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Northwest Biosciences Consortium: The Evolution of a Faculty Network

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Abstract
More often than not, faculty have limited opportunities to interact with colleagues that teach similar classes at nearby institutions. Particularly in regions with many institutions and institution types within a close geographic area, these interactions can be important to support student transfer between institutions. Increasingly, our students do not go to just one institution for the UG degrees but transfer from one to many different institutions over the course of their degree. The development of a regional network was our solution to this problem. The aim of the Northwest Biosciences Consortium (NWBC) was a broad implementation of the Vision & Change recommendations with two emphases: (1) incorporation of Vision and Change recommendations into the introductory biology curriculum for majors and non-majors, and (2) curricular support for students transitioning between and within institutions. We describe how these objectives shaped the development of the NWBC along with other formative factors, the lessons we learned from this work, and recommendations regarding the development of a regional faculty network.

Keywords
faculty network; science education; science department; Vision and Change

Introduction

The Northwest Biosciences Consortium (NWBC) was developed as an NSF-funded Regional Coordination Network as an inclusive network of higher education across the state. This report provides guidance for others who aim to establish a faculty community around a curricular or similar goal. The goal around which the NWBC coalesced was the implementation of the Vision and Change: A Call to Action (V&C; AAAS, 2011). The NWBC team identified the need for a regional faculty learning community where progress toward implementation of V&C is made in a bottom-up cooperative fashion. We founded our effort on previous regional networks including Port-PKAL (a Project Kaleidoscope group located around Portland, OR) and its spin-off, the short-lived Willamette Valley Biology Educators Network (WVBEN). These networks had arisen to support different goals, but many of the NWBC team leaders had participated in activities organized by these two groups and were familiar with the benefits such regional networks provide. The many advantages of faculty networks have been clearly articulated in the available literature (i.e. O'Meara & Campbell, 2011). Of particular interest is the work of Niehaus and O'Meara (2015) who identified the important role off-campus networks have in helping faculty develop agency, or the ability to identify goals important to them (such as career advancement) and mechanisms to achieve these goals.

In our case, the goal emphasized bringing V&C recommendations into introductory Biology at all types of institutions. The V&C report constitutes the first widely-used comprehensive framework for undergraduate life science education. It is grounded in decades of educational research about how students learn and provides distinct concepts and competencies that can be used to guide curriculum design. A central tenet of the report is that all students must gain an appreciation of the nature of science and the scientific process. (AAAS, 2011, p. 5). The transformative potential of this report is reflected in the magnitude of the effort to implement these recommendations and the need to build faculty capacity for active learning, inclusive pedagogy, formative and summative assessment strategies, and curriculum alignment. Several networks of faculty emerged to support implementations, the first of which was the Partnership for Undergraduate Life Science Education (PULSE), with support from the National Science Foundation (NSF), the National Institutes of Health, and the Howard Hughes Medical Institute. PULSE developed a series of geographically-defined networks to facilitate department-level implementation of V&C at institutions across the country, among a variety of other projects less relevant here.

While we set out to develop a modern, student-centered curriculum for introductory biology courses, we became equally excited about building a network and fostering important connections between faculty within our region. The curricular goal turned out to be an effective scaffold on which to build the network that emerged, which had enormous value as a learning community (Hubball & Albon, 2007). The lessons we learned along the way helped shape the NWBC into a successful conduit for implementation of V&C recommendations and also for realizing other important opportunities to improve life sciences education in the Pacific Northwest (the outcomes are described in a separate manuscript, in preparation).

Rationale for the NWBC

The composition of the NWBC leadership team reflected the institutional diversity within the state, with faculty from research institutions, regional comprehensive institutions, community colleges, and liberal arts colleges coalescing around the central objective to promote the implementation of V&C as a mechanism to improve common learning outcomes in the introductory biology curriculum at institutions across Oregon. The diversity of institutions participating in the network (both leadership and the broader network) was an integral part of our planning process, as we needed the input of faculty with diverse perspectives to effectively craft outcomes for students transferring vertically from introductory courses between and within institutions. The benefit of this diversity also had a positive impact on faculty in the network, as seen in the faculty comments (see the recommendations below.) In creating the infrastructure of our network, we were mindful of the many influences that shape faculty engagement in and satisfaction from their participation in the professional development activities of the network. For example, peer networks can (and should) promote gender equity (see review by O'Meara & Stromquist, 2015) and agency for non-tenure faculty members (Bond, 2015). Further, we made decisions with attention to how peer network dynamics such as open dialogue, consensus building, and sharing of challenges and resources can offer guidance, support members, and challenge existing institutional paradigms.

