

# **Evaluation of the First2 Network**

Year 2

## August 2020

Submitted to: The West Virginia Higher Education Policy Commission

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## **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

#### 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

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

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

#### **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 lowincome status)
  - 64% are first-generation college students
  - o 47% hail from rural communities
- Network members represent a wide array of West Virginia STEM stakeholder entities
  - o 50% are students
  - o 29% are university faculty or staff
  - 4% each are K-12 teachers and state government representatives
  - o 3% represent education non-profits
  - Others hail from industry, foundations, and the state education agency

Math Benchmark and only 34% of scored at or above the ACT Science Benchmark.

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.



**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.



- 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.



## I. Introduction

First funded in 2016, the First2 Network is a West Virginia alliance seeking to improve the early persistence of rural, first-generation science, technology, engineering, and mathematics (STEM) students in their programs of study. The Network was established as a means by which 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.<sup>1</sup> Research also suggested that first-generation studentsstudents whose parents did not attend collegemajoring in STEM disciplines face considerable obstacles to their college success.<sup>2</sup> Accurate estimates of how many West Virginia students could be characterized as first generation are difficult to obtain. However, given that fully 70% of adults in the state do not have a postsecondary degree,<sup>3</sup> many West Virginia STEM students matriculating to college are likely to be the first in their families to attend.

ICF serves as the external evaluator for the First2 Network. The evaluation employs a longitudinal, multimethod design to understand the project from various

#### **First2 Network Overview**

- The First2 Network is *collective impact* alliance, employing *improvement science* methods and insights from the *lived experiences* of rural, first-generation STEM students to improve persistence
- The aim of the Network is to double the rate of STEM students graduating in their majors within 10 years, from 30% to 60%
- 283 members, 50% of whom are students
- Members represent a wide range of West Virginia STEM education stakeholder organizations, including higher education, K-12 education, industry, and informal STEM education
- The Network has hosted 107 STEM interns since 2019
- Working groups undertook 53 Plan-Do-Study-Act cycles to test practices hypothesized to improve STEM persistence

stakeholder perspectives and via an array of data collection and analysis techniques (see Appendix A for further details). This report summarizes evaluation findings, conclusions, and recommendations from project launch in September 2019 through July 2020.

## 1. Overview of the First2 Network

The First2 Network is 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 INCLUDES program supports projects that improve access to STEM education and career pathways, particularly for groups that are underrepresented in STEM. First2 was one of the first 37 such projects, which were two-year design and development launch pilots (DDLP) to develop prototypes for new models that broaden STEM participation.



First2 Network Lead Organizations

The following organizations were awarded NSF INCLUDES collaborative grants to broaden the participation of underrepresented groups in STEM by improving persistence rates among rural, first-generation college students in STEM programs of study:

- Green Bank Observatory
- Fairmont State University
- West Virginia University
- High Rocks Educational Corporation
- West Virginia Higher Education Policy Commission Division of Science and Research

In 2018, following completion of the two-year DDLP, the First2 Network was awarded one of five grants to expand pilot projects into alliances. Alliances are *collective impact* projects, bringing together programs, people, organizations, technologies, and institutions to achieve results at scale, providing new research and leveraging NSF's broadening participation investments.

As an alliance the First2 Network facilitates collaboration among university STEM faculty, rural first-generation STEM undergraduates, National Laboratory STEM professionals, state department of education staff, informal STEM educators, industry representatives, among others, to study and address the problem of undergraduate attrition in STEM majors that occurs during the first two years of college. To achieve its aim, and

in addition to pursuing a collective impact approach, the First2 Network employs *improvement science* tools and processes, such as developing driver diagrams to conceptualize how to address dimensions of the problem at hand, and Plan-Do-Study-Act [PDSA] cycles to test improvements.

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 (as Steering Committee members, working group co-chairs, campus club leads, and mentors), participate as full peers in PDSA working groups, and conduct outreach to STEM-interested students at their former high schools and to state legislators. In addition, students have opportunities to participate in authentic STEM research experiences, for the purposes of building students' STEM knowledge and skill and enabling students to experience the practice of STEM.

Based in West Virginia, this project reflects increasing state needs for STEM workers and increasing concern that the often rural and first-generation college students in the state may struggle to complete their programs of study. Key First2 Network activities include:

- Facilitating working groups to iterate and study improvements to practices and programs using improvement science processes and tools (current topics include summer immersive STEM experiences, faculty-student engagement, and college readiness)
- Facilitating a capacity-building working group to plan for First2 Network growth and longterm sustainability and other ad hoc working groups to address specific issues (e.g., governance, marketing, student leadership)
- Integrating students into First2 Network leadership and into developing and testing change strategies



- Conducting early STEM experiences for rural, first-generation STEM students via summer research internships
- Operating a support network for students
- Facilitating a STEM Ambassadors program component to prepare students to return to their home communities to engage younger students' interest in STEM and to harness teachers' and school board members' support for STEM education, and to engage with legislators and other state education leaders about the Network's vision and efforts

To implement these activities in the context of collective impact, the First2 Network provides several leadership and management structures:

- Leadership Team: This team consists of principal investigators (PIs) and representatives from the five lead institutions (Green Bank Observatory [GBO], Fairmont State University [FSU], West Virginia University [WVU], High Rocks Educational Corporation [High Rocks], and the West Virginia Higher Education Policy Commission Division of Science and Research [HEPC DSR]), as well as key subcontractors, such as SRI.
- Steering Committee: This committee includes Leadership Team members, co-chairs of working groups, and students in First2 Network leadership roles.
- Backbone organization (and its mentor): To pursue ambitious goals across the crosssector networks characteristic of collective impact projects, backbone organizations provide centralized coordination and support of day-to-day operations and implementation of collaborative work. In general, backbone organizations are responsible for (1) guiding vision and strategy, (2) supporting aligned activities, (3) establishing shared measurement practices, (4) building public will to solve a difficult problem, (5) advancing policy to remedy the problem in question, and (6) mobilizing funding.<sup>4</sup> HEPC DSR serves as the First2 Network backbone organization. Because HEPC DSR has not previously undertaken such a role, however, SRI is subcontracted to FSU to provide capacitybuilding and mentorship support to HEPC DSR.

## **II.** Findings

This section discusses findings generated by evaluation data collection and analysis activities conducted from the start of the First2 Network's second year of operation, October 1, 2019, through July 31, 2020 (see Appendix B for all data collection instruments). As pertinent, data collected during the Network's first year are also reported for comparative purposes. To understand the various dimensions in which the First2 Network functions, findings in this section are organized according to four analytic levels: (1) context, (2) project structures and processes, (3) the systems the project seeks to change, and (4) impact. Details about the evaluation design and methods are included in Appendix A.



### 1. First2 Network Context

The First2 Network seeks to improve the persistence of West Virginia's rural, first-generation college STEM students in their programs of study—and it does so in relationship to a particular geographic, demographic, socioeconomic, historical, and political context. For example, the "Mountain State" of 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 (such as the 1982 *Recht* decision, which sought to establish education funding equity among the state's school districts). Based on information from public reports and databases, the following subsections overview the state's socioeconomic, historical, and political contexts, overall educational context, and general STEM education context.

#### 1.1. Socioeconomic, Historical, and Political Context

The only state falling entirely within the federally designated Appalachian region, West Virginia rivals Kentucky as the poorest state in the region. A total of 16 of the state's 55 counties are considered *distressed*, with high unemployment, low per-capita income, and high poverty rates; 14 are *at risk* of economic distress; and 24 are *transitioning* between strong and weak economies.<sup>5</sup> Average per-capita income in 2018 was \$25,479, below the national average of \$44,921, with 17.8% of the state population falling below the federal poverty line.<sup>6</sup> At the same time, while 86.5% of West Virginia residents 25 years of age and older are high school graduates,<sup>7</sup> in 2017, 70% of adults did not have a post-secondary credential.<sup>8</sup> Half (50.5%) of public school students qualify for free/reduced-priced school meals.<sup>9</sup>

Reasons for the state's social and economic woes are many but can generally be characterized as resulting from a "resource curse." Appalachia's "resource curse" means the region is rich in natural resources but its people are, ironically, poorer on average than those in less resource-rich areas.<sup>10</sup> Dynamics contributing to this circumstance include industry manipulation of state policy and legislation to protect the interests of natural resource extraction (e.g., coal, timber), economic instability arising from cycles of economic boom and bust, low tax bases arising from deals that limit corporate taxes, and the export of profits to the often out-of-state owners of industry.<sup>11</sup>

The state is notably racially/ethnically homogenous compared to other states. With a 93.5% white population,<sup>12</sup> only 3.6% of the population is black, and 1.7% is Hispanic (and the overall population in the state has decreased by 3.3% from 2010 to 2019). Of its 267,796 K-12 public school students, 89.7% are white, 4.2% black, 0.2% Hispanic<sup>13</sup>, 1% are English-language learners (ELLs)<sup>14</sup>; and 17.3% are students with disabilities.<sup>15</sup>

More than half (51.3%) of the state population lives in rural areas,<sup>16</sup> and 42.4% of West Virginia students attend public K-12 schools in rural places,<sup>17</sup> with nearly half (49.6%) of the state's schools located in rural communities.<sup>18</sup> Only roughly one quarter (21.6%) of West Virginia students attend schools in towns,<sup>19</sup> and earnings in households in rural school districts average barely more than twice the poverty level.<sup>20</sup> The average salary for teachers in the state's rural districts is \$4,000 below the national average, and although the graduation rate for rural



students is just above the national rural average, students in rural districts score well below the national average in the areas of reading and mathematics.<sup>21</sup> Because of the state's demographics, West Virginia's rural students are more likely to be white and English-speaking and at the same time more likely to be working under individualized education programs (IEPs) than the national average. In addition, the state's consolidation efforts have resulted in large county districts and schools and high transportation costs for rural districts.<sup>22</sup>

#### **1.2. Educational Context**

State trends in student achievement are mixed. Based on the West Virginia General Summative Assessment, reading performance for grades 4 and 8 declined between 2015 and 2018-with fewer than half of students scoring proficient or higher in reading. While reading performance for grades 4 and 8 increased slightly between 2018 and 2019, fewer than half of students scored proficient or higher in reading. Reading performance for grade 11 remained relatively stable from 2015 to 2019, with about half of students scoring as proficient or higher. Despite improvement from 2014 to 2018 in grades 4, 8, and 11 for General Summative Assessment math performance, fewer than half of 4th graders, slightly more than a third of 8th graders, and about half of 11th graders are proficient or higher in math.<sup>23</sup> West Virginia National Assessment of Educational Progress (NAEP) results from 2009 to 2017 reveal a slight increase in grade 4 reading over time, but in 2019 that number decreased slightly, with only one-third of students scoring at or above proficient. From 2009 to 2017, grade 8 math performance increased slightly but declined in 2019 with just 29% of 8th grade students scoring at or above proficient. In both reading and math, a large gap between West Virginia's performance and that of the nation overall has remained relatively stable over time. As in other states, achievement gaps between low-income students and their more advantaged peers, and between black and white students, persist.<sup>24</sup>

The state shows some growth in its efforts to ensure college and career readiness, however. Graduation rates have appeared to improve over time (84.5% in 2013–2014 to 91.4% in 2018–2019), while the rate of white and African American four-year high school students graduating on time increased (90.4% and 85.6% respectively, in 2017–18, and 91.5% and 88.2%, respectively, in 2018–2019).<sup>25</sup> The average ACT score of 2019 West Virginia high school graduates was 20.8, similar to the 2018 average of 20.3.<sup>26</sup> Roughly two-thirds (67%) of state high school graduates achieved the ACT English Benchmark, up from 61% in 2018. Only 33% of West Virginia high school graduates scored at or above the ACT Math Benchmark, however, up from 30% the prior year. A total of 34% of state high school graduates scored at or above the ACT Science Benchmark, up slightly from 32% in 2018.

