surprisingly, a higher percentage of backbone staff (59%) than partners (14%) reported interactions with more than 3 other Hubs. Hub directors do not see expanding these numbers for partners as a high priority in the future as they believe that non-Hub staff would not have a need to interact extensively with other Hubs.

“PMSP is our most direct and reliable way to build relationships with [K-12 teachers and SD] and find innovative ways to connect after-school, in-school, and out-of-school STEM maker education.”
– Portland Metro STEM Hub

Results of the focus groups with Hub directors and staff provided additional evidence that Hubs are beginning to develop as a larger networked community. When asked if Oregon STEM Hubs have developed a collective identity, respondents provided the following:

- A collective identity is forming but is not fully developed because Hubs were initially established within a competitive model.
- Feels like it is much further along that last year. Starting to feel like “partners in crime” and “comrades.” Feel like we’re on the same side.
- We now use some common messaging and resources.
- We keep each other in the loop.

When asked to what degree the STEM Hubs are collectively influencing STEM education across Oregon, directors offered the following:

- Most Hubs believe they are making a positive impact but are unsure of the measures required to “prove” it.
- Communities are more aware of Hubs, invite them to the table now.

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- Connections among community partners are starting to develop. Stronger in metro areas than in rural areas.
- Hubs are working with ELH, workforce investment, community colleges and Chambers of Commerce.

Although there is substantial evidence that STEM Hubs are beginning to develop a collective identity, there remain a number of challenges that will need to be addressed if Hubs are to live up to their potential. In particular, Hubs identified a number of areas to focus on in the future:

- Improved collective communications and a shared action plan.
- Shared measures of success and common data outcomes.
- Clearer communication on ODE's future expectations.
- Attend to equity/access issues particularly around urban vs. rural Hubs.
- Sustainable funding structure.

Conclusion and Recommendations

STEM Hubs continue to be perceived as valuable entities that promote a variety of educational activities and collaboration in and between schools, out-of-school providers of STEM-related learning experiences, community organizations, and business and industry. The findings presented in this report indicate that STEM Hubs are evolving and maturing and have made significant progress in the two years since the first evaluation. Communication and collaboration within and among Hubs have increased in both breadth and extent, Hub members feel that they have a voice and are respected, and Hubs are developing a stronger collective identity as they learn and share with one another. Partner data continue to indicate that many of the recent innovative student STEM learning experiences as well as partnerships with community organizations would not have been possible without leadership and resources from the local STEM Hub.

“The work that we are doing is innovative and needed in Douglas County.”
–Umpqua Valley
STEAM Hub Partner

However, there remain some potential challenges. In particular, funding issues—including the timing, amount, and sustainability of state funding to support STEM Hub activities—are at the forefront of the minds of STEM Hub leaders and partners alike. It is clear that STEM Hubs are playing a vital role in the regions they serve, and that regional STEM Hubs have been particularly effective at representing the unique needs across the diverse cultural and geographical landscapes across Oregon. In light of these findings, we recommend the following to support the successful functioning of STEM Hubs going forward:

- Consider supporting some form of **independent** facilitation between Hubs to help with collaborative endeavors and deepened relationships between Hubs that could enable, for instance, the pursuit of collective external funding for Hubs or the creation of efficiencies in professional development offerings across Hubs, the development of mechanisms for and improved coordination in communicating the value of Hubs to outside stakeholders.
- **Increase the connectedness** within Hubs by working with partners to ensure that they feel a sense of agency and ability to influence the activities and direction of the Hub. Hubs require continued efforts around nurturing a community of diverse partner organizations and the individuals who represent them. The long-term health and success of a Hub is predicated on the continued hard work of forming and sustaining a sense of community in which all partners and collaborators can find their niche and appropriate role and feel welcomed and supported.
- **Develop shared measures of success** with direction and support from ODE to ensure Hubs are meeting expected outcomes/goals. Many Hubs face similar challenges in demonstrating their value overall, and the success of their various initiatives and programs. Shared measures and approaches to evaluation can lead to efficiency and promises to yield high quality activities around demonstrating outcomes and impacts.
- **Seek clearer communication** of ODE’s future expectations for the Hubs, guidance on creating sustainable partnerships, and a **more sustainable funding structure**. The State of Oregon has made a significant investment into Hubs as collective impact organizations by supporting backbone structures for the Hubs. As a result, local communities of practice around supporting student success in STEM and CTE have formed. These communities are designed as long-term local or regional institutions, and their sustained success is now tied to the

broader health of their communities overall (beyond STEM or CTE). ODE can partner with Hubs on developing and supporting longer-term strategies for ongoing support and success.

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Technical Appendix

This section includes a description of the research methods and data collection instruments used in this study.

Survey Development

The survey used as a primary data collection instrument in this study was developed as a composite of multiple approaches to documenting the development of a community as a collaborative structure. The Connection subscale was developed based on a similar study investigating development of an Oregon regional collaborative.¹⁶ In order to better understand the context of the partnerships in each STEM Hub, we also asked a set of open-ended questions that allowed both STEM Hub backbone staff and partners to provide additional information to supplement their responses to the Likert-type questions. The open-ended and partner survey questions were adapted—using developmental evaluation principles—from a previous similar study at one Oregon regional achievement collaborative.