For all our good intentions, we first had to answer a more fundamental question: Was a new/different network needed to accomplish this objective? Could we promote V&C implementation through existing mechanisms such as regional conferences, local gatherings, or other networks? We concluded that the development of NWBC was necessary for a variety of reasons. First, the existing regional networks (PortPKAL, WVBEN) were no longer active. Second, the regional Northwest Biology Educators (NWBIO) conference that attracts instructors primarily from community colleges aims primarily at exchange of best practices, and its format was not conducive to synergistic collaborative work. Attendance at the NWBIO conference can be sporadic, particularly when it is held at remote locations, depending on available professional development funding at institutions. Third, our objectives, while complementary, did not align with the work of NW PULSE since that group focused on departmental transformation and participation required a team application. This precluded space for faculty who worked in isolation at their institution, or who did not enjoy the support of their department, their colleagues, or their institution. Collectively, these reasons led us to the development of NWBC, a faculty learning community (FLC) that aimed to offer a sense of belonging and teamwork. To achieve this, attendance to all workshops was free and open to all life sciences faculty in our region, and financial support for travel expenses was provided for colleagues who travel longer distances or teach at institutions with limited resources.

Development of the NWBC

The primary problem that provided the impetus for the formation of the network was to address the variation in introductory biology experience of students across institutions, which was perceived to be impacting the success of students transferring between institutions. We realized that transfer occurs not just between institutions but also occurs vertically through the transfer of students from introductory coursework to upper division classes. Biology is reflective of other STEM disciplines, in which the attrition rate during introductory coursework represents a major

drop in retention (Batz et al., 2015). Less than 40% of students who begin introductory coursework actually complete a STEM degree (PCAST, 2010). This drop is, of course, a major impetus behind the "call to action" represented by V&C (AAAS, 2011).

For inter-institutional transfer students, who are also more likely to be from underrepresented groups, the barriers represented by transfer shock (Cejda et al., 1998) and poor articulation (Shapiro et al., 2017) increase the likelihood that a student will not complete a degree. Poor articulation of degree requirements means that students also may transfer with credits that they cannot use or must repeat. In Oregon, the six-year degree completion rate for community college students who transfer with 45-55 term credits is 75%, compared to 84% for full time freshmen beginning and remaining at a four-year institution (HECC, 2018), a number lower than earlier estimates (Arnold, 2001). This is why it was so important that our network bring together all types of institutions in the region.

If the problem of vertical articulation presented us with a problem, we considered the V&C recommendations as a solution. These recommendations, built around a broad set of Core Concepts and Competencies that allow room for flexibility in implementation, presented an opportunity to consider shared agreement as to what should be covered in introductory courses so that all students could successfully take what they learned in those courses to their upper division coursework, whether they remained at the same institution or transferred to a new one.

As we crafted and shaped the NWBC network, we had an original problem (vertical transfer) and goal (implementation of V&C in introductory life science curriculum) in mind, but that did not necessarily translate into a clear process for the creation of the network. Many of the decisions we made were responsive to challenges that we faced and identified issues about network development. We did not know then (and have since learned a lot) about communities of practice in STEM education, a concept that gained strength after the publication of the report by Kezar and Gehrke (2015). The authors describe strategies used by groups of people who work together toward a common goal and help participants transition from focusing on the individual toward developing a collective set of values and goals. In fact, our group initially struggled to gain traction with our work, indicative of our collective inexperience in network development. We decided to start with small, manageable steps until we had a clearer idea how to proceed; it turned out to be the right approach and in agreement with the recommendations put forth by Kezar and Gehrke (2015) for communities of transformation. Figure 1 depicts a timeline of our major activities.