The 2018 high school dropout rate for West Virginia was above the national average (6.4% and 5.3%, respectively),<sup>27</sup> and the college-going rate for state public high school graduates steadily declined between 2009 (55.8%) to 2014 (50.6%) and increased only slightly in 2015 (51%) and 2016 (51.6%). College-going rates in 2017, 2018, and 2019 remained relatively unchanged (51%, 50.1%, and 50.5% respectively).<sup>28</sup>

West Virginia's postsecondary students are served by 13 public four-year institutions,<sup>29</sup> 9 public community and technical colleges,<sup>30</sup> and 8 independent four-year colleges.<sup>31</sup> In terms of



persistence and degree completion, the state falls below national and regional averages. In the 16-state Southern Regional Education Board (SREB) region, the one-year persistence rate for the 2015 cohort of full-time, first-time bachelor's degree-seeking freshmen at public four-year institutions was 85%.<sup>32</sup> West Virginia is in last place among SREB states in overall first-year persistence with a rate of 77% for 2016. West Virginia's HEPC reports a 31.2% on-time graduation rate for first-time freshmen pursuing bachelor's degrees, compared to 40.6% nationally.<sup>33</sup> In West Virginia, low-income students, many of whom are also first-generation college students, graduated at a rate of just 22.4% in 2014, an increase from 21.5% in 2013. From 2010 to 2014, the graduation rate for low-income students increased 5.6 percentage points.<sup>34</sup>STEM Educational Context

West Virginia high school students indicate higher levels of interest in STEM than nationally, according to a 2016 report by ACT—58% versus 48%.<sup>35</sup> Among those ACT-takers indicating interest in pursuing STEM studies in 2017, only 30% achieved the Mathematics Benchmark and 32% the Science Benchmark. Even more concerning, only 11% achieved the STEM Benchmark (a derived score combining Mathematics and Science scores and correlated with success in STEM courses that STEM students commonly enroll in).<sup>36</sup>

Policymakers, education leaders, and advocates have taken up the call to improve STEM education across the state. The West Virginia Department of Education (WVDE), for instance, has planned a comprehensive statewide approach to improving STEM education, and advocacy organizations such as WV Forward, the Education Alliance, and the West Virginia Public Education Collaborative are implementing initiatives to promote STEM. In addition, young people have access to various STEM enrichment opportunities, including STEM summer camps at state

#### A Note About COVID-19

COVID-19 (coronavirus disease 2019) is a respiratory disease caused by a novel coronavirus. First identified in humans in December 2019, by March 2020 COVID-19 had become a pandemic. To protect public health and limit viral spread, state and local governments closed schools, which transitioned to online instruction for the remainder of the academic year. This circumstance, in tandem with student health, economic, and housing needs, represents a profound contextual dynamic in the life of the First2 Network. Project implications have included a pivot to ensuring student well-being during the transition to online instruction. extensive planning to provide summer internships virtually, cancelation of the Network's spring conference and other in-person meetings, and loss of presentation opportunities.

institutions of higher education, the Governor's STEM Institute, and programs sponsored by the National Aeronautics and Space Administration (NASA) and GBO. Due to public health provisions—such as social distancing—associated with the COVID-19 pandemic, however, many Summer 2020 STEM experiences were canceled or were offered as online-only opportunities.

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. In addition, prior to the launch of the First2 Network as an NSFfunded Alliance, West Virginia had not been involved in national collective impact STEM education and equity networks, such as STEM Ecosystems or GlobalMindED. Since then, the First2 Network applied successfully to become a designated STEM ecosystem and has entered into a partnership with GlobalMindED to offer academic coaching training to higher education faculty and staff in the state.

Nationally, despite the rapid growth of enrollment in STEM disciplines in recent years, the number of students graduating with a STEM degree has remained relatively stagnant due to diminishing student retention rates.<sup>37</sup> While these results indicate the success of elementary and secondary education in cultivating interest in STEM fields, more work still is needed to understand the dwindling retention rates at the postsecondary level.<sup>38</sup> Recent studies have found that among students who enrolled as a major in a STEM field within their first year of postsecondary education, 37% had completed a degree or certification in a STEM field within 6 years, 7% maintained enrollment in a STEM field, and 55% had either switched to a non-STEM field or left postsecondary education.<sup>39</sup> Improving STEM retention nationally and in West Virginia in particular is thus crucial to ensuring a stable STEM pipeline and underrepresented young people's fair access to STEM educational opportunities.

### 2. First2 Network Structures and Activities

This section examines key First2 Network structures and the activities such structures enable. Data sources include Network documents, Elements of Collaborative Change interviews, working group self-assessments, a Steering Committee survey, and feedback from the Network's November 2019 conference (all data collection instruments are located in Appendix B). The following subsection begins by describing First2 Network participants.

### 2.1. Participants

An important component of First2 Network effort is the facilitation of multiple summer internships for rising college freshman who are rural, first-generation, and/or belong to other groups underrepresented in STEM. These two-week internships engage students in authentic STEM research experiences with faculty and peers, as well as opportunities for networking and building relationships with similar students. Interns are also offered opportunities in the upcoming academic year to

- Join a campus club for rural, first-generation, and other underrepresented students
- Participate in academic year leadership programs
- Become a STEM ambassador by visiting hometown communities, legislators and/or school administrators
- Join academic year research programs to begin or continue STEM research activities
- Participate in professional meetings and conferences

A total of 107 interns have participated in First2 Network summer experiences since 2019 (see Table 1); 30 interns participated in 2019, compared to 77 in 2020, an increase of 157%. Sixty-



nine of the 77 (86%) 2020 interns responded to the pre-test administration of the survey, one section of which requested demographic information. More than two thirds (67.7%) of interns were young women, and more than three guarters (77.8%) identified as white. A total of 9.1% identified as Black/African American, 5.1% as Asian, 2.0% as Hispanic or Latinx, 2.0% as Other, and 1.0% as American Indian/Alaska Native. The percentage of racial/ethnic minorities represented among Network interns is higher than the percentage represented in West Virginia. As noted earlier in this report, 3.6% of the state population is African American or black, and 1.7% is Hispanic.

Approximately two fifths (43.4%) of interns were eligible for a federal Pell grant, nearly a third (29.3%) were not Pell eligible, and more than a guarter (28.3%) were uncertain about their Pell eligibility status. Nearly two-thirds (63.6%) of interns self-identified as being a first-generation college student. Almost half (46.5%) of interns hail from rural places, more than a guarter (27.3%) from towns, 17.2% from the suburbs, and only 5.1% from a city.

Table 1: First2 Network Intern Demographics, 2019 and 2020						
	20 Resj	19 Intern pondents N = 30	20 Res <sub>i</sub>	20 Intern pondents N = 69	To Res	otal Intern pondents N = 99
	Ν	Percent	Ν	Percent	Ν	Percent
Male	9	30.0%	22	31.9%	31	31.3%
Female	21	70.0%	46	66.7%	67	67.7%
Other	0	0.0%	1	1.4%	1	0.0%
White*	21	70.0%	56	81.2%	77	77.8%
Black/African American*	5	16.7%	4	5.8%	9	9.1%
Hispanic/Latino/a*	0	0.0%	2	2.9%	2	2.0%
Asian*	0	0.0%	5	7.2%	5	5.1%
American Indian/Alaska Native*	1	3.3%	0	0.0%	1	1.0%
Middle Eastern or North African*	0	0.0%	0	0.0%	0	0.0%
Native Hawaiian or other Pacific Islander*	0	0.0%	0	0.0%	0	0.0%
Other*	0	0.0%	2	2.9%	2	2.0%
Pell eligible	10	33.3%	33	47.8%	43	43.4%
Not Pell eligible	7	23.3%	22	31.9%	29	29.3%
Don't know/No reply	14	46.7%	14	20.3%	28	28.3%
First generation	23	76.7%	40	58.0%	63	63.6%
Rural	13	43.3%	33	47.8%	46	46.5%
Town	9	30.0%	18	26.1%	27	27.3%
Suburb	2	6.7%	15	21.7%	17	17.2%
City	2	6.7%	3	4.3%	5	5.1%

\*Racial/ethnic identity percentages may not round to 100% because students had the option to select all categories that applied.

As of June 2020, the First2 Network included 283 members (see Table 2), an increase of 97% from 144 in Year 1. Half (50.5%) of members were students, and more than a quarter (28.6%) were university faculty or staff. Although in smaller percentages, the First2 Network membership also included K-12 teachers, state government staff, representatives from education non-profits,



a national laboratory, local education agencies, and personnel in the state education agency, as well as industry and foundations representatives. Information about the institutional roles of 12 members was unavailable.

Table 2: First2 Network Member Institutional Roles					
Role	Ν	Percent			
Student	143	50.5%			
College/University Faculty or Staff	81	28.6%			
Unknown	12	4.2%			
K-12	11	3.9%			
State government	11	3.9%			
Education non-profit	8	2.8%			
Industry	4	1.4%			
Foundation	3	1.1%			
National Lab	3	1.1%			
Independent consultant	2	0.7%			
State education agency	2	0.7%			
Backbone mentor	1	0.4%			
INCLUDES Hub	1	0.4%			
NASA education outreach	1	0.4%			
Total	283	100.00%			

Note: Percentages may not equal 100% due to rounding.

#### 2.2. Document Review

The First2 Network supports its core activities via several key structures to make progress toward its goal of improving the early persistence of rural, first-generation STEM students. Review of First2 Network documents—such as quarterly reports to NSF, meeting notes, and records from the Carnegie Foundation for the Advancement of Teaching's Networked Improvement Learning and Support (NILS) platform in which Network members document their PDSAs—illuminates the ways in which the Network has made progress toward implementing its core activities. Such data also provide evidence of the extent to which the Network has established and implemented the five elements of collaborative infrastructure critical to the effectiveness of collective impact efforts to broaden STEM participation:

- 1. Vision: Engaging the community in a shared vision
- 2. Partnerships: Providing a platform for collaborative action
- 3. Goals and Metrics: Allowing for evidence-based decision-making
- 4. Leadership and Communication: Increasing communication and visibility
- 5. Expansion, Sustainability, and Scale: Establishing the capacity to grow and sustain<sup>40</sup>

#### 2.2.1. Improvement Science Activities

Members of working groups participate in improvement science activities, such as developing a driver diagram of the problem they aim to address and conducting PDSA cycles to investigate whether new or modified practices improve the outcomes in question. Each working group focuses its efforts on one aspect of the STEM dropout problem. Over the course of this year, the



Network included five working groups, each conducting a number of PDSAs (see Table 3). As of June 2020, the Network had conducted 53 PDSAs.

Table	e 3: Number of Year 2 PDSAs	by Working G	roup
	Working Group	N of PDSAs	
	Faculty-Student Engagement	16	
	Student Leadership	16	
	Immersive Experiences	13	
	Capacity Building	4	
	College Readiness	4	
	Total	53	

The Measurement Team was established in August 2019 and met every two weeks beginning in January 2020. In addition to providing guidance on issues of shared measurement and Network data systems, this team offers support to working groups engaged in PDSAs. This year, the Measurement Team assigned liaisons to each working group, developed PDSA guidance materials, and participated in working group meetings to assist with PDSA planning.

#### 2.2.2. Shared Vision

To engage West Virginians in the First2 Network's shared vision, Network lead organizations, participants, and students communicated widely using an array of media. This included the transition of the Network website to a new platform on June 15, 2020, publication of a quarterly Network newsletter, establishment of a Network YouTube channel, and updated promotional materials for tabling at conferences and other events. In addition, HEPC DSR's STEM magazine, *The Neuron*, distributed to all post-secondary faculty in the state, includes several articles about the Network. The Winter 2020 issues featured an announcement regarding First2 Network's summer immersion program. A special issue published in June 2020 featured insights from First2 students about how the COVID-19 pandemic has affected their lives and studies.

Student First2 Network members serving as Legislative Ambassadors conducted outreach to the state legislature and to policy leaders in state agencies such as WVDE. During the winter of 2019-20, eight student leaders, five project leads, and one First2 Network alumnus made formal presentations about the First2 Network to the House and Senate Education Committees, making a total of 40 personal connections with legislators. Students also met with the middle and secondary director, student success coordinator, and Associate Superintendent of Schools at the WVDE.

In addition, members of the First2 Network presented information about the Network's efforts at the following external meetings during this project year (several other presentations were cancelled due to health concerns associated with the COVID-19 pandemic):



- West Virginia Women in Technology Conference. October 21, 2019.
- Flash-talk to entire West Virginia Science Teachers Association Conference audience. October 24-26, 2019.
- West Virginia Science Teachers Association annual conference. October 25-27, 2019. First2 Network delivered two workshops:
  - Scientific principles applied to improvement: Plan-Do-Study-Act.
  - Student Panel Discussion: First2 Student Leaders engaged in a 25-minute panel discussion <u>https://www.youtube.com/watch?v=c2xV1GyWjDI&feature=youtu.be</u>
- Network for Earth-space Research, Education, and Innovation with Data (NEREID) Convergence Accelerator Workshop. November 20-13, 2019.
- Inaugural NACADA (formerly National Conference on Academic Advising) West Virginia Drive-In. Bridgeport, WV. March 6, 2020.
- GlobalMindED Virtual Panel: First2Network (NSF INCLUDES) for STEM; Rural and First Gen Collaborations. May 27, 2020.
- Virtual Conversation on First-Generation Student Experiences. Hosted by First2 Network member Kathryn Williamson and students of her Ambassadors for Change course. April 13, 2020. <u>https://tinyurl.com/WVU-FirstGen-Conversation2020</u>
- FSU led the effort to create a special First2 track for the spring West Virginia Academy of Sciences (WVAS) Conference. Nine abstracts were accepted into the inaugural First2/WVAS track. This meeting was first postponed and then cancelled altogether for 2020 due to restrictions associated with the COVID-19 pandemic.

