Evaluation of the First2 Network

Year 2

August 2020

Executive Summary

The First2 Network is a *collective impact* alliance seeking to improve the early persistence of rural, first-generation science, technology, engineering, and mathematics (STEM) college students in their programs of study across West Virginia. The Network was established to address a troubling problem identified by research, namely that attrition from STEM majors is most likely to occur during students' first two years of college, and that students whose parents did not attend college—first-generation college students—are at even higher risk of attrition.

Supported by a five-year National Science Foundation (NSF) grant from the program called Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES), the First2 Network engages a wide range of state STEM stakeholders in *improvement science* activities to test ways to improve STEM persistence. To augment the learning afforded by improvement science cycles, the Network facilitates research studies, investigating subjects including major selection and persistence among rural, first-generation students and identifying community factors associated with STEM success. Other core Network features include immersive research experiences for rural, first-generation or other underrepresented minority (OUM) students during the summer before their freshman year, STEM outreach conducted by Network students to promote STEM to younger students and to build support for the Network among state education leaders, and campus clubs to ensure ongoing student support.

Another hallmark of the First2 Network is its adherence to the principle that students—those with the *lived experience* of barriers to STEM persistence—should inform the search for ways to improve STEM persistence. Given this commitment, Network students serve in Network leadership roles, participate as full peers in improvement science activities, and conduct outreach to STEM-interested high school students and to state legislators. Students also participate in authentic STEM research experiences with Network professors and at industry sites.

ICF serves as the external evaluator for the First2 Network. The evaluation employs a longitudinal, multi-method design to understand the project from various stakeholder perspectives and via an array of data collection and analysis techniques. This report summarizes evaluation findings, conclusions, and recommendations from project launch in

> **Key Findings from Year 2 Evaluation**
> - 97% increase in membership, from 144 in Year 1 to 283 in Year 2
> - Students represent 50% of the membership
> - 157% increase in number of summer interns, from 30 in Year 1 to 77 In Year 2
> - 53 Plan-Do-Study-Act cycles to test practices hypothesized to improve STEM persistence
> - Higher levels of STEM social capital among members in Year 2 than Year 1
> - 2020 interns had a stronger sense of STEM identity and school belonging, and improved research attitudes, knowledge, skills, and behaviors, following First2 Network internship participation
> - Fall-to-Spring STEM persistence rate of 2019 interns was slightly higher at 80% than the Fall-to-Fall STEM persistence rate of 74% among similar West Virginia freshmen

September 2019 through July 2020. Conclusions are summarized below, organized by four analytic levels.

Context. West Virginia is among the most economically and educationally challenged states in the nation, yet it also has a long history of labor struggle, a rich cultural legacy, and some of the country's most forward-thinking education equity efforts. The context in which the First2 Network maneuvers is characterized both by its legacy as an extractive economy and the determined efforts of its residents to improve conditions. West Virginia, the only state falling entirely in the federally designated Appalachian region, is poorer, less diverse, and less educated than the nation at large.

The STEM achievement of state students remains depressed compared to students in other states. For example, fewer than half of 4th graders, slightly more than a third of 8th graders, and about half of 11th graders scored as proficient or higher in math on 2019 state assessment. Data from the National Assessment of Educational Progress indicated that 29% of 8th grade students scored at or above proficient on the latest math assessment. Only a third (33%) of West Virginia high school graduates scored at or above the ACT Math Benchmark and only 34% of scored at or above the ACT Science Benchmark.

First2 Network Members

• Interns are diverse
   ○ 9% identify as African American, 5% as Asian, 2% as Hispanic/Latinx, 2% as Other, and 1% as American Indian/Alaska Native
   ○ At least 43% are eligible for federal Pell grants (a proxy measure of low-income status)
   ○ 64% are first-generation college students
   ○ 47% hail from rural communities
 • Network members represent a wide array of West Virginia STEM stakeholder entities
   ○ 50% are students
   ○ 29% are university faculty or staff
   ○ 4% each are K-12 teachers and state government representatives
   ○ 3% represent education non-profits
   ○ Others hail from industry, foundations, and the state education agency

West Virginia is designated as eligible for the Established Program to Stimulate Competitive Research (EPSCoR)—that is, the state is one in which NSF has determined the need for special investment because it has received less than or equal to 0.75% of NSF research funding. EPSCoR eligibility is one indicator of limited STEM capacity, a circumstance EPSCoR funding seeks to ameliorate. On the other hand, the First2 Network successfully established relationships with national collective impact STEM education and equity networks, including STEM Ecosystems or GlobalMindED. Engagement in such networks is one strategy for enhancing West Virginia's STEM education capacity.

Although the social and educational context in which the First2 Network operated has changed little since last year, the COVID-19 pandemic significantly altered Network activities. Most notably, to protect the health of Network members and interns, the Network facilitated 2020's nine summer research internships online, an adaptation requiring substantial planning and coordination. In addition, face-to-face meetings were cancelled, as were conference presentations.