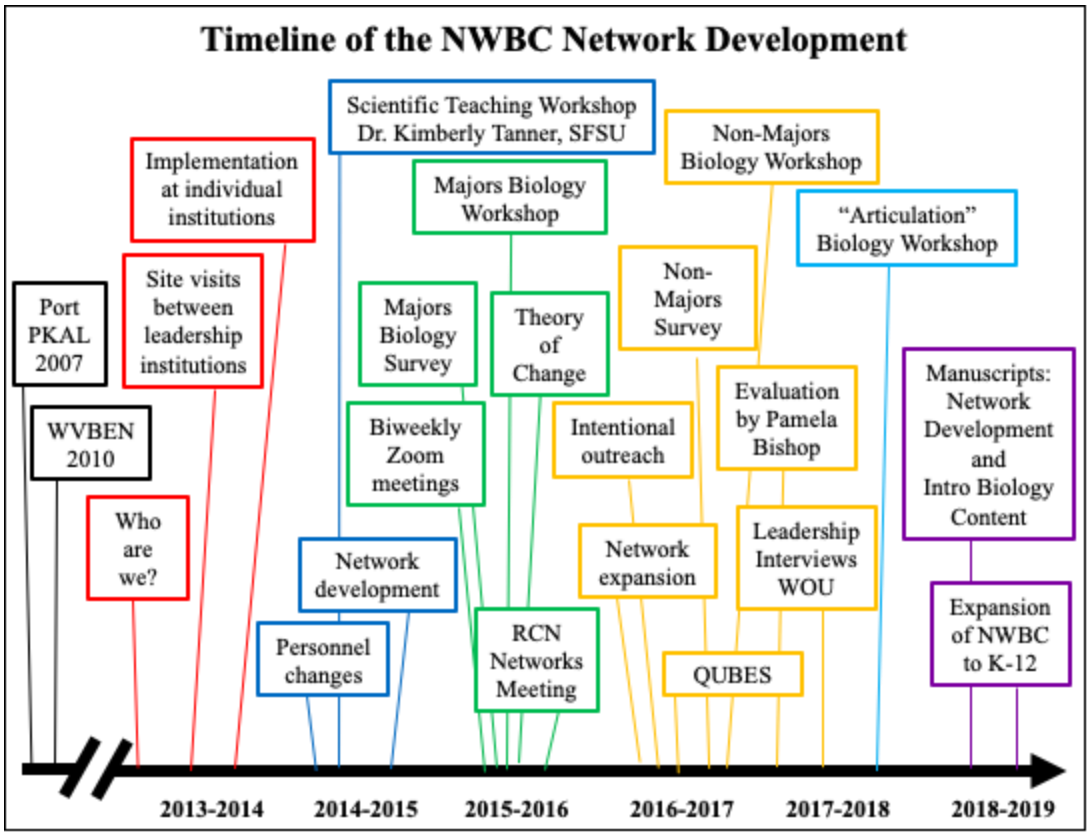

Figure 1: Timeline of the NWBC Network Development. The Northwest Biosciences network was funded by an NSF RCN grant between 2013 and 2018. Activities are color-coded by year of occurrence. Major outward focused development opportunities for the network members are found at the top of the figure (Scientific Teaching Workshop, Majors Biology Workshop, Non-majors Biology Workshop, and "Articulation" Biology Workshop), while internal work of the core leadership team to support the network development and implementation are found towards the bottom of the figure, supporting the external work of the network.

The most meaningful act in the first year of this effort was to establish a set of reciprocal visits by each member of the leadership team to each of the participating institutions. These visits allowed for familiarization of the advantages and challenges each of our members (and their institutions) faced and helped us create a "baseline" of knowledge and resources. These site visits were also critical to building the relationships and trust within the leadership team. We were then able to properly identify specific goals that would define success within our network. In addition to our initial goal (alignment of introductory curriculum with V&C), we aimed to incorporate student-centered active learning, inclusive pedagogy, and appropriate assessment strategies in our curricula. It was clear from that point that the NWBC had already expanded its original focus, and we decided that these elements should be incorporated into the V&C implementation activities. This experience helped our leadership team appreciate the value of flexibility in thinking about our work and objectives, a lesson that proved crucial for all future work.

The first NWBC workshop was limited to colleagues from our home institutions, and we benefited greatly from the experiences and expertise of Drs. Kimberly Tanner and Shannon Seidel who

graciously agreed to create a "mobile" version of the SEPAL Scientific Teaching workshop they developed at San Francisco State University (for details see Owens et al., 2018). The workshop provided a template for rich intradepartmental conversations to promote the objectives of NWBC. Consistent with the principles of faculty learning communities (FLCs; Cox, 2001), we solicited feedback from our colleagues who provided ideas for topics to be included in future workshops. This first workshop provided us with a model for organizing our own workshops. The growth of the number and diversity of network institutions and members can be observed in Figures 2 and 3. It also forced us to quickly become familiar with the basic concepts of managing a network (communication, promotion, engagement, implementation) and overcome any notion of academic hierarchy among the network members. An additional benefit was that the leadership team did not have to plan the details of this workshop, effectively providing a much needed reduction in the cognitive load during that first year of this effort and building on this as a model for subsequent years of this effort.