The survey was administered to both STEM Hub backbone staff and selected partners using an online format and was designed to be completed in 15–30 minutes, depending on the partner's level of interaction with the STEM Hub. A link to the survey was provided to the STEM Hub leaders and thus distributed to their extended staff, where applicable, and partners for completion. The first portion of the survey included closed-ended items developed by the research teams on Connection. Survey respondents were asked to rate how much they agreed with each item using a set of five Likert-type response choices (1 = *Strongly Disagree* to 5 = *Strongly Agree*). The Connection questions were not displayed to those partners who reported interacting with the STEM Hub once or twice/year (or less frequently), in order to limit these questions to those partners who were best able to report on features of the STEM Hub as well as to reduce respondent burden. In our analyses, we only included those respondents who completed 50% or more of the survey. The number of respondents included in analysis for each STEM Hub are presented in Table A1.

¹⁶ Alan Daly, pers. comm. 2016

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Table A1. Completed 2019 Survey Responses by STEM Hub and by Role

STEM Hub	STEM Hub Leader / Backbone Staff	STEM Hub Partner	Total
Central Oregon STEM Hub	12	23	35
Columbia Gorge STEM Hub	12	18	30
East Metro STEAM Partnership	6	43	49
Frontier Oregon STEM Hub	3	32	35
Greater Oregon STEM Hub	7	6	13
Lane County STEM Hub	10	8	18
Oregon Coast STEM Hub	14	46	60
Portland Metro STEM Partnership	13	47	60
South Metro-Salem STEM Partnership Hub	6	21	27
Southern Oregon STEM Hub	5	25	30
Umpqua Valley Regional STEAM Hub	11	13	24
Total	99	282	381

Focus Groups

Acknowledging that survey responses can sometimes mask important subtleties and the unique contexts of each Hub ecosystem, the project team conducted four Focus Groups with xx-xx Hub directors and staff per group in order to better understand the current accomplishments and challenges from different perspectives.

The project team developed a protocol designed to gather information regarding the development of a collective identity among Hubs and how this process could be better supported.

Each group was asked five open-ended questions that were developed to elicit open-ended responses that would provide a richer context for understanding the collaborations among STEM Hubs:

1. How do you currently learn from one another?
2. What support do the STEM Hubs get from the state?
3. Do you believe that as a whole the Oregon STEM Hubs have developed a collective identity?
4. To what degree do you see the STEM Hubs collectively influencing STEM education across Oregon?

5. What, if any, barriers are there that you feel are preventing the development of a collaborative network among the STEM Hubs?

Sample Sizes and Analysis Plan

A total of 779 individuals were invited to complete the survey. Data presented in this report reflect 381 valid responses from both STEM Hub partner organizations and STEM Hub leaders and backbone staff, representing a response rate of 49%.

Open-ended data were analyzed and summarized thematically. See Table A2 for a description of the coding categories. Given the small sample size, quantitative data were analyzed using simple descriptive statistics.

Table A2. Descriptions of Codes Developed for Survey Qualitative Item Analysis

In a few sentences, please describe the nature of your organization's partnership with the STEM Hub.
Partnerships characterized as General Support offered no specific focus but noted supporting the Hub's efforts when needed. Teacher Development refers to both increasing opportunities for professional development in training and networking as well as improving existing opportunities. Diversity Promotion specifically targets increasing underrepresented groups' participation in STEM (girls, minorities, etc.). Student Opportunities refers to creation of new programs as well as increased capacity and improvement for existing opportunities. CTE Provider refers to those who offer CTE opportunities within the Hub. Career Development refers to introducing STEM careers to younger students as well as increasing training and education opportunities to guide and prepare students for STEM careers. Advocating for the Hub refers to publicly supporting and championing the work of the Hub to others.
Please provide one example of positive change in your community as a direct result of the work of the STEM Hub.
Communication refers to improved opportunities for general interaction with other partners in the Hub. Collaboration refers to improved opportunities for planning, data sharing, etc. that might lead towards joint work. Implementation refers to creating new, or further developing existing programming, sharing of physical and monetary resources, etc. [Communication, Collaboration and Implementation were constructed as categories of increasingly more actionable interaction between Hub partners]. Increased Awareness refers to higher visibility of STEM and STEM education efforts in the region. Resources Access refers to both physical resources (e.g. equipment) and monetary resources that were not available to organizations/individuals prior to the Hub's existence. Student Programs and Teacher Professional Development both include creation of new opportunities, as well as improvement and expansion of existing opportunities.
What one change would make the STEM Hub more successful?
Outreach refers to communication with those outside the Hub and promoting the Hub's efforts. Strategic Planning refers to focusing the Hub's efforts and establishing or clarifying the Hub's sense of direction. Program Development refers to creating new opportunities for partners or the community within the context of the Hub. Partnership Improvement focuses on enhancing cooperation between partners and the Hub. Sustained Funding refers to both increases in available funds, as well as longer-term, more stable funding opportunities, often with hopes for less competition. Increased Staffing refers to expanding the capacity for Hubs to hire more backbone staff. Growth generally refers to additional time needed for the Hubs to develop partnerships and establish themselves, as well as expanding the scope of the Hub over time.
What makes you most excited about being engaged in the STEM Hub?
Engagement refers to being involved in and contributing to the work done in the Hub in general. Networking focuses on making connections with others within the Hub. Engaging Students and Engaging Teachers both refer to working with and impacting those groups, specifically, rather than the community at large only. Hub Impact refers to the direct effects that come from the Hub's contributions to the community. Collective Impact refers to the collaborations that allow groups to be more influential together than they would as individuals.