First2 Network members also contributed to the National INCLUDES Network in various ways. In addition to participating in several affinity groups, First2 Network joined the National Network in the following:

- NSF INCLUDES National Network Webinar: "Strengthening Capacity to Implement Culturally Responsive Practices." September 25, 2019.
- NSF INCLUDES National Network Blog Post: Sarah Riley of the First2 Network. January 6, 2020.
- STEM for All Video Showcase 2020: Student Voice: Solving the Puzzle of STEM Persistence. May 5-12, 2020. <u>https://multiplex.videohall.com/presentations/1752</u>
- NSF INCLUDES National Network Twitter <u>#INCLUDESChat</u>: Engaging Student Voice. May 29, 2020.

#### 2.2.3. Partnerships

Partnerships provide a "platform for collaborative action,<sup>41</sup> and underwrite the power afforded by collective action. Review of First2 Network documents—including quarterly reports to NSF, Leadership Team meeting minutes, and other project data—indicates that the Network continued to expand and to formalize its relationships with other entities.



As of June 2020, 283 individuals were Network members, 124 of whom were involved in at least one working group. This is an increase of 97% from Year 1; according to the Year 1 annual report, the Network included 144 members.

In addition, the First2 Network formalized its relationships with seven institutions of higher education in the state through Memoranda of Understanding (MOUs): FSU, Marshall University (MU), the University of Charleston (UC), the West Virginia School of Osteopathic Medicine (WVSOM), West Virginia State University (WVSU), WVU, and the West Virginia University Institute of Technology (WVUIT). GBO also signed a MOU with the Network. These agreements describe how each institution will contribute to the Network (e.g., assigning two liaisons to the Network, providing data on the progress of first-generation STEM students, participating in Network conferences and working groups) and how the Network will support institutional membership (e.g., through data analysis, information-sharing, access to learning and networking opportunities). An important feature of these MOUs is that they are signed by high-level administrators (such as a Dean or Provost) or faculty (such as a department chair) as one means of ensuring institutional buy-in and continuity.

The First2 Network established partnerships with several other STEM entities in the state. For instance, a representative of the Chemours Company is a Network member and last year donated funds to support an internship. Representatives of the Health Sciences and Technology Academy (HSTA) are likewise First2 Network members, assisting other members to learn how HSTA's effective college preparation practices could be applied throughout the state to improve STEM readiness. Finally, the NASA West Virginia Space Grant Consortium is also represented in the Network and provides research opportunities for First2 Network students.

Partnerships also enable Network members to build relationships beyond the state boundaries and connect with other networks seeking to broaden STEM participation and improve STEM teaching and learning. To this end, the Network has established relationships with GlobalMindED and STEM Ecosystems. GlobalMindED is a non-profit network that strives to help first-generation and underrepresented college students achieve career success by providing them with professional skills, resources, networks, mentors, experiential learning, and social support. The STEM Learning Ecosystems Initiative is a national network of 89 projects, members of which participate in a range of peer-to-peer opportunities for sharing insights and leanings.

#### 2.2.4. Goals and Metrics

Clear shared goals and metrics enable Network members to gauge their progress over time and to make decisions informed by evidence. Review of Leadership Team meeting notes; materials associated with the Reverse Site Visit to NSF conducted on March 3, 2020; and Measurement Team minutes—as well as evaluator participant observation of meetings of the Leadership and Measurement Teams, and participation in the Reverse Site visit—indicates that the First2 Network made progress toward confirming key outcome measures and establishing data systems.



In terms of key outcome measures, the First2 Network defined three levels of STEM persistence outcomes its members will track, hypothesizing that the Network will influence STEM persistence in progressively larger scales. These measures are as follows:

- Micro: The early STEM persistence rate of students who directly participate in First2 Network activities
- **Meso:** The early STEM persistence rate of students at participating First2 Network institutions
- Macro: The early STEM persistence rate of students in all West Virginia colleges

The Measurement Team also engaged in several efforts to articulate goals and metrics. These activities included the development of an inventory of measures employed across the Research and Evaluation Teams and refinement of the First2 Network logic model. The Measurement Team will next align measures with the finalized logic model. Finally, the Measurement Team is beginning to conceptualize a data dashboard for the Network and participating institutions.

Another indicator of progress is the launch of an ad hoc committee to explore student tracking processes and systems that the Network might adopt. Consisting of members of the Student Leadership, Research, Measurement, and Evaluation Teams, this committee has recommended to the Leadership Team that the Network leverage its relationship with HEPC as its backbone organization to access the institutional data HEPC compiles from public institutions of higher education in the state. This recommendation places the onus of student tracking on the backbone rather than the Student Leadership or other teams and is one way of ensuring that student tracking can be sustained after the INCLUDES grant ends given that such data collation is already a function HEPC performs.

Research, evaluation, and other measures are only useful to the Network insofar as they are reported to members. To that end, the Evaluation Team provided rapid-response evaluation summaries following administration of data collection instruments. These included summaries of evaluation findings from the November 8-10, 2019 conference survey; two administrations of the Working Group Self-Assessment; two administrations of the Steering Committee Survey; and four student focus groups facilitated in April 2020. Similarly, the Research Team produced at least eight manuscripts, conference presentations, and theses on their First2 Network findings, according to a review of Network quarterly reports to NSF.

#### 2.2.5. Leadership and Communication

Leadership development of members—including students—enables the First2 Network to build the capacity to pursue change and support the next generation of leaders taking up the cause of rural, first-generation STEM student persistence. Communication supports this agenda, with Network outreach across the state to policymakers, schools, and interested organizations. Quarterly reports to NSF, meeting minutes, and working group documentation provide evidence that the Network continues to provide leadership opportunities to members and to communicate about its efforts to leaders and potential champions.

According to meeting minutes and PDSA documentation, members of the Student Leadership working group—consisting almost entirely of students—have conducted PDSAs on their



Hometown Ambassador site visits. Hometown Ambassadors visit their former high schools to talk directly to students, STEM teachers, and others in positions of local authority about their STEM college experiences and the First2 Network. Students completed 14 hometown visits this year.

Some students also served as Legislative Ambassadors, conducting outreach to the state legislature and to policy leaders in state agencies such as WVDE. This year, eight student leaders, five project leads, and one First2 alumnus gave formal presentations to the House and Senate Education Committees of the West Virginia legislature, and met with the middle and secondary director, student success coordinator and Associate Superintendent of Schools at the WVDE. Students made a total of 40 personal connections with legislators.

Members of the Student Leadership working group identified the need for smaller, campus-based support groups for rural, first-generation STEM students. To meet this need, working group members established First2 campus clubs at four institutions. In addition to providing students with safe, positive environments for sharing struggles and advice, campus clubs created new leadership opportunities for students as club leaders.

In addition to their Network leadership activities, First2 Network students also engaged in research and presented their findings.

- Three First2 students presented the results of their research at WVU's Virtual Undergraduate Spring Symposium. April 2020. https://virtualspringsymposium.wvu.edu/
  - Aubrey Cumberledge (Biology); Mentor: Craig Barrett. Phylogenetic Relationships in New Caledonian Palms (Arecaceae) with a Focus on Archontophoeniceae and Chambeyronia
  - Jordan Means (Immunology and Medical Microbiology); Mentor: Timothy Eubank. Isolation of Mouse Macrophages and Differentiation to M1 and M2 Phenotypes
  - Isabella Hurley (Biology); Mentor: Daniel McNeil. Patient's Expectation of Medication for Dental Pain
- Three First2 Student Members presented the results of their research at FSU's Celebration of Student Scholarship. April 2020. <u>https://guides.library.fairmontstate.edu/CelebrationOfStudentScholarship</u>
  - Sarah Starcovic (Chemistry) and Shannon Knowlton (Architectural Engineering Technology); Mentor: Erica Harvey. Standardization and Reproducibility to Support Hands-On Solar Energy Research
  - Kiersten Lowdermilk, Mentor: Kristy Henson, Assistant Professor of Forensic Science. Using Dermestid Beetles to Enhance Forensic Science Curriculum

Another indicator of leadership development and communication is the finalization of governance documents in which leadership roles and responsibilities have been formalized. Approved by the Leadership Team on April 14, 2020, the First2 Network by laws articulate the Network's purpose, goals, values, working norms, commitment to diversity and inclusion, Network roles, working group roles, Leadership Team and



Steering Committee roles and responsibilities, meeting procedures, decision-making process, and conflict resolution process.

#### 2.2.6. Expansion, Sustainability, and Scale Up

The need to build its capacity to expand and self-sustain after grant's end has been an emerging priority during the First2 Network's second year. Document review indicates that the Network leadership has pursued this goal in several ways.

First, the Leadership Team focused efforts early in the grant year to reconfigure development of its backbone organization, HEPC DSR, in partnership with the mentor backbone organization, SRI. The Leadership Team, HEPC DSR, and the backbone mentor co-developed a mentorship and development plan for the year, a plan led and implemented by a new backbone coach. Additionally, HEPC hired a new Director of the HEPC DSR, replacing the former HEPC DSR First2 Network PI, and a full-time First2 Network Program Coordinator. HEPC also submitted to the Leadership Team a communications plan outlining the role HEPC DSR would play in managing Network communication.

Second, the Capacity Building Team engaged First2 Network members in identifying an external Advisory Committee to provide a twice-yearly review of high-level aspects of the Network (such as its strategic plan, partnerships, communications, etc.) and to support its progress toward sustainability. The Leadership Team invited individuals who play state leadership roles in education, STEM, industry, and state government. As of this writing, Advisory Committee members currently include:

- Anne Barth, Executive Director, TechConnect West Virginia
- W. Clayton Burch, West Virginia Superintendent of Schools
- Amelia Courts, President/CEO, Education Alliance
- David Mohr, Senior Policy Analyst for the Committee on Education for the West Virginia House of Delegates
- Donna Hoylman Peduto, Executive Director, West Virginia Public Education
   Collaborative
- Robert Plymale, Senator, West Virginia Senate
- Ulises Toledo, Associate Vice President for Administration, WVSU
- Sarah Tucker, Chancellor, West Virginia HEPC and Chancellor, West Virginia Community and Technical College System

Review of Leadership Team and Steering Committee meeting notes and planning materials confirm a third strategy for building Network capacity for expansion and sustainability—the development of a strategic plan. Over the course of three work sessions in June and July, members of the Leadership Team and Steering Committee developed strategic goals designed to build the Network infrastructure needed to attain sustainability, articulated indicators of goal achievement, and crafted initial action plans to reach goals.



Publication and presentation of First2 Network research and evaluation findings is a fourth strategy for expansion and sustainability. Similarly, sharing lessons learned and new insights with others interested in broadening STEM participation is a means by which to promote the work of the Network and engage potential new members. Members of the Research Team presented at the following conferences this year (due to health concerns associated with the COVID-19 pandemic, Research Team members were unable to present other accepted papers at conferences that were cancelled):

- Stewart, J. (2020). Using machine learning to understand the retention of STEM students. American Association of Physics Teachers Winter Meeting. Orlando, FL. January 18-21, 2020.
- Stewart, J. (2020). Using machine learning and big data to understand the retention of *STEM students*. American Physical Society Meeting 2020. Washington D.C. April 18–21, 2020.
- Darrah, M. (2020). Using social network analysis to measure growth in the First2 Alliance in WV. West Virginia Council of Teachers of Mathematics. Stonewall Jackson Resort, WV, March 13-14, 2020.

The Research Team authored three whitepapers as well, documenting learnings from the project's research effort:

- Humbert, R., Darrah, M., & McJilton, L. (2020). *Developing a coding system of rural areas to link factors that contribute to STEM Success.*
- Darrah, M., Humbert, R., Cowley, K., & McJilton, L. (2020). Analyzing the growth of a statewide network to increase recruitment to and persistence in STEM.
- Stewart, J. (2020). Exploring rural/first-generation retention and degree selection at West Virginia University.

Network members were also invited to submit an article to the peer-reviewed journal *Scholarship and Practice of Undergraduate Research*. Entitled "Potential impact of short-duration research experiences on STEM self-efficacy among early stage first-generation college students," this manuscript will be submitted to the journal editor in September.

#### 2.2.7. Document Review Summary

In sum, review of First2 Network documents indicates considerable progress toward implementing the five elements of collaborative infrastructure that enable collective impact. Outreach and communication efforts have contributed to the furtherance of the Network's shared agenda and to sustainability. The Network established core shared metrics and facilitates a Measurement Team to address emerging measurement issues. Network expansion, MOUs formalizing institutional alliances in West Virginia, and new relationships with national STEM education and first-generation collaboratives demonstrate the Network's growing collection of partnerships. Leadership development opportunities (for adults and students alike), strategic planning, establishment of an Advisory Board of state education leaders, and outreach to policymakers and other STEM education stakeholders converge to enable progress toward expansion and sustainability.