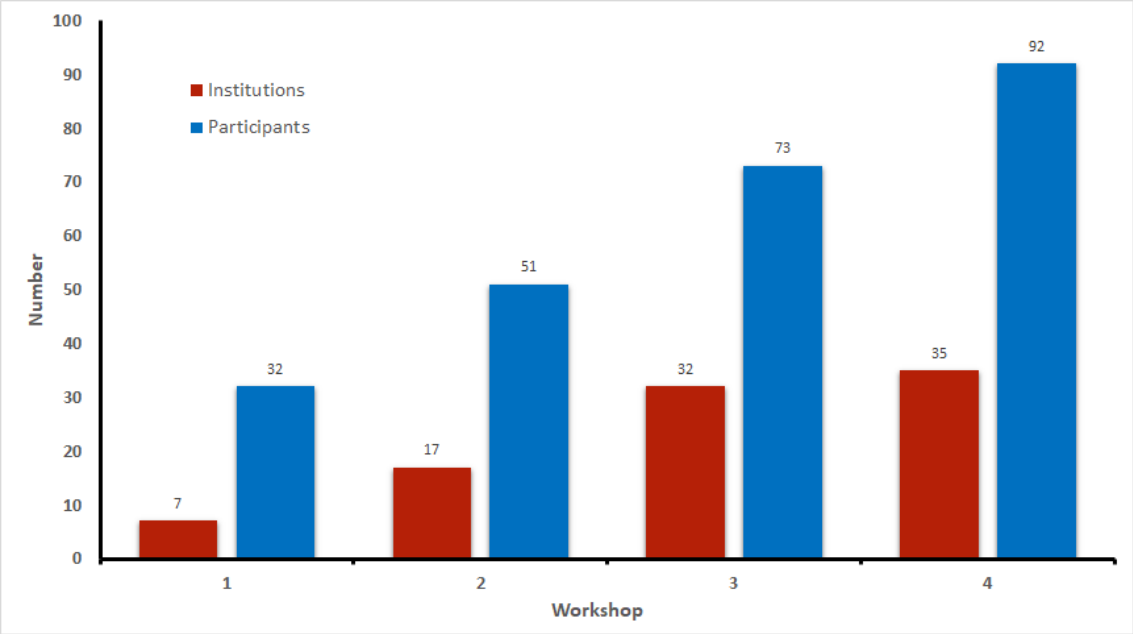

Figure 2: Number of workshop participants and number of represented institutions by year. In workshop 1, NWBC hosted a Scientific Teaching workshop for our member institutions' faculty. Attendees were surveyed to determine the types of networking opportunities they desired, and in response the NWBC offered a second annual workshop on Majors Biology, a third annual workshop in non-majors Biology, and finally a fourth annual workshop focused on Articulation.

For the second NWBC workshop (Majors Biology Workshop, Fig. 2), we elected to focus on the introductory biology curriculum for students who intend to major in life sciences disciplines, with particular emphasis on the V&C concepts. Through a series of case studies, we guided workshop attendees through the kinds of problems students face when the curriculum is not aligned properly and they experience gaps in knowledge and/or preparation for upper division courses while modelling evidence-based teaching practices. This exercise facilitated meaningful discussions about departmental expectations and coordination. The participants then engaged in a variety of

activities to identify the most appropriate concepts and competencies that should be included in the introductory biology course load.

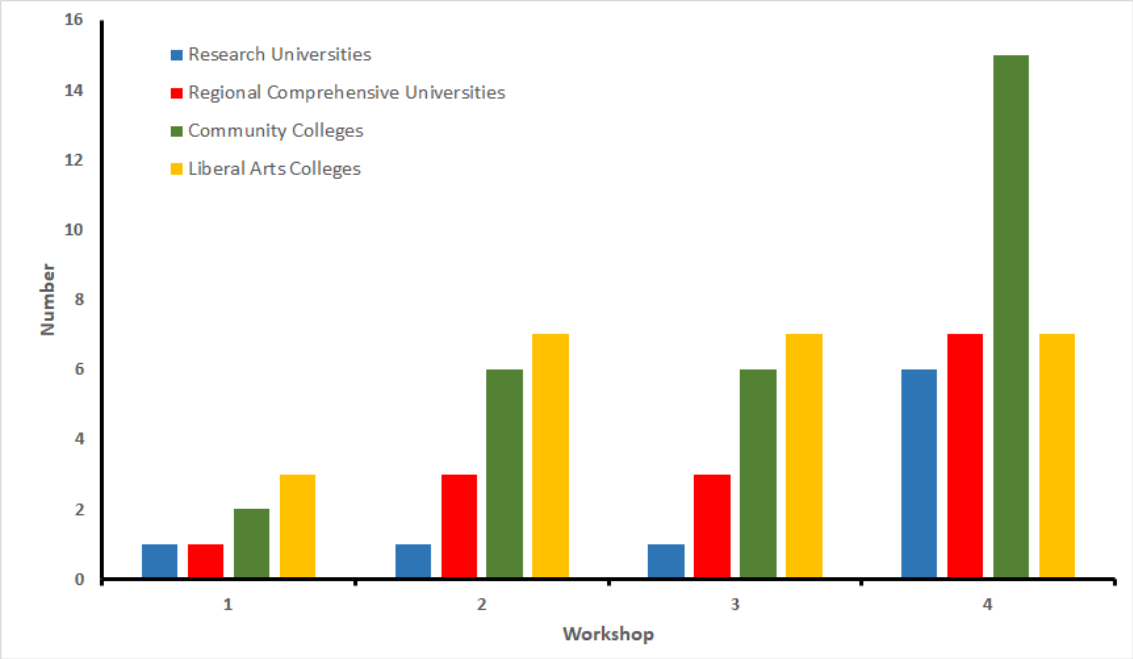

Figure 3: Diversity of institution type by year. With intentional outreach and network expansion, the number of institutions increased year by year. A key characteristic of the network is the intentional diversity of institutions represented, with no hierarchy of importance of institution type. The composition of the core leadership team matches the composition of the institutions during the first workshop. The types of institutions increased at the same rate until the fourth workshop when community colleges as well as public research universities and regional comprehensive universities see a large jump.

One of the things we decided very early in our workshop preparation was that we wanted to always provide concrete ideas and tools based on primary education literature that participants could use to help them implement ideas from workshops at their home institutions. For the second workshop, we introduced the tool of threshold concepts (Cousin, 2006; Loertscher et al., 2014; Ross et al., 2011) as one method of introducing students to complex topics and discussed assessment strategies to help students prepare for upper division courses.