Table A3. What Is Your STEM Hub All About? (% Responding Yes) Top Row for each Hub is 2019, Bottom Row is 2017; Bolded values indicate agreement (>60%) rates on those areas where a Hub seems to focus.

Hub	Yr	Prep students for STEM careers	Improve K-12 STEM education	Increase graduation rates	Reach under-served communities	Provide / improve CTE	Provide early learning experiences	Improve out-of-school learning	Provide teacher PD	Provide local STEM workforce development
Central Oregon	2019	74	86	26	43	66	29	46	71	48
	2017	77	80	46	69	58	37	71	66	77
Columbia Gorge	2019	70	97	17	60	33	40	80	70	50
	2017	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
East-Metro	2019	71	76	18	78	58	16	61	53	65
	2017	69	69	39	85	69	23	54	69	62
Frontier Oregon	2019	82	94	29	68	38	53	74	77	21
	2017	87	97	73	92	62	65	65	89	78
Greater Oregon	2019	54	92	0	39	39	31	39	69	46
	2017	62	85	39	54	46	31	46	77	54
Lane	2019	78	94	28	67	83	33	56	78	61
	2017	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oregon Coast	2019	71	88	15	53	24	32	49	86	39
	2017	79	90	47	58	63	58	68	79	58
Portland Metro	2019	52	93	15	62	20	23	55	90	42
	2017	90	100	43	87	40	23	90	97	67
South Metro-Salem	2019	52	82	19	52	48	11	37	63	56
	2017	95	100	84	95	63	37	63	90	79
Southern Oregon	2019	59	69	28	52	59	21	59	55	45
	2017	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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Umpqua Valley	2019	71	92	38	67	46	38	67	71	54
	2017	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table A4. Answers in 2019 to “Which of the Following STEM Hubs Have You Interacted With?” (Row is affiliated Hub, Column is Hub Respondent Reported Interaction With; Shades of purple represent higher rates of interaction)

Hub with which respondent reported interaction (outside of own hub)												
		Central Oregon	Columbia Gorge	East Metro	Frontier Oregon	Greater Oregon	Lane County	Oregon Coast	Portland Metro	South Metro-Salem	Southern Oregon	Umpqua Valley
Respondent Hub Affiliation	Central OR		2%	4%	0%	1%	2%	4%	5%	3%	2%	2%
	Columbia Gorge	1%		3%	0%	1%	1%	1%	3%	2%	0%	2%
	East Metro	1%	2%		1%	1%	2%	2%	14%	4%	1%	1%
	Frontier Oregon	0%	1%	1%		2%	1%	1%	3%	2%	0%	1%
	Greater Oregon	1%	2%	2%	3%		2%	4%	3%	2%	0%	1%
	Lane County	3%	0%	1%	0%	0%		2%	3%	2%	0%	1%
	Oregon Coast	0%	1%	3%	1%	2%	2%		9%	2%	1%	2%
	Portland Metro	1%	3%	17%	1%	1%	5%	8%		10%	2%	3%
	South Metro-Salem	0%	1%	8%	0%	1%	2%	5%	16%		0%	2%
	Southern Oregon	1%	1%	3%	0%	1%	2%	3%	3%	2%		3%
	Umpqua Valley	0%	1%	2%	1%	0%	2%	2%	5%	2%	1%	

Table A5. Factor analysis output from SPSS including Total Variance Explained

Items	Factor 1	Factor 2
I feel respected by other partners in the Hub/Partnership	.86	
I work well with the other partners of the Hub/Partnership	.86	
I respect the other partners in the Hub/Partnership	.81	
I can ask other partners for help and advice	.78	
I have open and honest exchanges with other partners in the Hub/Partnership	.76	
I can trust the partners in the Hub/Partnership	.69	
Even in difficult situations, partners in the Hub/Partnership can depend on each other	.68	.43
The way the Hub/Partnership is organized provides appropriate opportunities for sharing amongst partners	.63	.45
I am being supported by other partners in the Hub/Partnership	.59	
I have influence over the direction of the Hub/Partnership		.85
I have influence over decision-making within the Hub/Partnership		.83
I am able to make productive contributions to the Hub/Partnership		.75
I feel recognized for my contributions to the Hub/Partnership		.69
My voice is being heard in the Hub/Partnership	.46	.64
% of Variance Explained	57.20	9.88