### 2.3. Elements of Collaborative Change Interviews

In February and June 2020, the evaluators invited randomly selected members of the First2 Network to participate in one-hour telephone interviews about the ways in which the five elements of collaborative change were evident across the Network. The interview protocol was organized into two main sections. The first section focused on interviewees' assessments of Network progress (e.g., learning about how to broaden STEM participation, largest achievements to date), whereas the second section solicited information about interviewees' perceptions of how Network members are collaborating.

#### 2.3.1. Elements of Collaborative Change Interviewees

Ten Network members participated in Elements of Collaborative Change interviews during February 2020, and three members participated in interviews during June 2020. Unfortunately, because the audio file associated with one June interview was corrupted, transcription was not possible, and therefore findings from only two June interviews were included in this analysis. In addition, because only two interviews were available for analysis from June 2020 and were unlikely to represent the range of Network perspectives emerging from the early summer's Network efforts, the following analysis combines data from both February and June.

Respondents included five faculty members, three students, one WVDE staff member, one representative from a WVU office providing student support services, one representative of a health sciences mentoring program, and one industry representative.

#### 2.3.2. Elements of Collaborative Change

#### Shared Vision and Common Agenda

Interviewees were unanimous in their agreement that Network members embraced a shared vision and common agenda. As one respondent stated it, "the mission has always been very clear and very focused, and so I think everybody comes to it with knowing exactly...what the goal is." One respondent, however, added that those who have been members of the Network from the onset "definitely share the same vision" whereas newer members are in the process of internalizing it.

Two respondents also noted that, although members had a common agenda, this did not preclude contextualized variations. Explained one interviewee, "What works on some campuses I can tell you [isn't] going to work at [my college]. Implementation of things is different between campuses. So, I think that's [been] known from the very beginning that it's not going to be a one-size-fits-all solution." One interviewee cautioned that conferences with numerous sessions and topics could obscure communication of the overarching vision and agenda to members.

#### Partnerships

Asked about the ways in which and to what extent does First2 Network engage diverse partners, most interviewees reported they were aware that the Network included representatives from a wide range of institutions. Said one respondent,

They're not just hitting colleges. They are hitting – they have worked on and get – and I know there are some industry partnerships that have been developed. And



they are working with the HSTA group ... and I know they're trying to work with state government and legislators and stuff like that. So, they've – I think they seem to be hitting a lot of the different stakeholders or people that could and the groups that could help.

Two interviewees indicated that they were aware that Network leaders conducted considerable outreach to STEM stakeholders throughout the state. As one put it, "They're always reaching out to folks that can give us a different view of what – what's needed and what they can bring to the table." One interviewee also reported that the Network was consistently interested in and welcoming of diverse perspectives. As s/he elaborated,

I hear an issue that's going on there or something that they want to address or there's somebody in there that's very talented that I think that they could bring a perspective to us, all I have to do is just say, hey, this – we have to check this out. And you know, and ... It's just very open and considered and that's appreciated.

One respondent noted that it was challenging to develop partnerships with industry representatives, explaining, "I don't see industries with largesse or even the ability to have largesse.... And the second problem is, there aren't as many large industries in West Virginia as there are in other states."

#### **Shared Metrics**

All but one interviewee reported that they were uncertain how the Network uses shared metrics to support shared learning and improvement. The respondent who did reply discussed data emerging from PDSA cycles, describing how working group members employed such data to investigate whether tested practices led to expected outcomes.

#### Leadership and Communication

Asked how the Network builds leadership among partner organizations or individual members, four interviewees reported that all members—including students—were provided leadership development and service opportunities. As one such member put it, "It's simply through enabling and again giving each new partner that comes to the table, basically as large portion or piece of the activities and mentoring, and again, leadership management that they're willing to take on." Four respondents highlighted the ways in which student voice and participation were encouraged. One member explained that this was accomplished by "empowering them, letting them know that they have a voice, first of all, and that everyone—even the adulty adults, as they say—are there to listen and to learn from the students." Another interviewee elaborated,

So, at our meetings, we had students present as well as the student representatives, and so having them participate in the meetings and be, like one of them was – became the secretary at times at meetings and they got to have an understanding of what it takes to kind of monitor that. As secretary of the faculty meetings, I understand what a challenge that can be.

Finally, one interviewee reported that leadership was modeled, especially to support student leadership development: "Just modeling for them how to participate in a meeting because a lot



of them didn't know.... And so modeling that for the students and then watching them kind of become comfortable and grow."

Interviewees were then asked about their perception of the extent, and in what ways, the Network ensures cross-Network communication to build trust, to assure progress toward achievement of shared goals, and to sustain collective momentum across the Network. Six interviewees reported that working group and other Network meetings were a primary means of ensuring ongoing momentum. "I think the meetings are really the part that glues the different campuses together," said one such respondent. Another member explained in further detail,

The biggest [communication effort] I can think of is the semi-annual conferences for the entire network, again, to come to all meet together and participate in several different networking type events, functions, to build those collaborations. And so that's really where you get the cross functionality. The deliberate act of encouraging mixing between, again students and educators and private company chemists, scientists, that's the biggest one. And then further from there, it's, again through participation in these working groups that are very cross-functional.

Four members cited the First2 Network website as an important means of communication. Said one such respondent, "There is, of course, the [website] where all the working groups can get their information, forums, communicate with everybody. So, I think between kind of the big picture meetings and the hub, the NILS diagram, I think that helps to get information out to everybody." Two of these respondents, however, also noted that they were not yet comfortable with the website platform and as a result did not refer to it as they might otherwise. (These two respondents were interviewed in February of 2020, before the Network transitioned its website to a new platform). A fifth respondent also reported that email was used for information-sharing and to answer questions.

One interviewee noted that student leaders on participating campuses played an important role in communication. As s/he explained, such students served as liaisons between the Network and students in Network campus clubs, as well as with faculty.

Two respondents discussed challenges to effective Network communication. One such respondent reported that, despite Network communication efforts, there remained important barriers, including competing priorities and geographic separation across campuses. The other interviewee mentioned that communication might be made difficult by power dynamics, explaining, "Different campuses are different sizes; if you have State compared to WVU, State is a lot smaller and they won't have as many people, which is kind of hard because even if it's equal with the amount of people at the institution, WVU is going to have more of a say in things because it's bigger."

#### Expansion, Sustainability, and Scale

Interviewees noted various ways in which the Network is expanding the reach of its efforts and working to scale its promising practices across the state and elsewhere. Four respondents reported that the Network pursued expansion by conducting outreach to generate interest in the Network's agenda. These interviewees described Hometown Ambassadors, for example. One such member characterized this as a "good outreach effort" because it "lets students and



teachers know and then they can suggest it to students who might not have thought about it for themselves," while another discussed outreach to legislators as the Network's ability to "play the politic[al] game, which is a feat in itself."

Two respondents cited meetings and conferences as expansion efforts. For one, this meant progressively larger conferences in the state, while the other explained that member participation in conferences with national partners could support expansion beyond state boundaries.

For two other interviewees, the principal means of expansion was through increased numbers of summer internships. "They never stopped reaching out to anyone that they think, you know, is interested or might be interested" in summer research experience, said one respondent.

One interviewee reported that the Network sought to support expansion by seeking additional resources. This member cited "some of the scaffolding that they're starting … looking for alternative resources for funding of, like, the summer internship." Another interviewee explained that the Network encouraged and empowered members to conduct outreach to similar organizations and to peers. As s/he elaborated,

Let me give you an example. I mean, I'm a chemist at a private company on the Ohio River. And up and down the Ohio River, there are a lot of other companies like mine that have chemists and engineers like me. And so, it's very easy for me to reach out by e-mail, by phone call to people that are in neighboring cities and neighboring counties to say, hey, here's something our company was interested in. I'm guessing since you are just like me, your company will be interested as well. And so, it's, it's through allowing and again, enabling and empowering each member to find other people just like them that are in their local region once we leave the group meetings from again, like Charleston or when we go back to our home cities and we can reach out to people just like us.

Finally, one interviewee noted that the ability to meet colleagues through the Network encouraged collaboration beyond the confines of Network activities themselves. S/he explained it this way: "And like this just a couple of weeks ago, I was a guest speaker at the college initiative group. She has a class and a STEM class for college kids here on campus. And, you know, I was one of the guest speakers in it. You know, I mean, it's just nice to see us use ... each other as resources."

Network members were next asked how the Network planned to sustain its work after INCLUDES funding ended. Some interviewees were unaware of sustainability plans, but five respondents offered a few answers. Four members reported that the Network sought partnerships to pursue additional funding. For instance, one such respondent said the Network was "trying to get money from other places such as private companies and through funding at each of their individual universities for example. And additional grant money from the U.S. government." Another elaborated, "I think that's one of the reasons why we're bringing in the whole thing with business and integrating opportunities for when kids can have internships. And, you know, if business needs a workforce that is well trained, they need to see how we can provide that."



One interviewee mentioned that the Network was considering ways in which student alumni could assist with sustainability, perhaps continuing to serve as mentors to incoming freshman.

#### II.2.3. Network Progress

#### Learning about Broadening STEM Participation

Asked what they were learning about broadening STEM participation because of their participation in the Network, six respondents reported that they had learned more about the barriers to STEM persistence that rural, first-generation students face, including sparse exposure to high-level STEM courses (and a resulting fear of being unable to complete STEM courses in college), reluctance to request assistance from STEM faculty, and lack of adequate math preparation in high school. Three respondents indicated that they had learned how important additional support—whether it be high school counseling targeting first-generation students or on-campus support networks for such students—is to enabling students to overcome challenges to their persistence. Insights about the value of summer immersion experiences were cited by three interviewees; two noted that they understood more about how such internships could support STEM persistence, while the third reported that the internships "opened their [students'] eyes" about the practice of STEM.

According to one respondent, s/he became more aware of the range and diversity of STEM efforts across West Virginia, an understanding that s/he lacked before becoming a member of the statewide First2 Network. One respondent reported learning how much members could learn from how other member institutions were attempting to improve student engagement. And another interviewee indicated learning that another component of the STEM persistence issue concerned the availability of STEM jobs to graduates, explaining, "I think that that's part of the vision is that this is an effort to ensure that West Virginians have the – who are interested in STEM, have the STEM education that they need to stay in state if at all possible, yes.... we do have to have the jobs for them once they get out. We've got to have those jobs for them."

#### Largest Network Achievement to Date

Interviewees were then asked about their perceptions of the Network's biggest achievement to date. Four respondents cited the collaboration enabled by the Network. As one such Network member put it,

I think the collaboration from multiple schools, private industry, just all the organizations that are involved in this is really amazing. I guess I've never been involved with such a big project as this and when I first got involved with it, I didn't really realize how big of a – of a network it is, but it's really great to see all the interested parties trying to tackle this issue from multiple angles. So basically, it's not just an academic issue.

Another such respondent noted the advantage of having 19 universities across the state "working together, sharing their experiences, communicating" and "working on the same goal."

Four responses cited the way in which the Network valued student voice and supported student leadership as the Network's biggest accomplishment. As one such interviewee clarified, "... the



student voices ... are making it clear where some of the issues [influencing STEM persistence] lie."

[The interns are] still hanging out. I can see them out and about on campus together ... that's a huge leg [up] for them. They came in with a close-knit group. They came in knowing the campus and being more familiar. Also appearing in five responses were references to the Network's establishment of various means to help students acclimate to college and their STEM majors, and to persist in their studies. Said one such respondent, "It's a great way

for them to learn about the university, faculty, staff, students, everything, and then also learn about the majors. So, then they go to college their freshman year [and] they already have background information." Another explained, the interns "are still connected and interacting, and they practice together. They're still hanging out. I can see them out and about on campus together ... that's a huge leg [up] for them. They came in with a close-knit group. They came in knowing the campus and being more familiar." Ongoing mentoring was another feature of this support, as one interviewee elaborated: "I think they are so accepting and if you're in the First2 Network, you have some really good mentors you can talk to and ask questions of and that makes first-gen or minority students a lot more comfortable in that environment."

Three respondents reported that the Network's largest achievement to date was its quick development and expansion. The result of this accomplishment, according to one such interviewee, is "there's so many eyes on the problem that there weren't before."

One interviewee reported that the Network's greatest achievement thus far was that it was raising awareness about the challenges to STEM persistence faced by rural, first-generation students, while another two indicated that the Network was creating interest in STEM efforts and STEM programs available to students throughout the state.

#### Network Influence on Institutions

Asked how, if at all, has the Network influenced their institution, six respondents cited the Network's impact on students. According to one interviewee, the Network has generated more opportunities, resources, and supports for students, and has

... made available to us more opportunities for our program graduates if that makes sense. So, when our kids get through the program, they have more, you know, they've graduated from high school, they're moving into college. Now, they have this First2 Network ... that we're slowly building and it's in its infancy, but you see it on a college campus.