Just prior to the second workshop, two members of our leadership team attended the January 2016 RCN Summit meeting in Washington DC organized by the American Association for the Advancement of Science and the National Science Foundation, where we learned about ways to better design our network and assess its effectiveness. We benefited from a series of questions posed by the panelists (Beck et al., 2016) to further develop the network infrastructure:

- How would you define success for your network?
- What approaches have you tried for measuring or documenting success?
- What assessment/evaluation techniques have worked well?
- What are the challenges?

- Describe a particularly satisfying assessment result your network has achieved or hopes to achieve.

These questions helped our team better appreciate the need for a more robust organization of our network. Subsequently, we invited Dr. Pam Bishop, Director of the National Institute for STEM Evaluation and Research (NISER; https://niser.utk.edu), to facilitate a Theory of Change workshop (Fig.1 - Theory of Change; for details see http://www.theoryofchange.org/what-is-theory-of-change/) to help us identify problems we could address through NWBC and solidify our short-, intermediate-, and long-term goals for the network. The leadership team also identified desirable outcomes and strategies for the network to achieve these objectives. We performed a separate evaluation of the leadership team to identify strengths, weaknesses, and potential gaps in our understanding of the NWBC work and the way the team operated. This series of interviews was conducted through a qualified external evaluator who offered feedback that guided us through the remaining two years of this grant. Because the confidential interviews provided leadership with an opportunity to share concerns, doubts, and frustrations, we were able to recommit to a shared understanding of our mission and to refine our structure to shape our pursuit of that mission.

The third NWBC workshop (Fig. 1, Non-Majors Biology Workshop) focused on the introductory biology curriculum for non-majors, aiming primarily to incorporate the V&C competencies into biological concepts that are accessible and relevant to all students. Participants first examined their syllabi for alignment with their preferred learning objectives before they practiced active learning activities such as wicked problems, jigsaw groups, and poster gallery walks. They were then asked to form smaller FLCs to design activities they would then adopt in their own courses. The workshop concluded with discussions on developing interdisciplinary institutional FLCs around competencies and a member of the leadership team was designated to coordinate follow up with the FLCs.

The final NWBC workshop (Fig. 1, Articulation Workshop) was a culmination of the previous four years of work. The meeting focused on articulation planning and attracted several faculty from the State of Washington who identified the necessity of course alignment to benefit students who transfer horizontally (from one institution to another) and vertically (from introductory to intermediate and then advanced courses in life sciences). In this discussion, the group benefited from the experiences of the University of British Columbia system and developed a similar cohesive syllabus template approved by the attendees as a foundational document upon which discussions on articulation could be based. We wish to highlight that the workshop attracted interest from the Oregon Higher Education Coordination Commission, tasked with issues of credit transfers between public institutions in Oregon. Finally, a further demonstration of the flexibility of the NWBC leadership team in designing workshops of interest to the attendees was the addition of evidence-based tools such as Dynamic Governance (Buck & Villines, 2007), the BioCore Guide (Brownell et al., 2014) and the introduction of the BioSkills Guide (Clemmons et al., 2019), then still under development.

Outcomes from the NWBC Workshops

The NWBC leadership team was keenly aware of the need for appropriate assessment of all workshop activities for two reasons: formative and summative evaluations helped guide us to design activities that were current, relevant, and of benefit to the attendees. Specific outcomes have

been disseminated via the network at regional and national conferences and posted at QUBES (https://qubeshub.org/community/groups/nwbc/about). A separate account on the outcomes is in preparation. In the present report, we wish to highlight one unanticipated outcome from the work of NWBC: the creation of a faculty network. What we did not foresee when we designed the NWBC around V&C was that networks and relationships change over time, and they do so for good reasons. As time moved on or as goals were met, participants chose to engage in different projects, changed institutions or priorities, and new participants joined the network as it became more inclusive. These forces helped us add flexibility and diversity to the work and shaped our outreach efforts and outcomes. Exit questionnaires and follow-up surveys indicate that NWBC participants valued the sense of belonging perhaps even more than the extensive and diverse content covered. Participants wrote: "Enjoyed discussion of biology with folks who love biology as much as I do." "All were involved in the final redaction for this meeting - Exciting to have a product will be able to share at our institutions." "Well fed. Satisfied with the time spent and product produced." "Awesome. I learned a lot about writing learning outcomes. It was also great to meet other educators." Their one-word summary of the workshop included "Inspired", "Optimistic", "Tired", and "Excited". We are pleased that the NWBC did not just provide opportunities for professional development but also occasions for faculty to come together and support each other in an inclusive community of practice. This outcome is important as research indicates that when faculty establish meaningful relationships as part of a cohesive network they become more productive, develop new ideas for research and collaboration, and gain a sense of agency (Kezar, 2014).