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First2 Network Structures and Processes. The Network saw considerable operational and functional improvements over the course of Year 2, including the successful implementation of four of the five elements of collaborative infrastructure critical to the effectiveness of collective impact efforts to broaden STEM participation: shared vision, partnerships, leadership and communication, and plans for expansion and sustainability. Although the Network leadership confirmed several shared metrics, these were not widely communicated and members were not aware of them.

During Year 2, working groups undertook 53 Plan-Do-Study-Act (PDSA) cycles, an improvement science process for iteratively testing practice improvements. Members reported that working group processes had improved since the project's first year, particularly in terms of PDSA cycle facilitation, although more support for the Study phase appears warranted.

Leadership structures and processes also improved during Year 2. Steering Committee members, for instance, reported clearer governance and communication processes, and full implementation of their roles leading working groups and championing the Network by communicating about it widely to others.

Members indicated that the November 2019 First2 Network conference was of high quality, included meaningful activities, integrated student perspectives, and offered useful information that could be employed in participants' work. Post-conference sessions for working groups were likewise reported to be valuable, with opportunities for members to learn what other working groups had accomplished, to participate in additional training about how to facilitate PDSA cycles, and to engage in planning activities. Suggestions for improvement included providing more time for in-depth discussion, more time during which student members could complete homework assignments, and better use of technology.

Systems Targeted by the First2 Network. The First2 Network aims to change the systems that influence STEM persistence. Over the course of Year 2, Network members conducted a wide array of activities to improve two key elements of the relevant systems: (1) pathways (such as those along which students progress through school levels and STEM programs) and (2) structures (such as state education policies, resource flows, relationships and connections, and power dynamics). The principal way in which the Network sought to improve pathways was through the facilitation of PDSA cycles in working groups to identify, test, and refine discrete improvements on a small scale. In addition, members also sought to improve the structures that shape the quality and linkages among pathways that rural, first-generation students follow as they pursue STEM majors. For instance, the Network strove to reduce barriers to students' full participation in their education during the transition to online instruction during the COVID-19 pandemic in the spring of 2020 by assisting students to obtain internet and computer access to students lacking it. Other efforts to change structures included communicating about the Network with state policymakers to build longer-term political and financial support for its work and developing relationships with national entities to provide new training and networking opportunities to state STEM education stakeholders.

Another systems change pursued by the Network is the establishment of a sustainable backbone organization within the state Higher Education Policy Commission's Division of Science and Research (HEPC DSR), with the capacity to provide backbone support to other

initiatives across the state should the need arise. In collective impact projects, backbone organizations provide centralized coordination and support of day-to-day operations and implementation of aligned and collaborative work. Because HEPC DSR had no prior experience in this role, the Network employs a dual-backbone strategy, wherein an experienced backbone organization provides mentorship and other support to the HEPC DSR team, with a gradual release of responsibility to that team over the course of the grant. Considerable progress was achieved during the year in terms of improved backbone organization staffing, more targeted mentorship to HEPC DSR, and improved clarity about backbone roles and responsibilities. Remaining areas of need include further integration of the First2 Network throughout HEPC, improved communications within and outside the Network, and forming more alliances with other agencies across West Virginia.

A third systems change the Network seeks is to develop a sustainable statewide collective that ultimately assists members to make changes to their institutions that better support the STEM persistence of rural, first-generation students. As networks develop and their collaborative efforts mature, what members value about their participation evolves, progressing from valuing networking itself to valuing the ways network involvement enables institutional change. In general, members tended to value their Network participation similarly in both Year 1 and Year 2, continuing to value most highly the networking and community building, and knowledge acquisition, benefits associated with their First2 Network engagement.

Impact. An important impact of the First2 Network is the development of stronger STEM social capital among STEM education stakeholders in West Virginia. STEM social capital includes the social connections among STEM stakeholders—relationships, reciprocities, networks—that facilitate potential access to tangible resources, such as STEM educational opportunities, scholarships, jobs, and funding. Social network analysis reveals that, compared to the project's first year of operation, the Network has more members in Year 2, more multidirectional relationships among members, and stronger collaborative engagement within relationships, all of which indicate growth in the STEM social capital of members.

Focus groups with 2019 interns illuminated the impact of summer internships and other Network activities on student experiences this year. One important outcome was the development of STEM social capital among students who, given their rural and first-generation statuses, were unlikely to be embedded in networks of STEM students and professionals already. Internships also eased student transitions into college by enabling them to become familiar with campuses; meet other rural, first-generation STEM students; and establish relationships with STEM professors. Students additionally reported that internships improved their confidence to do STEM coursework and that ongoing Network support helped them progress and persist in their STEM studies. On the other hand, although students thought that Network members genuinely cared about their perspectives and respected their voices during meetings, they also reported that they had relatively less power to lead the Network and to offer suggestions that would be acted upon.

Students who participated in 2020 internships demonstrated statistically significant improvement between pre- and post-testing on six measures: School Belonging, STEM Identity, Knowledge About Research, Attitudes and Behaviors About Research, Personal Skills, and Research Skills. In other words, 2020 interns had a stronger sense of school belonging and STEM identity after

participating in First2 Network internships, as well as stronger knowledge about knowledge about research, improved attitudes about research, increased personal skills, and improved research skills. In addition, interns consistently rated their experiences highly and described myriad ways in which internships enhanced their capacity. Valued most highly by interns was the opportunity to build relationships with similar students, mentors, and STEM faculty—that is, the opportunity to develop their STEM social capital.