Another respondent pointed to the support the Network has provided to students, stating, "Just having that support system was huge.... It just helped me gain a clearer understanding of what I want to do with my life." One interviewee explained that the Network has provided peer-to-peer opportunities for students, including sharing of resources and providing support among students. Respondents further noted that the Network "has provided an avenue for us to directly impact students, aged people, students with STEM" and that the Network has "an impact on this



limited number of students ... and that's going to be a bigger number." Another interviewee noted the Network's influence on increasing connections with students in meetings and "hearing their views outside the school, which actually influenced a lot of things in their classes."

Regarding awareness of first-generation students, one interviewee reported the First2 Network has influenced the institution to "add that statistic into our dashboard of information" in an effort to engage these students to stay committed to STEM areas. S/he continued that STEM students tend to stay at the institution but transfer to a different major. According to this interviewee, being able to engage with other institutions through the First2 Network is helpful in that "we're trying to understand that reasoning and what kind of supports, and learning, from other institutions has been helpful with that." The Network's influence on increasing awareness of STEM was addressed by another interviewee who elaborated,

First generation has been kind of a topic at the university for a while. And so – and of course that STEM we have – we want to see students successful in STEM. And as far as – I mean I was in the role when this kind of started or in that transition into this role of getting just first generation. And so, I think it's great to see you have a different kind of group targeting different areas. Those students that are interested in STEM, they can do that type of stuff and then have campus-wide first-generation stuff.

First2 Network members are influencing their institutions in terms of awareness and growth of the program. A respondent indicated her/his institution's board of governors "learned about my office and wanted to know more. And so, I think that, as a whole, the institution is definitely behind it and cares to see the students be successful." Another respondent had the opportunity to share information about the First2 Network with top administrators at her/his institution. Yet another interviewee spoke of the impact of the Network's outreach, reporting that more faculty from his institution are attending First2 Network meetings as a result of First2 outreach.

Two of the First2 Network members interviewed commented on how the size of a member institution may impact the Network's influence, since smaller institutions would have fewer faculty participating in the Network. As one such interviewee noted, "It's hard to implement [First2] when you're the lone voice." Another interviewee noted, however, that although there are only "a couple of other STEM faculty [from my college] that are participating," s/he believes the institution is starting to incorporate "some of the ideas and change ideas and things like that in our classroom."

One respondent cited the impact First2 has had on her/his organization, noting that "one of our main directives over the next 10 to 20 years is funding STEM-related let's say growth ... and a lot of that is as a recruiting tool, and so, yes, the First2 Network has impacted our company, I think greatly, from a recruiting point of view." Yet another spoke of the Network's influence in this way: "I think this experience or some of the things that [the] First2 Network has been doing to improve the retention are really good and we can actually use them in our university as well."



#### **Contextual Factors Influencing Network Progress**

Interviewees were asked to share their perceptions of contextual factors that are either enabling or impeding Network progress.

#### **Contextual Factors Enabling Network Progress**

Invited to discuss the contextual factors that support progress of the First2 Network, one respondent cited the resilience of the culture in West Virginia. As s/he explained, "especially for people that are born and raised in this state ... I think there's a different type of resilience that comes along ... I feel the Network kind of builds off of that type of resilience ... and that's helpful."

Another respondent suggested two factors that facilitated Network progress, noting there are "so many people that are uneducated here and they want that opportunity for their kids" and that "there are a lot of politicians that are open to our Network and are excited about it."

Two interviewees cited networking as a factor that contributes to the Network's effectiveness. As one of those noted,

I think there's a lot of weight in being able to say to each [of the] folks I work with or that, you know, hey, we're collaborating with or searching the state. Or, hey, this is what we've got going on with [higher education institution]. That's a big deal. That's a big deal. And this is a good that's coming out of it. You know, we're addressing these kids. We're making a difference in these programs. I think that there's that power in being able to have that network.

#### **Contextual Factors Impeding Network Progress**

Interviewees were also asked to discuss contextual factors that jeopardized progress of the First2 Network. Two respondents indicated that having sufficient time to devote to Network activities was a concern. One shared that as the Network grows, it may become more difficult to keep up with e-mail traffic, meetings, and other activities, but noted also, "It's such a great goal that we have, such a great program, such great people to work with. And I think that personal aspect that, you don't want to let these people down that you're working with, makes you spend more time than maybe you have on this particular project." Another respondent agreed that schedules can limit time to participate in Network activities and suggested that the Network might achieve more buy-in if there were different levels of partnership or participation that require attending fewer meetings.

West Virginia's lack of qualified teachers in STEM disciplines and a "mass exit of great educators" were suggested by one respondent as impediments to the Network's effectiveness. This respondent added that "policy, state politics, have played into that in a large way." Two additional respondents noted that state politics and regulations may impede the Network's growth. Another interviewee spoke of an inequitable emphasis on the various STEM subjects:

I think if we, [the] United States, did not put so much emphasis on the testing and the accountability as math and English language arts, then I think that our teachers in the lower grades would be putting more emphasis and time on teaching the other subjects. And by that, I mean the sciences. Young students



come to school in love with science. Somewhere between young people and coming to high school, either because they don't have that education, that experience of science, too many of them don't have the love for science that they might. And when you enter a high school classroom with the rigor that it's going to have, if you don't have a background, it's going to be a challenge to catch up to the demand that's going to be expected then, yes.

Two respondents cited the challenges associated with technology as an impediment to the Network's progress. As one respondent put it, "Technology is definitely statewide an issue when you're not in a bigger area." Another cited lack of reliable internet in some areas and the availability of very few internet service providers. S/he continued that physical distance and "inaccessibility to those kinds of things" make Network participation difficult.

Regarding the various role groups and types of organizations represented in the Network, one respondent commented that this factor both helps and impedes the Network. S/he noted that having a variety of voices and perspectives contributed to the strength of the Network and that "each person joins the group to give back." S/he continued that

There's also a component of 'what am I getting from it?' Or 'what is my organization getting from it?' And when you have so many different types of people involved, it pulls on the Network in so many different ways. It's often hard to agree on what's the best, let's say, path forward on different things.

Two interviewees cited the size and type of participating institutions as an impeding factor, particularly related to smaller or private institutions. One commented that some activities that work well at larger institutions may not be well-suited for smaller institutions, but that while the larger schools "kind of overshadow the rest of us" at times, "it's not everything, of course … there are suggestions, recommendations, change ideas, things like that that we can do here and there's some things that we can probably do better, but sometimes the big schools … get a little more attention." Another noted that faculty and administrators hailing from public institutions may know more about what is occurring across the Network than do their peers at private institutions, and that "we only have a few faculty members that can spread their time to attend meetings and things of that nature."

According to another interviewee, the time it takes to adjust institutional processes is an impediment to the effectiveness of the Network. This interviewee suggested to her/his institution that systematically collecting data on students' first-generation status would be helpful, but no progress had been made on this front.

One interviewee reported that financial bureaucracy was an impeding factor. Only one respondent commented on the COVID-19 pandemic, noting it was the biggest impeding factor, especially for First2 Network internships that had been planned. This respondent expressed that students would have been positively impacted by participating in the face-to-face internship on her/his campus and making connections with other students and faculty during the experience.

#### Effective Network Processes and Structures

When asked to share their perceptions of what is working well in the First2 Network, three respondents cited the effectiveness of the Network's cross-functional working group structure



and the focus on various areas of expertise and interest, although one respondent noted it has been hard to participate in working groups because of scheduling issues. One individual noted, "I think really the working groups are working well personally. I like that I can sort of focus in on a small task and kind of work on that instead of kind of the big picture sort of stuff.... So, the working group that I'm in leans more towards my interests and expertise. So, it's something that I'm having success with I think." Another respondent commented on the Network's vision for working groups and the involvement of multiple role groups:

I think the vision into multiple sub-working – sub-teams or what we're calling working groups, I think, works really well because there are a number of different thrusts, if you will, and it involves so many working parts, so many moving parts. You have academia that being college or secondary schools, you have industry, you have government labs. There are so many different subgroups that our ability to make teams that are cross-functional among all of those, but still keep them small enough so that they're truly working groups has been very good.

Five interviewees discussed the effectiveness of collaboration and networking among institutions and individuals across the Network. Two commented on the opportunity for students to connect with university faculty and with each other, which,

We have a really focused powerful leadership team in the hard directors. I just think they would—they're strong and they're quiet and they're gentle, but they just keep driving and pushing what needs to get done.

as one interviewee noted, "leads to "strengthening that link amongst the students themselves and empowering them to communicate with each other and just work together." A third respondent shared that the collaboration among institutions contributed to creating interest in STEM across the state, noting "this whole idea can be spread out a lot quicker than just – if it was one organization" and that the Network "did a good job with that." And according to another respondent, collaboration stimulates members' understanding of the broader purpose and perspective of the Network and helps members realize they are not alone in the challenges they face in encouraging STEM persistence. This respondent pointed to that understanding as "one of our biggest benefits."

One interviewee commented on the effectiveness of the Network's Leadership Team. "I think we have a really, you know, powerful – I think we have a really focused powerful leadership team in the hard directors. I just think they would – they're strong and they're quiet and they're gentle, but they just keep driving and pushing what needs to get done," as evidenced by the growth of the Network, the way in which student leaders are promoted within the Network, and the integration of counselors into Network activities.

Four individuals mentioned additional processes and structures that they viewed as effective:

- Mentors "are very open, and you can come to them."
- Clubs are working well because "you can get together with the people on your campus and get to know them and be comfortable with them."


- The Network has done "a great job of getting partners across the state working with the State Department of Ed[ucation], with those industry partners."
- "I've been to a couple of conferences and I think those are helpful. And then also, (keep) letting the students or allowing the students to go to events throughout the year. I mentioned the Capitol earlier, we visited the Capitol.... it was intimidating, but the whole experience, it was something that we – it was scary, but we made it through and I think that it was a huge – I'm sorry – it was just – it was empowering."

## Finally, one respondent

commented on the membership of the Network: "So, what's working well is the best group of people you could hope to work with. I know programs can be like families that

... what's working well is the best group of people you could hope to work with. I know programs can be like families that don't work well for you and that's not what's happening, so that's a wonderful part.

don't work well for you and that's not what's happening, so that's a wonderful part."

#### Suggestions for Improvement

The focus of the next question to interviewees was their perception of Network structures and processes and suggestions for improving these to ensure the Network achieves its goals. One interviewee suggested the Network further define its goals and "tighten its focus," noting that there are "so many dimensions the students need support in." This individual reflected that

For efficiency, some people could suggest we could have more focus and I think we are actually trying to redefine what our drivers are. The particular weaknesses you could say that we're trying to address. So that's the evolving part of the program; by evolving, I mean just last week we were introduced to the process where we might, in view of our previous experience, kind of redefine what the drivers are and what exactly were trying to address.

Four respondents raised concerns around the scheduling of meetings and activities, and suggested that the roles, schedules, and locations of the many Network members be considered when arranging meetings to better accomplish Network tasks. One such individual noted, however, that "they're usually pretty good to put out polls to see what times people are available." Another stated that having smaller groups might help address this issue. Still another respondent "enjoy[s] the regular big picture meetings, but I think it would be nice to have at least some time for working groups to meet," suggesting s/he would like to use this time to recruit new members. Another individual suggested the Network share ways that members can contribute if they are not able to attend every meeting.

Continuing with at least two face-to-face conferences each year was suggested by one interviewee who pointed out that "we get so much done when we can work together and meet together.... That makes such a difference being able to do that. I hate to see that go away."

Four interviewees stated that improving awareness and communication would strengthen the Network. One suggested improving communication among institutions regardless of institutional size or type. Another suggested that making Network members more aware of how to access



shared materials would be helpful, as well as sharing challenges and successes among all working groups. A third respondent noted that s/he is "not a fan of Google docs." Another respondent shared that sometimes "rules are not clearly defined" and that knowing whom to contact about particular issues was often unclear. To address this challenge, this individual expressed the need for clarity regarding whom to contact with questions or concerns about various topics (e.g., communication, budget) would be helpful.

Another interviewee commented on the specific challenges faced by private institutions and suggested the Network attend to those challenges by improving communication so that both public and private institutions are kept apprised of Network meetings and activities. Lastly, one respondent suggested that Network leaders consider ways to hold members accountable for their own Network participation and the tasks for which they have taken responsibility.

#### Additional Comments

Finally, interviewees were asked to share any final comments about their perceptions of the Network that may not have been addressed in the formal interview questions. One respondent shared the following:

It took an amazing group of people to have conversations to begin with, to recognize the problem, and then to mobilize an effort to write the grant. And we're fortunate to get the grant. I've had experiences (with) these folks for quite a while with some of their other programs that they've provided for teachers and students, and it's an amazing group of people.... I think it's fantastic that this group is in place to help kids not just go to college but be successful in STEM.

A second respondent shared that participation in the Network has been a "useful experience" and that, while there was some "learning as you go" involved, there were also gradual improvements in areas such as communication and data management. According to this individual, the Network has been "a very good resource that we can use in our university" and that it has been helpful to understanding the issues students in West Virginia face and how they can be supported, such that "we can use that in our university … to improve … graduation." Another reflected on how important the Network is to the state and how much it is needed. This individual commented that s/he would "love to see it grow."