We have evidence of network success beyond the specific goal that brought us together. After the Oregon State Higher Education Coordinating Commission (HECC) launched an initiative to develop state-wide articulation agreements for various majors under the Oregon Transfer Compass, a workgroup of Biology faculty from around the state were convened to develop community-college to university pathway. This workgroup was not an NWBC activity, but it was mostly comprised of NWBC members who had already worked together on challenging articulation problems. This Biology workgroup has been cited by the Higher Education Coordinating Commission and the Oregon Public University Interinstitutional Faculty Senate as a model of successful collaboration in the state-wide collaboration process to develop articulation agreements in the Oregon Transfer Compass and was the first to complete an agreement. Through the network's innovative articulation framework NWBC took one small step to progress from a community of practice to a community of transformation (Kezar & Gehrke 2015).

To underscore our point regarding the success of NWBC to create a community around the V&C implementation, we quote from the recent V&C volume prepared by AAAS (2018):

> "Of considerable importance is the way in which Vision & Change has contributed to the creation of a "sense of community," enabling those interested in improving education in biology to, in the words of a participant, "find your people." The document has helped to create a "shared language" that facilitates conversations about common concepts and science practices, and enables interdisciplinary conversations." (p. 2)

Lessons Learned and Recommendations

Starting the Network

The challenge of the work that we undertook was developing a network where none existed before. While the original goal was to build a network to foster use of V&C, what actually happened was that we used the shared goal of implementing V&C to provide an impetus to bring people together to form the network. We found the central idea of improving introductory biology, via a framework endorsed by nationally respected organizations (e.g., AAAS, HHMI, NSF) to be a mechanism for drawing new members to the group. At our first workshop, 100% of respondents to the post-workshop survey agreed that the event was "a good use of my time" and 71% of them planned to attend future events. We found that once connected to the group, our attendees stated "social networks are priceless," and they continued to join us for that social connection as well as for the opportunity to take part in the stated goal of the network. "I've gotten to know a lot of like-minded biology instructors who are local who I never would have met otherwise."

We would be remiss if we did not highlight the essential nature of National Science Foundation support in initiating and growing the network. The network itself initially coalesced around the writing of the grant and the sense of accountability provided by the grant encouraged continued efforts and necessitated momentum. The available support allowed the leadership team to engage in the organizational work of the effort. It also allowed us to offer free workshops and even provide modest travel support for participants who could not have otherwise taken part. The prestige afforded by NSF support was an enticement for institutions and individuals who wished to familiarize and align themselves with the V&C framework valued by a leader in science education practice (who has placed funding in support of that framework).

Recommendation - Starting a Network

A core philosophy around which network membership can coalesce is a scaffold around which to build the network. Grant funding can attach both accountability and prestige to the effort; even the proposal preparation process can help to build shared vision and provide the impetus to begin a network effort. Attaching the core philosophy to a major effort or core vision of a larger prestigious organization lends credence to the emerging network.

Growing the Network

The evolution of the network might best be described as punctuated equilibrium, in which major inflection points served to rapidly advance the growth and success of the network, followed by phases of quiescence and reflection on each period of advance. Generally, each of these inflection points was preceded by some struggle to address a challenge faced by the network. In many ways, an iterative cycle of the team development identified by Tuckman (1965) in which the group initially struggled (storming) to establish shared goals and practices (norming) by which to effectively achieve outcomes (performing). Each period of the group performing at a high level was often followed by an additional cycle of storming, norming and then once again, performing. The norming period was critical, in each case involving an opportunity to bring the leadership team together. When the network was in its earliest phase, consisting only of members of the

leadership team attempting to determine how best to move forward, we struggled to move past a focus on the differences between the team members. By visiting one another's home institutions we began to focus not only on the commonalities but also on what we could gain from team members who had different experiences. The institution visits and conversations led to a first workshop in which each leadership team member invited colleagues from their home institution to attend the first professional development workshop and provided further opportunity to bring together faculty from diverse institutions around a common goal. Following reflection by the core leadership group after the second workshop, intentional outreach was performed to expand the network's reach geographically and by institution type. This outreach increased participation at each of the last two workshops (Figures 2 and 3). In this effort, we were aided by consultant Pam Bishop who worked with the team to develop a Theory of Change model that helped shape how the group determined the planning of future network activities around the expansion of the network.

Recommendation - Growing the Network

Launch a network with accomplishable goals that are immediately within the ability and grasp of the network. At all phases, attempt to maintain an abundance mentality focused on commonalities and strengths rather than differences and deficits. Leverage initial successes and can-dos to build out by employing strategies and resources that have been learned and borrowed from other networks, including people and ideas. Gathering feedback from all network members is crucial.

Adding Value to the Network

Responsiveness to membership interests and needs helped us substantially. To achieve the challenging work of building a set of shared learning outcomes, we needed to engage faculty in work they found meaningful and keep them coming back to the table. Growing the network meant we needed to make sure new members felt that their time was well spent. We quickly learned to structure our events around big ideas. Following our second workshop, a number of participants identified the incorporation of threshold concepts as a big new idea that they found meaningful and could incorporate into their practice following the workshop. "Take-home items were easy to distribute to others in my department, which started conversations and encouraged them to attend other NWBC events." Our third workshop emphasized incorporation of "wicked" problems (Kolko, 2012), and the use of Dynamic Governance models (Buck and Villines, 2017) to facilitate the fourth workshop provided our network members with new ideas that could be added to professional practice (some of our membership went on to report using all of these big ideas immediately -within one year - of the workshop). "The workshops are always supportive and engaging and help motivate me to try new things in my class. I developed a new final project in one class to connect the content of the course to real world problems the students cared about."