Because the Fall 2020 semester had not commenced for 2019 First2 Network interns as of this writing, it was not yet possible to analyze Fall-to-Fall persistence rates. Instead, the Fall-to-Spring persistence rate among 2019 interns was compared to the Fall-to-Fall persistence rate of similar students who were freshmen in 2016, 2017, and 2018, using data disaggregated by HEPC. Comparison students were rural, STEM-declared freshmen eligible for Pell grants (Pell grant eligibility was employed as a proxy measure for first-generation status given that HEPC does not collect such data). Analyses revealed that the Fall-to-Spring STEM persistence rate of 2019 interns was slightly higher than the Fall-to-Fall STEM persistence rate of similar students who were freshmen in 2016, 2017, and 2018.

Recommendations. Network leaders may want to consider the following opportunities for improvement as they embark on the project's third year.

- **Continue proactive recruitment of members and interns:** Given the pressing need for greater STEM social capital across West Virginia, Network leaders should consider additional tactics to ensure that the membership is refreshed as some members exit (due to retirement, relocation, etc.) and new individuals assume important STEM education roles in the state.

- **Finalize and communicate shared metrics widely:** The Network made considerable progress implementing four of the five elements of collaborative infrastructure this year; member awareness and use of shared metrics, however, was minimal. As a result, Network leaders, in close collaboration with the backbone organization, should confirm a core set of shared metrics and devise means of communicating them across the Network.

- **Continue technical assistance to working groups:** Working groups undertook 53 PDSAs this year. Nonetheless, some members reported a need for additional information about how to conduct these iterative cycles, as well as occasional hands-on support.

- **Maintain PDSA momentum:** The core work conducted by the Network takes place in working groups, each of which addresses an element of the STEM persistence problem. Given the centrality of such effort, Network leaders should ensure that members recognize the importance of PDSAs to the ability of the Network to achieve its aim. Moreover, Network leaders may want to consider how best to ensure that members experience a consistent press to conduct this work.

- **Address opportunities for improvement in working groups:** Network leaders may want to consider devising and targeting additional support to ensure that working groups function optimally, particularly in terms of collaboration, dissemination, and reflecting on equity.

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- **Enhance communication to support learning:** Network leaders might consider ways to increase communication across the Network as working groups complete PDSA cycles and the Research Team completes study analyses. Such communication should emphasize what was learned through such efforts and help members articulate the implications of findings for their own Network work.

- **Clarify membership roles and responsibilities:** Network leaders may want to consider posting clear information about membership roles and responsibilities on the project website. In addition, to the extent it will support effectiveness and sustainability, the Network might consider instituting various levels of membership, each with distinct time commitments and responsibilities.

- **Improve communications:** In the coming year, Network leaders should fully implement the new communications plan, continue to clarify communication responsibilities, and consider administrating an audience survey to assess the effectiveness of communications plan strategies.

- **Resolve governance issues:** The Steering Committee and Leadership Team might consider identifying remaining and new governance issues for the purpose of determining how best to resolve them. In addition, Network leaders and backbone organization staff should continue to clarify which responsibilities will be assumed by the Leadership Team and which by HEPC DSR.

- **Continue sustainability efforts:** Network leaders should continue to pursue sustainability by implementing the strategic plan, engaging the new Advisory Committee in efforts to plan for post-grant continuation, and promoting the Network more widely across HEPC.

- **Develop clarity about systems change:** Given that the Network intends to generate change in the systems that constrain STEM persistence, Network leaders should clarify how the Network will leverage the practice improvements emerging from PDSAs to achieve systems change.

- **Invest improved STEM social capital:** Network leaders should plan how to invest STEM social capital to advance the Network aim. For example, the Network could facilitate collaborative grant proposals, crowdsource the development of materials, conduct synchronous statewide events to promote the Network vision, or combine the power of state STEM education leaders to advocate for a policy that would support STEM persistence.

- **Continue to offer rich summer internships:** First2 Network interns report that the summer research experiences enhanced their STEM efficacy and identity, enabled them to build relationships with other students and professors, and eased their transition to college life. Such experiences may be particularly formative for rural, first-generation students who likely lacked access to authentic, hands-on research experiences prior to matriculation.

- **Address student concerns about power dynamics:** Given that the elevation of student voice is a core Network value, Network leaders should address student concerns about power dynamics forthrightly and collaboratively.

- **Finalize and implement the First2 Network student tracking process:** To ensure that the Network can track the progress of student interns over their college careers, Network leaders, in collaboration with the backbone organization, should review, finalize, and implement the student tracking process proposed by the Measurement Team. This process will transition most responsibility for tracking to the backbone organization, will leverage HEPC's role as aggregator of statewide data, and will ensure that student tracking can occur after the INCLUDES grant ends.