#### 2.3.4. Elements of Collaborative Change Interviews Summary

In sum, Elements of Collaborative Change interviewees reported that four of the five elements of collaborative infrastructure were present and in continuous development. However, only one of the twelve interviewees reported awareness of the Network's shared metrics or how they were deployed to support collective learning, improvement, and goal achievement. The one member who did report familiarity with shared metrics identified data emerging from PDSA cycles as an example of such metrics. However, this member did not indicate knowledge of any other measures, such as STEM persistence rates among First2 Network interns, first-generation and rural students at participating institutions, and statewide, nor of Network progress indicators, such as working group self-assessment scores.

According to interviewees, the Network's most important achievements to date include the collaborative opportunities generated through the Network, the genuine promotion of student



voice and leadership, provisions of multiple supports and resources for student, and quick Network development and expansion. Asked to discuss Network influence on their institution, members noted that the Network had ensured that rural, first-generation STEM students had access to more support, resources, and connections on their campuses. Some respondents also reported that the Network contributed to the rising profile of STEM persistence issues and the experiences of first-generation students on their campuses.

Interviewees only described a few contextual factors that facilitated Network progress. These included the power afforded by a collective effort drawing upon partners across the state, and the associated credibility from being a part of that effort. Political support for STEM education improvement, parents' commitment to their children's education, and the resilience of West Virginians were also mentioned.

Interviewees also discussed contextual factors that impeded Network progress. These included the shortage of sufficient time to engage in Network activities, education policies that prioritize accountability and assessment rather than instruction and curiosity, and lack of broadband access, particularly in rural areas.

Invited to identify effective Network structures and processes, interviewees highlighted opportunities for collaboration and the ways in which working groups facilitated focus on specific aspects of STEM attrition.

Members also offered several suggestions for improvement. Scheduling improvements were recommended, including the establishment of membership levels, each level requiring different levels of commitment and meeting attendance. Other suggestions included tightening Network goals and focus and improving communications across the Network.

## 2.4. Working Group Self-Assessments

During the First2 Network's first year of the current grant, the Evaluation Team developed the Working Group Self-Assessment to investigate formative questions about working group progress. The self-assessment rubric asks working group members to rate the extent to which 39 indicators are weaknesses or strengths in the working group's capacity to engage in improvement efforts and achieve goals. The 39 indicators fall into eight dimensions of working group effort: (1) collaborate, (2) plan, (3) do, (4) study, (5) act, (6) dissemination, (7) reflect on equity, and (8) build capacity. Dimensions 2 to 5 each represent one phase in PDSA cycles. The rating scale is as follows:

- 1 = This is a weakness for our working group.
- 2 = This is more of a weakness than a strength for our working group.
- 3 = This is neither a weakness nor a strength for our working group.
- 4 = This is more of a strength than a weakness for our working group.
- 5 = This is a strength for our working group.

Analysis of changes in mean ratings over time provides some indication of change in working group effort and progress as the Network develops.



In addition, working group members were invited to provide additional feedback about each dimension via two open-ended questions: (1) What policies, organizational structures, environmental factors, events, or other issues do (or could) support this dimension of collaboration? and (2) What policies, organizational structures, environmental factors, events, or other issues do (or could) jeopardize this dimension of collaboration?

Evaluators administered the self-assessment, intended for all members, chairs, coordinators, and students who participate in a working group, four times since grant inception—May 2019 (Q1), July 2019 (Q2), October/November 2019 (Q3), and April/May 2020 (Q4)—after each quarter of program implementation. Moving forward, evaluators will administer the survey semi-annually during each grant year to continue tracking progress while limiting data collection burden on participants.

#### 2.4.1. Characteristics of Respondents

For the data collection in Q1, Q2, Q3, and Q4, most working group members received the same set of questions on the Working Group Self-Assessment. However, the Capacity Building working group originally received a somewhat different survey in Q1 and Q2, reflecting the group's unique mission to enhance the First2 Network's organizational capacity. In Year 2, all working group members were invited to reply to an identical set of items.

For the remaining working groups—Faculty-Student Engagement, Immersive Experiences, Student Leadership, and College Readiness—the overall response rate varied by period, as shown in Figure 1. The largest number of responses in Q4 were from members of the Student Leadership working group, with a total of 21 respondents. In addition, the Student Leadership response rate increased the most dramatically over time. The second largest number of Q4 responses came from members of the Faculty-Student Engagement working group, with 11 respondents, and the third largest came from the Immersive Experiences working group, with 10 respondents.



Figure 1: Count of Self-Assessment Responses by Working Group for Q1, Q2, Q3 and Q4



For the most recent administration, a total of 49 respondents indicated that they were engaged in a change activity at the time they participated in the survey. As shown in Figure 2, one-third of the change activity responses in Q4 came from the Faculty-Student Engagement working group. Asked about the change activities in which they participated, most respondents highlighted their work in their working groups, in student group or club activities, and in summer immersive experiences.

Table 4 provides an overview of the distribution in respondents' responses across the last two administrations. For the most recent administration, 19



#### Figure 2: Percent of Self-Assessment Responses by Working Group for Q4

of the 24 respondents who reported that they had engaged in change activities identified several areas of change activity. Member responses reflected efforts to engage faculty, students, or both through PDSA efforts. Most of the respondents highlighted their efforts in their working groups, in student group or club activities, and in summer immersive experiences. Specifically, student summer activities including immersive experiences was rated at the top of the list for most commonly mentioned change activities. "I am helping with the change ideas of summer immersion and the student leadership group as a whole," one participant noted.

Enrollmont Status		v 2019	April/M	lay 2020
Enrollment Status	Ν	%	Ν	%
Yes, participated in change activity	10	30%	24	49%
Student Experience	3	30%	11	46%
Working Group PDSA Involvement	-		2	8%
Professional Development and Faculty Engagement	3	30%	3	13%
Capacity Building	3	30%	1	4%
COVID Issues	-		2	8%
No Comment Provided	1	10%	5	21%
l don't know	16	49%	13	27%
Νο	7	21%	12	24%

## Table 4. Respondent Change Activity Status

Of the 24% of respondents who indicated no participation in a change activity during Q4, a few commented that they had limited involvement in the working group or had no time to devote to working group activities. Similarly, approximately 21% indicated no involvement in change activities during Q3. As one such Network member explained, "I am currently on a sabbatical, so I had no current classes and limited interaction with the club.... Preliminary discussions were



held with the students, but of course around spring break the pandemic changed plans, so the change activity will be postponed to the fall." More than a quarter (27%) responded, "I don't know" when asked whether were participating in a change activity. Most respondents who selected this response option were student members who were unsure of what constituted a change activity. Said one student member, "I'm not really sure what my role as student is within this working group. To really be participating in anything."

#### 2.4.2. Working Group Self-Assessment Ratings by Quarter

The Evaluation Team analyzed working group self-assessment ratings across the following quarters: May 2019 (Q1), July 2019 (Q2), October/November 2019 (Q3) and April/May 2020 (Q4). For this analysis, we calculated mean scores for each dimension. The resulting dimension means represent the extent to which Network members rated each dimension as a strength or as a weakness in their working groups using a scale of 1 = This is a weakness for our working group to 5 = This is a strength for our working group. Thus, a score of approximately 3.5 - 4.5 represents more of a strength than a weakness and a score of 1.5 - 2.5 represents more of a weakness than a strength. Respondents were also given the opportunity to select a *not applicable* response option; such responses are excluded from this analysis.

Across Q1, Q3, and Q4, working group members rated four of the eight key dimensions as more of a strength than a weakness: Collaborate, Disseminate, Equity and Building Capacity (see Figure 3). In fact, respondents rated these four dimensions consistently more highly than the PDSA cycle dimensions of Plan, Do, Study, and Act—with the exception of Q2 mean ratings for Disseminate and Equity. Within the Equity dimension, the lowest-rated item for the Q2 period, *working group focuses attention on policies, practices, and culture that are reinforcing patterns of inequity in the state*, may reflect the ongoing challenges during that time of recruiting a diverse pool of participants. As one respondent put it, "We are WVU-heavy." In terms of the Q2 Disseminate dimension, Q2 represents the summer months for students, faculty, and staff. Given the summer challenges associated with student and faculty schedules (e.g., end-of-semester activities such as final exams and graduation, students and faculty may leave campus for vacations or work), the low Q2 mean may reflect difficulties associated with dissemination during a particularly busy time on campuses. Overall, Q2 to Q3 showed the largest improvements in mean scores across the year. The highest mean rating across all four quarters was for Collaboration during Q1, with a mean of 4.7.





Figure 3. Average Dimension Ratings by Quarter

For dimensions of Plan, Do, Study, and Act, members gave the highest ratings to the Plan cycle. Respondents gave consistently higher ratings in the final half of the year, Q3 and Q4 (3.8 and 3.6) compared to Q1 and Q2 (3.5 and 3.3), representing working group activity and growth in the clarification of the problem and identification of the improvement to test cycles, according to Plan subscale items. By Q3 and Q4, respondents also reported growth in the Do, Study, and Act phases of the PDSA cycle.

In the following subsection, we examine means associated with items in each dimension. Due to smaller sample sizes in Q1 and Q2, Q1 and Q2 responses will be excluded from growth comparisons—except for the Plan, Do, Study, and Act dimensions associated with PDSA cycles, with Q1 serving as a baseline against which to asses change. For the following analyses, responses of 1 = This is a weakness for our working group and 2 = This is more of a weakness than a strength for our working group will be combined to indicate that the item is a weakness. Responses of 4 = This is more of a strength than a weakness for our working group and 5 = This is a strength for our working group will also be combined to indicate that the item is a strength. Responses of 3 = This is neither a weakness nor a strength for our working group will remain the same.

#### **Collaborate Dimension**

We compared working group members' assessments across four quarters of their working groups' strengths and weaknesses in terms of the Collaborate dimension, which included eight items (see Figure 4). The largest strength of the Collaborate dimension was *Working group members recognize and respect one another's perspective*, with 82% of respondents indicating that this was a strength in Q3 and 100% reporting this in Q1 and again in Q4, reflecting a growth of 18 percentage points from Q3 to Q4. The second most important strength was *The working group ensures that student perspectives are considered*, with 77% reporting this to be a strength in Q3 and 88% reporting so in Q4, representing an increase of 10 percentage points; this was also a strength in Q1 and Q2. Notably, there was a growth from Q1 to Q4 in *The* 



working group establishes routines that promote collaborative decision-making and guard against power imbalances, with 73% to 93% of member agreement. Overall, in five of the eight Collaborate items, mean ratings improved between Q3 and Q4. One item, *The working group members represent the demographic and geographic diversity of our state*, stayed the same at 77% of respondents indicating this item to be a strength. One item—*The working group includes STEM professionals who were rural, first-generation students*—slightly declined between Q3 and Q4, although 95% of respondents in Q4 indicated it was still a strength. The remaining item showed minimal or no change from Q3 to Q4, with 93% of working group members indicated they meet regularly.



4% 86% 27% 73% 23% 73% 73% 73% 73% 73% 77% 77% 71% 71% 71% 71% 71% 71% 73% 73% 73% 73% 73% 73%	0% 14% 76% 4% 86% 100% 100% 95%	27% 100% 73% 85% 85% 83%	100% 91% 23% 77% 88%	4% 86% 86% 55% 55% 55% 73% 73% 33% 93%	100% 18% 9% 73% 23% 77% 87%	100% 81% 82% 110%
Q1 Q2 Q3 Q4 Q1 Q2 Q3 The working group members represent the demographic and geographic diversity of our state.	Q4 Q1 Q2 Q3 Q4 pup The working grou includes STEM professionals who were themselves rural, first- generation students.	Q1 Q2 Q3 Q4 The working group members meet together regularly.	Q1 Q2 Q3 Q4 The working group ensures that student perspectives are considered.	<ul> <li>Q1 Q2 Q3 Q4</li> <li>The working group establishes routines that promote collaborative decision-making and guard against power imbalances.</li> <li>A strength</li> </ul>	Q1 Q2 Q3 Q4 The working group members establish norms of interaction that support collaborative decision-making and equitable participation in all phases of the work.	Q1 Q2 Q3 Q4 The working group members recognize and respect one another's perspectives and diverse forms of expertise.

Note: Percentages may not equal 100% due to rounding.