Recommendation - Adding Value to the Network

For major network events or efforts, it is helpful to provide manageable small goals and tangible products that are immediately useful to network members. Flexibility of goals was important. Not all ideas will be used by all members and some members may use them in different ways. It is these small scale elements that have value to network members locally and in the short term that

bring them back to participate in broader network goals that occur over longer times and with broader reach.

Managing the Network

As the goal of the network emerged as being secondary to the network itself, flexibility of the network rapidly became a key element for success. While we always retained the goal of incorporating V&C recommendations into introductory biology, we did make many adjustments to how the network engaged in meeting that goal based upon feedback from network members and on emergent opportunities. The leadership team incorporated this information in the planning of subsequent workshops. When one of our guest trainers from the first workshop became a junior faculty member at a Washington institution in 2017, we took advantage of the opportunity to add her to the leadership team, gaining additional expertise and also making connections to an adjacent state.

During a period where leadership team structure anticipated a shift due to personnel changes, we requested interviews of leadership team members by external evaluators to allow for confidential feedback around sensitive workload topics. These interviews allowed us to discover a communication gap—while we had strong consensus on the value of our goal, some members felt that they were taking on extra work, while others expressed feeling uncertain about their role and reluctant to overstep. We improved our strategies for task management, including identifying responsibility of tasks to primary and secondary leaders that improved team function and productivity.

There were times when our leadership team did not adjust in response to changes in personnel availability or buy-in, attempting to maintain the initial structural design without a sense of intentionality but rather through inertia. This did not necessarily serve the network well; some of the responsibilities distributed through the leadership team were not good fits to the individuals who took them up because they felt obligated to do so, with a loss of productivity that would be expected under these conditions. For example, following the 2017 workshop, the individual tasked with coordinating follow up with the institutional FLCs did not implement an effective strategy and by the time other leadership team members began to follow up, momentum had stalled for most FLCs. Capitalizing on the interests and expertise of all members of the leadership team presented a continuous challenge and more regular evaluation check-ins could have helped continue to provide the confidential feedback that made it easier for the leadership team to probe at these disconnects.

Recommendation - Managing the Network

Calibration at all levels of the network is essential but particularly amongst core leadership. Networks engage in continuous improvement when they respond and adjust not only to what goes wrong, but also to what is going well. It is important to understand the experience of network members and that of network leadership, to ensure a cohesive and effective network. The role of regular network evaluation, including of the leadership structure, cannot be overemphasized. We especially recommend including an iterative mechanism for formative evaluation of network leadership team to help guide the work of these individuals.

Communicating in the Network

We found that regular communication in the network through a variety of mechanisms was essential. Small working groups that met both in person and via virtual meeting platforms (either within the context of a larger workshop or emerged outside of the workshops for planning and follow-up purposes) tended to be the most common mechanism by which people engaged in the network.

Network members found the in-person opportunities and connections to be the most valuable. “I always took something positive away from the meetings, and I'd be much more motivated to attend some kind of in-person workshop or group work. Online [asynchronous collaboration] just isn't the same.” The use of organizational platforms like QUBES helped organize the network documentation but did not appear to be used as a way for network members to connect. Even for the members of the leadership team, small, in-person meetings tended to be the most common way in which the team moved goals forward. These opportunities for communication did make a difference for network members who found themselves at home institutions that were less than supportive. “I can only speak for myself (not my department or institution), but I found it VERY valuable to spend time with colleagues from other institutions who were facing some of the same issues in teaching introductory biology. Sharing strategies and feeling supported in trying new things is essential to me overcoming my hesitancy to get out of my "rut" and make positive changes to my teaching.”

Intentionally providing opportunities for network members to work with colleagues from a variety of different institutions was a significant component of network growth. From the earliest days of the network, the leadership team was formed of colleagues from a diverse array of institutions who collaborated to achieve network goals. We found that bringing people together to explore how developing a shared vision could bridge our differences added value to the network and increased the likelihood that our members could work together to support network success.

> “This was huge for me. I have only taught at one institution (private), and attended a private university for my own education, so I had very little knowledge of other undergraduate and faculty experiences. Participating in NWBC really hammered home for me how much we all face similar challenges, employ the same strategies, and end up giving our students experiences which are fundamentally much more the same than they are different. I have let go of any ‘snobbery’ about private institutions and have huge respect for my colleagues at community colleges and state schools, and respect for the students they teach.”

Recommendation - Communicating in the Network

Careful planning of network events to allow members multiple opportunities to engage with a variety of colleagues not only builds cohesion, it provides individual support to members. Network members gain by engaging with colleagues with diverse experiences and perspectives to accomplish a shared objective. For network members who may regularly work in greater isolation (in small departments, in far-flung locations, or who may lack agency in their departments), the opportunity to find commonalities and support from new colleagues can be the greatest value in the network.