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#### Figure 4. Collaborate Dimension Strength Levels by Q1 (N=7), Q2 (N=11), Q3 (N=22), and Q4 (N=42)



Respondents were also asked to describe what policies, organizational structures. environmental factors, events, or other issues do (or could) support the dimension of Collaborate. More than half of respondents (31 of 49) provided a response in Q4. Nearly onethird of those respondents (10 out of 31) discussed the necessity of working as a team. We coded comments into seven themes: (1) working as a team, (2) need more involvement, (3) strong leadership, (4) organization, (5) roles and responsibilities, (6) scheduling challenges, and (7) respecting other voices. Examples of comments organized under each of these themes are presented in Table 5. Respondents' answers indicated stronger leadership, communication, and organization, as compared to this time last year. Despite scheduling conflicts mentioned as a challenge, one respondent noted that "regular meetings help keep everybody in touch about the process." Another respondent mentioned the importance of incentivizing student and faculty leadership roles. While most respondents discussed satisfaction with the group collaboration, a few had mixed feelings. One respondent reported, "I feel a little lost sometimes as to what we're currently working on. I understand the larger goals, but don't completely understand how we're getting there." Another member shared, "There seems to be a lack of organizational structure information inside the group...lack of communication."



# Table 5. Sample Comments about Collaboration Efforts in Working GroupActivities for Q4

Торіс	Collaboration Comments
a. Working as a team	Open, free, diverse opinions and expertise add perspectives and keep focus aligned with strong impetus on students and needs.
	Collaboration has been an intrinsic part of the culture of the WG [working group] from the start. This is a shared value.
	The fact that we are all from other areas and schools helps up bring compromise and ideas to the table. It fosters a lot of thinking.
b. Need more involvement	We also need more buy-in from more people and institutions. Maybe it's just the summer, but we only have a small core group who is active.
	It would be great to see more industry leaders involved in this working group to support the group's goal of building industry partnerships and workforce development.
	l would have liked to see more student involvement. There are student members of the group, but had little interaction with them during our faculty/student working group
c. Strong	Good leadership, diversity of members
leadership	We have chairs that make sure the meetings are conducted and all voices are heard. This is a strength, but bad chairs can lead to voices not heard.
d. Organization	They seemed pretty organized. While I cannot attend a lot, when I do, they are always ready to listen to my opinion, too.
	In addition, utilizing technology as a means for communication has been effective as well as setting up an agenda for each meeting by the group leaders.
	We have clear agendas for each meeting, and participation is encouraged and welcomed from each participant. Students tend to attend each meeting, as well as industry reps who are themselves first-gen. Minutes capture the thoughts of each person.
e. Roles and	separate some roles and ensure that more work gets spread out amongst more members.
responsibilities	I wonder if we should formalize additional roles in the working group, i.e., in addition to the co- chairs, maybe we could have an "outreach" person who is in charge of reaching out to new members, a NILS person, a liaison for coordinating with other working groups.
f. Scheduling challenges	Everyone is busy. It is sometimes harder to ask people to do things outside the meetings unless they are directly resourced by the grant.
	Time, time, time I just never seem to have the necessary time to focus on this it shouldn't be extracurricular, but it is.
g. Respecting other voices	Some [members] often have bias towards some colleges over others. I feel left out of the discussion most of the time when they focus mainly on WVU
	Some campuses do not have as much representation as others, making their voices a little less heard/important, but we are working to ensure everyone is included.
	Experience from the pilot project and hearing voices from administrators and students involved in the pilot project were very helpful and supportive of the group's efforts.

#### Plan, Do, Study, and Act Dimensions

As indicated earlier in this report, working groups have 53 documented PDSA reports. To examine the extent to which PDSAs are progressing, respondents were invited to rate items associated with each PDSA phase. Longitudinal data are presented in the figures following (Q2 and Q3 are excluded from some analyses due to very small sample sizes).

For the **Plan** phase, ratings on all items increased between Q1 and Q4, with one exception (see Figure 5). Whereas 33% of respondents reported that their working group *makes decisions about PDSA measurement that balance rigor and feasibility* in Q1, only 29% did so by Q4. *The working group agrees to focus upon a shared aim* was consistently rated as a strength across all three quarters, with 71% rating it as a strength in Q1, 86% in Q3, and 82% in Q4.





Note: Percentages may not equal 100% due to rounding.

#### Figure 5. Plan Dimension Strength Levels in Q1 (N=6), Q3 (N=13), and Q4 (N=22)



Members described their experience in the working group as time-consuming, but worthwhile, when responding to the question *What policies, organizational structures, environmental factors, events, or other issues do (or could) support this dimension of collaboration?* One respondent commented, "Individual members have been using PDSA cycles successfully." Another member discussed planning and engaging students in activities but had limited success in PDSA documentation. Some members described ways to improve upon the planning, use, and documentation for their PDSA change activity efforts:

- "Maybe more time in meetings to work on specific PDSA cycles rather than having everyone do them on their own."
- "Integrating fishbone and driver diagrams and making resources easier to access."
- "Strategic plan for the organization will help our working group."
- "We need to involve adultier adults at each institution to better partner with our student leaders (on campus and in hometown high schools)."
- "More training in assessments and measurements as well as surveys to those involved in running PDSAs."

Members acknowledged the value in integration of student members in working group activities. However, some reported that there are still challenges with promoting student engagement and voice within the PDSA planning cycle. Two comments from members reflected this view:

- "... with so many students, it's hard to keep everyone engaged if they don't have an active role or doing something tangible."
- "Keeping the work of students separate from the work of others in this network could possibly diminish the possible returns of student work."

Several respondents noted that participation in the working group activities was limited by the COVID-19 pandemic. As one such respondent noted, "Current issues with COVID cause a major shift in instructional design and reevaluating PDSA." Given that the pandemic persists, working groups continue to adjust. Another Network member decried "faculty members who are too overcommitted and who are being pulled in too many different directions and the COVID-19 pandemic."

Asked to rate the strength of aspects of the **Do** phase of PDSAs, ratings for all items but one improved between Q1 and Q4 (see Figure 6). Half (50%) of respondents reported that *The working group helps participating institutions implement improvement strategies for addressing problems of practice* was a strength in Q1, compared to 45% in Q4. The largest ratings increase was associated with *The working group uses PDSA forms to record expected outcomes of each improvement strategy implements*, with 33% of respondents indicating this was a strength in Q1 and 80% reporting this to be the case by Q4





Note: Percentages may not total 100 due to rounding.

Figure 6. Do Dimension Strength Levels in Q1 (N=6), Q3 (N=9), and Q4 (N=22)



Invited to discuss how the Do phase might be supported, some respondents agreed that attending in-person meetings "was especially beneficial to forward momentum and support of working group efforts." Others praised the support received from the Measurement Team to implement PDSA cycles. Overall, comments were positive about active members being engaged and providing support to one another.

When asked about the challenges to the Do phase, members mentioned time and additional support. As a few explained:

- "Unable to complete PDSAs cycle or repeat them due to time, funding, or effort."
- "For 'Do' ideas that require participants outside of the proposing faculty or collaborative group, finding groups or participants (particularly students) to help engage or assist with data collection can be difficult due to time commitments."

Another respondent discussed the effort put forth by the Network to support effective PSDAs but noted that a lack of consistency in assessment strategies "was frustrating and discouraged active participation towards these measures."

For the **Study** phase of PDSA working group activity, few respondents in Q2 and Q3 indicated that they could provide feedback; as a result, analysis is limited to Q1 and Q4. Figure 7 shows that between Q1 and Q4, the percent of respondents reporting that *The working group shares findings in ways that take into account the needs of the Network and its members* increased from 40% in Q1 to 70% in Q4. On the other hand, the percent of respondents indicating that *The working group analyzes data collected about improvement strategies and compares them to projections developed in the Plan step* declined from 60% to 30% between Q1 and Q4.



<u>Note:</u> Percentages may not total 100 due to rounding. \*Represents a variation in the number of respondents: Q1 (N=6)

#### Figure 7. Study Dimension Strength Levels in Q1 (N=5) and Q4 (N=10)

Asked to elaborate on the ratings, members believed that support from the Measurement Team would help them better utilize this phase appropriately. In fact, one member shared, "The data analysis group will be a big help with this," while another suggested, "I think it would help us to have a protocol for "study" period – a way that we report across the network … we are missing a lot of possible data capture and aren't sure which foci would most help the network expand. We'd benefit from guidance here."

In terms of supportive factors for the implementation of this phase, respondents described a need for increased guidance and support in understanding what "would most help the network expand." Another member described the desire to connect with other student group or club faculty members to "share ideas of what worked and did not work." This respondent continued, "I think this is particularly valuable given COVID-19 circumstances and how we may be able to help navigate."

In terms of the **Act** phase of the PDSA cycles, ratings for three of the four items associated with this subscale improved between Q1 and Q4 (see Figure 8). For example, whereas 40% of respondents indicated that *The working group iteratively tests what related processes or supports are needed to ensure that effective improvement strategies produce improvements reliably* was a strength in Q1, 60% did so by Q4. One item was rated similarly in Q1 and Q4, with 60% of respondents reporting in both quarters that *The working group determines whether the improvement strategy being tested should be adopted, adapted and re-tested, or abandoned* was a strength.



### Figure 8. Act Dimension Strength Levels in Q1 (N=4), Q3 (N=6), and Q4 (N=12)

Asked to discuss what might support effective execution of this phase, members noted the importance of "having the support of the Measurement Team." This respondent continued saying, "[They] helped me pivot the goal of my PDSA to be more meaningful." For another such



respondent, success came from "members who support each other and share results, surveys, etc., so that others can learn from and adapt from what others in the group have done."

Invited to discuss the challenges associated with implementation of the Act phase, half of respondents mentioned lack of participation or engagement from a variety of members and institutions. Two respondents discussed respecting time of all members, especially student members. One person shared how "spending too much time focusing on certain things and not getting to the agenda" can limit progress towards goals.

#### **Disseminate Dimension**

Due to small sample sizes, data for Q1(N=4) and Q2 (N=1) are not included in this analysis of the Disseminate dimension. As shown in Figure 9, the most highly rated strengths in this dimension were *The working group contributes to Network dissemination efforts* and *The working group shares results in ways that take into account the needs of relevant audiences*. Nonetheless, ratings for these two items declined between Q3 and Q4 (100% to 86% and 93% to 86%, respectively).

The percent of respondents rating *The working group develops and shares new tools and/or routines that can be adapted to support improvement work in other settings* as a strength also decreased between quarters (from 85% in Q3 to 57% by Q4). The reasons for this decline are unclear, but it can be noted that two fewer respondents rated this item than rated the other three items in the Disseminate dimension. As one respondent wrote, "I think we do a good job of this in the working group, but less so to the network at large; streamlining the network portal might help." The percent of Network members rating the remaining item (*The working group develops and shares knowledge and theory that furthers the research base*) as a strength increased slightly between Q3 and Q4 (from 57% to 60%).



Note: Percentages may not equal 100% due to rounding.

\*Represents a variation in the number of respondents: Q3 (N=8) and Q4 (N=13)

Figure 9. Disseminate Dimension Strength Levels in Q3 (N=7) and Q4 (N=14)



Most members commented positively about their dissemination efforts, identifying a variety of supportive factors. For example, several members shared examples of their progress toward reporting and dissemination. According to one such respondent, "Several different members were to have presented and one member has initiated the writing of a publication." Another respondent added, "We've had guest speakers at our meetings, which has helped us share ideas and learn from other organizations." Several respondents reported relying on the support from the Steering Committee to provide stipends for travel, conferences, and "willingness of steering committee to do presentations to interest groups." Other dissemination supports included working group members sharing information about the progress of PDSA cycles and assisting each other with Institutional Review Board (IRB) submissions. Overall, respondents described differing levels of dissemination but nonetheless reported that the Network supported such efforts.

A few respondents suggested that the increased necessity of communicating online resulting from public health recommendations to social distance during the COVID-19 pandemic has led to greater dissemination efforts. As one such member shared, "Going virtual has actually helped with dissemination as well. Far more people could join our conversation than if it were in person. The potential for virtual breakout rooms also seems promising."

Other respondents, however, viewed the turn to virtual communication as a factor that challenged dissemination efforts. Several below reflect these views:

- "Several presentations at nationwide venues were canceled due to the pandemic."
- "COVID-19 has slowed many dissemination efforts, particularly a pretty big change idea we had, which was the collaboration with WV Academy of Science to bring presenters together for a series of talks and workshops on initiatives for STEM success."
- "COVID-19 ... hampers our ability to meet with interest groups and for student clubs to meet. We really have to rethink how we do this ..."
- "COVID-19 put a damper on sharing of results with statewide and nationwide audiences. W.G. [working group] members have shared about their in-progress or potential PDSA cycles. W.G. members have helped each other with IRB submission."

#### **Reflect on Equity Dimension**

As shown in Figure 10, respondent ratings for only one of the three items associated with the Reflect on Equity dimension increased over time (Q2 data are excluded from this analysis due to a small sample size). By Q4, 81% of respondents reported that *Working group activities take into account members' work demands and roles in their respective organizations*, compared to 75% in Q3, and 67% in Q1.