Evaluating the Network

The success of the network is evidenced both in the achievement of stated network goals and in the collaborations that, while not directly related to the initial goals, grew out of network connections. “It's great to have a community across institution types in this region. I have asked people for help with classes and have gotten feedback about grant writing and negotiation as well.” We did ultimately produce V&C aligned learning outcomes for Introductory Biology. This process took far longer than we originally anticipated, but the time we took and the flexibility we allowed is what allowed us to achieve not only this but other outcomes. These other outcomes, such as side-collaborations between network members, did not necessarily reflect goals initially articulated in the grant proposal. These grew organically from the activities and discussions during the workshops. We learned to value the flexibility a network provides, and deliberately provided space for new ideas to come to the forefront during the meetings.

Without a doubt, participation in the Northwest Biosciences Consortium network engaged more faculty in thinking about the curriculum as a whole and how the work students are doing in their introductory courses connects to student learning: “I think more about the content I teach and whether it is something of value to me, or really furthers the students' ability to be successful in future courses.” It also was extremely helpful to have network members operating with a shared framework provided by V&C: “It made me more aware of vision and change, effectively better focusing my teaching with more direction towards concepts rather than memorization of facts.” While some institutions initially engaged in little to no participation with the network, having a critical mass of those that have become a part of the network has made it possible to enable meaningful curricular work. By using a dynamic governance strategy (learned via participation with the PULSE network), all network members gained a voice in the process without derailing progress.

The implication of this shared framework and broader conception of the role introductory courses play in the whole curriculum (both within and between institutions) is the ability of network members to coordinate articulation changes more quickly and effectively. “It's enlightened the way I think about curriculum. I think about curricular choices in a much more ‘systems’ based way—choices I make for my individual classes can impact or are impacted by what's going on in other institutions.” In 2018, the state of Oregon passed House Bill 2998 (subsequently branded as the Oregon Transfer Compass). This legislation required the formation of “seamless” transfer pathways from any 2-year to any 4-year public institution in the state. Due to the number of majors graduating with a high number of excess credits, Biology was identified as among the first working groups to build a pathway. Members of the workgroup were largely familiar with the NWBC network (of the 17 community colleges and 7 universities represented, all but four representatives had attended an NWBC workshop, and two members of our leadership team also acted as organizing leads in the state effort as well) and brought an already shared vision to the workgroup. The working group was identified by state staff as the most effective and was the first to complete a transfer pathway. While the Transfer Compass work was not sponsored by the NWBC network, the groundwork laid by NWBC in bringing together the local higher education Biology community helped enable the success of this workgroup.

Recommendation - Evaluating the Network

There may be individuals or entire institutions that initially elect not to participate in network activities. This does not preclude forward momentum by the network and these individuals and institutions may come alongside as the network gains traction. Dynamic governance strategies allow all network members to provide feedback when the ultimate goal is consent to try network recommendations and revisit the outcomes of those recommendations. Goal achievement is likely to occur outside but adjacent to the formal activities of the network.

Sustaining the Network

Network connections have facilitated other opportunities as well. This is highlighted by a variety of activities that emerged from network connections. Network members provided commentary and feedback to help guide the development of the BioSkills guide (Clemmons et al., 2019). Dr. Carol Fergusen at Southern Oregon University used the network as a communication hub to facilitate the organization of a symposium focused on active learning at the AAAS Pacific region meeting. Several members of the leadership team have been invited to participate in steering capacities in other efforts (MOSI, NSITE, PULSE) and have collaborated on successful funding efforts to continue to advance goals related to improving Life Sciences education and extend those goals to education in other STEM disciplines, as well. NWBC has also continued to host gatherings at regional life sciences education meetings and is currently engaged in an effort to extend the network to colleagues at the high school level.

It is gratifying to see elements of the network continuing to come together to collaborate, but these have tended to be highly targeted (around specific goals) auxiliary to other network efforts (such as PULSE) and less inclusive than the broader network grown over the life of the funded workshops. Early attempts to incorporate the network into an established regional meeting focused on undergraduate biology education have had mixed results. As NWBC workshops were funded and even allowed for travel support, we suspect that expenses to attend a professional meeting may be prohibitive, particularly for community college faculty and adjunct faculty.

Recommendation - Sustaining the Network

To build sustainability there should be a continuation plan in the face of turnover among network membership. Support for continuation beyond an initial funding effort or achievement of a stated objective may be accomplished by connecting with other networks or more established organizations, but careful consideration of the factors that made network participation valuable or available to membership must be undertaken when examining pathways forward. As we consider the future of NWBC, expanding our goals to include all introductory science offerings, we continue to be mindful of our experiences and we base the recommendations we offer on what we have learned.

Conclusion

Our experience with developing the NWBC indicates that a successful network requires a scaffold of shared goals but also requires a flexible approach to meeting those goals and willingness to

explore new opportunities that inevitably arise. Careful listening to our partners both within and beyond the network allows for successful capitalization on new opportunities and enhances sustainability.

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