However, ratings declined steadily between Q1 and Q4 for the remaining two items in the Reflect on Equity dimension: *develops targeted strategies that specifically and differentially take into account underlying advantages that some people have, as well as challenges that other groups face* (falling from 100% agreeing that this was a strength in Q1, to 88% in Q3, and 68% by Q4) and *focuses attention on policies, practices, and culture that are reinforcing patterns of inequity in the state* (declining from 100% in Q1 to 88% in Q3 to 70% in Q4).



While ratings of the Reflect on Equity dimension decreased over time, several Q4 respondents noted that this dimension was, as one put it, "a work in progress." Another such member pointed directly to continued efforts to engage "faculty and students from many institutions throughout the state."



Note: Percentages may not equal 100% due to rounding.

## Figure 10. Reflect on Equity Dimension Strength Levels in Q1 (N=6), Q3 (N=8) and Q4 (N=21)

Additionally, members voiced some concerns about awareness of people not participating in the First2 Network. As noted by one respondent in Q3, "We need to more openly discuss those facing adversity by bringing them to the table." Although more respondents reported that reflecting on equity was a strength than reported it was a weakness, none provided any comments about factors supporting this dimension when invited to do so and only six shared comments about challenging factors. Among those who responded to the prompt about supportive and challenging factors, a few agreed that more efforts should be made to engage "more underrepresented groups." Several also identified a challenge overcoming power disparities with members who have more leadership, time, or authority in the working group. As one member shared, "It's easy to first give the most agency to those who deliver... but they are often those with most privilege – better outcomes from those who have fewer barriers...? I don't know how to find this balance, honestly." Another respondent cited institutional size and power as a challenge: "There is a heavy leaning of larger institutions in the working group, so most of the ideas and dissemination are oriented that way, which sometimes can make those at smaller institutions who are doing some of these things already feel left out."

Several other respondents suggested that working group members should reflect on their own biases to promote awareness. A few comments that reflect this area of struggle include:



- "I just feel like there needs to be some inner self-evaluation regarding equity. Again, often I feel left out in discussion and I feel like WVU gets the most time to speak and prosper."
- "I think we need more awareness of the equity issues that might be affecting our group."

#### **Build Capacity Dimension**

A majority of respondents indicated that efforts to build the capacity of First2 Network members and the organization were a strength. Specifically, Figure 11 shows that in Q4 respondents' strength levels were similar (within 5 percentage points) to Q3 on two items: working group members develop professional identities that value engaging in sustained collaborative inquiry with one another to address problems of practice (80% and 75%) and assume new roles and develop the capacity to conduct Network activities (73% and 79%). For the remaining three items, the percent of respondents rating these as strengths declined over time. The largest decrease from Q3 to Q4 was 24 percentage points (*The working group establishes conditions in participating institutions that lead to sustained impact beyond the life of the Network*). Nonetheless, this represents an increase of eight percentage points since Q1.





Note: Percentages may not equal 100% due to rounding. \*Represents a variation in the number of respondents: Q4 (N=23)

#### Figure 11. Build Capacity Dimension Strength Levels in Q1 (N=6), Q3 (N=7) and Q4 (N=24)

Asked about factors that support capacity building, Q3 respondents noted efforts made by working group members—especially students—to build network capacity. Said one such member, "Student members of this group have stepped up and made positive in-roads in the building capacity plans for this group." Q4 respondents reported increased satisfaction about the adjustments to create "manageable expectations" of working group member involvement. Several respondents also indicated that there are or should be working group efforts to recruit new members. These comments are shown below:

- "Faculty are interested and want to be involved. They care."
- "More outreach to grant officers on their perspective campus to help find ways to create sustainable grants and funds for First2 to proceed with."
- "Working groups provide an opportunity to get to know many more people and groups, which helps lead to new partnerships."

In terms of challenging factors, two members suggested there still exists some uncertainty around how to get involved in student-led outreach efforts. As a result, student work may not be acknowledged or valued as much as the work of other members within the working groups. As one member shared, "Other working groups might not be aware of how they can join in [student] work, or otherwise wrap our student leaders in support." One suggestion for improvement included providing a description of working group roles in an accessible area of the portal so new and current members can access it. Some additional concerns noted include:

- "Uncertainty of time and capacity of existing members."
- "... how to resource more people to help build capacity."
- "... that members can convince institutions to sustain First2 immersive experiences after funding."

#### 2.4.2. Working Group Self-Assessment Summary

The number of respondents to the Working Group Self-Assessment continued to grow, from eight respondents in Q1 to 49 in Q4. Twice the number of respondents reported Do, Study, Act, and Disseminate dimension strength levels in Q4 as compared to Q3. For the Collaborate, Equity, and Build Capacity dimensions, there was at least a 40% increase in responses between Q3 and Q4. This increase suggests that more First2 Network members are engaging in working group activities.

While mean ratings of the eight dimensions of working group focus did not change dramatically between Q3 and Q4, decreases in the percent of respondents rating individual items associated with each dimension as a strength provides some insight about opportunities for improvement. For example, although overall mean ratings of the Reflect on Equity dimension were only slightly lower in Q4 than they were in Q1, the percent of respondents indicating that *The working group develops targeted strategies that specifically and differentially take into account underlying advantages that some people have, as well as challenges that other groups face declined from 100% in Q1 to 68% by Q4. Similarly, whereas 100% of respondents reported that <i>The working group focuses attention on policies, practices, and culture that are reinforcing* 

patterns of inequity in the state was a strength in Q1, by Q4 only 70% did so. The percent of respondents rating several individual items as strengths in the Collaborate dimension declined somewhat over time: The working group includes rural first-generation students; The working group ensures that student perspectives are considered; and, The working group members establish norms of interaction that support collaborative decision-making and equitable participation in all phases of the work. Several items in the Disseminate dimension were also less likely to be rated as strengths over time, including The working group contributes to Network dissemination efforts; The working group shares results in ways that take into account the needs of relevant audiences; and, The working group develops and shares new tools and/or routines that can be adapted to support improvement work in other settings.

## 2.5. Steering Committee Surveys

Administered in March 2019, March 2020, and June 2020, the Steering Committee Survey asks members of the Steering Committee to rate the status of Steering Committee progress in terms of 22 statements about Steering Committee functions, processes, and results. Four open-ended items solicit feedback from respondents about what works well on the Steering Committee, what issues the Steering Committee is facing, and how Steering Committee processes and structures could be improved.

Using a scale of 1 = *Not started;* 2 = *Beginning/early stage;* 3 = *Making progress;* and 4 = *Fully achieved*, Steering Committee members reported consistent improvements in progress between March 2019 and June 2020 in terms of nine statements about the Steering Committee (see Table 6). By June 2020, the highest rated statement about the Steering Committee was *The Steering Committee meets sufficiently regularly* (with a mean of 3.91), although even in March 2019 this was the most highly rated item. In June 2020, the lowest rated items were *The Steering Committee has developed a clear vision for the First2 Network* and *Steering Committee members have a clear understanding of the Network's next steps*, both with means of 3.18. Nonetheless, given that a rating of 3 indicates that the Steering Committee is making progress, such a score is not cause for concern.

The largest mean rating increase, indicating the area in which the most progress was achieved, was for the item *Communication within the Steering Committee is constructive*. The mean rating for this statement increased by 0.91 points, from 2.91 in March 2019 to 3.82 by June 2020; this improvement also achieved statistical significance at the .05 level. Also achieving statistical significance was *The Steering Committee provides oversight and governance of the First2 Network*, mean ratings of which increased by 0.72 points, from a mean of 2.73 in March 2019 to 3.45 in June 2020.



	March 2019		March 2020				June 20	March 2019- June 2020		
	Ν	Mean	SD	Ν	Mean	SD	Ν	Mean	SD	Change
The right people serve on the Steering Committee.	11	3.27	.647	13	3.31	.480	11	3.36	.505	+0.09
The Steering Committee meets sufficiently regularly.	11	3.91	.302	13	3.77	.439	11	3.91	.302	0.00
The Steering Committee has developed a clear vision for the First2 Network.	11	2.82	.405	12	3.17	.577	11	3.18	.603	+0.36
The Steering Committee provides oversight and governance of the First2 Network.	11	2.73	.647	13	3.46	.776	11	3.45	.522	+0.72*
The Steering Committee has agreed upon a decision-making process.	11	2.91	.701	13	3.38	.870	11	3.45	.820	+0.54
Steering Committee members trust each other.	11	3.27	.647	13	3.46	.660	11	3.64	.505	+0.37
Communication within the Steering Committee is constructive.	11	2.91	.701	12	3.42	.669	11	3.82	.405	+0.91*
Steering Committee communications are timely.	11	3.09	.831	13	3.23	.599	11	3.27	.647	+0.18
Steering Committee members have a clear understanding of the Network's next steps.	11	2.64	.505	13	2.77	.599	11	3.18	.751	+0.54

#### Table 6: Mean Year 2 Ratings on Steering Committee Survey Items, Part I

\*Significant at the .05 level of statistical significance

Steering Committee members were also asked to rate progress on 13 items concerning their Steering Committee roles, using the rating scale of 1 = *Not started*; 2 = *Beginning/early stage*; 3 = *Making progress*; and 4 = *Fully achieved*. As shown in Table 7, all mean ratings increased between March 2019 and June 2020, with the increase associated with four items reaching statistical significance. These items include *In my role as a Steering Committee member*, *1... Help the Network determine how to coordinate the work of Improvement Teams* (an increase of 0.82 points), *Keep abreast of working group activities* (an increase 0.74 points), *Help the Steering Committee determine how to track the Network's progress* (an increase of 0.67 points), and *Understand the responsibilities associated with my Steering Committee member*ship (and increase of 0.56 points).

In June 2020, the highest mean ratings—indicating that the items were fully achieved or almost fully achieved were for *In my role as a Steering Committee member, I…Lead a working group* (mean = 4.00) and *Champion the First2 Network by communicating with others in the state and elsewhere about its work* (mean = 3.75). The lowest mean rating in June 2020 was 3.00 for the items *In my role as a Steering Committee member, I…Help the Network determine how to coordinate the work of Improvement Teams* and *Help the Network determine how to coordinate the new knowledge that working groups generate.* Nonetheless, this mean score on the 4-point scale indicates that respondents perceive progress occurring in both instances.



	March 2019			March 2020			,	June 20	March 2019- June 2020	
In my role as a Steering Committee member, I	Ν	Mean	SD	Ν	Mean	SD	Ν	Mean	SD	Change
Understand the responsibilities associated with my Steering Committee membership.	11	3.00	.447	13	3.38	.650	9	3.56	.527	+0.56*
Lead a working group.	11	3.36	1.362	9	3.78	.441	6	4.00	.000	+0.64
Keep abreast of working group activities.	11	2.82	.603	13	3.92	.277	9	3.56	.527	+0.74*
Keep up to date on what working groups are learning.	11	2.73	.467	13	3.23	.439	9	3.22	.667	+0.49
Help the Network determine how to coordinate the work of Improvement Teams.	11	2.18	.874	11	2.82	.603	9	3.00	.707	+0.82*
Help the Network determine how to coordinate the new knowledge that working groups generate.	11	2.27	.905	13	3.00	.577	10	3.00	.667	+0.73
Help make decisions about the direction of the Network.	11	3.09	.701	13	3.54	.519	8	3.38	.518	+0.29
Help make decisions about the processes the Network uses to conduct its work.	11	3.09	.701	13	3.31	.630	8	3.50	.535	+0.41
Help to keep Network members accountable to one another.	11	2.91	.539	12	3.00	.603	9	3.22	.667	+0.31
Help the Steering Committee determine how to track the Network's progress.	11	2.73	.647	13	2.85	.689	10	3.40	.699	+0.67*
Contribute to decisions about how to onboard new First2 Network members.	11	2.64	.924	13	3.00	.577	11	3.36	.809	+0.72
Help to onboard new First2 Network members.	11	2.64	1.027	12	3.17	.577	10	3.20	.919	+0.56
Champion the First2 Network by communicating with others in the state and elsewhere about its work.	11	3.36	.505	13	3.85	.376	8	3.75	.463	+0.39

#### Table 7: Mean Year 2 Ratings on Steering Committee Survey Items, Part II

\*Significant at the .05 level of statistical significance

On the final portion of the survey, respondents were asked to reply to four open-ended questions about their perceptions of the Steering Committee's progress to date. Comparative thematic analysis of responses to these questions over time suggests that Steering Committee perspectives on progress have shifted since Year 1. When asked to describe what is working well on the Steering Committee in March 2019, most respondent comments referred to dedicated members, group cohesion, and early progress in establishing First2 Network processes. By June 2020, most member replies lauded the Steering Committee's well-organized, constructive meetings that include regular updates from working groups.

The second open-ended question asks respondents to discuss the issues the Steering Committee faces at the moment and how such issues are being addressed. Replies from the Network's first year focused on too many or inefficient meetings, feeling overwhelmed by Network commitments, uncertainty about issues of Network governance, and tension about unresolved problems. Comments on the June 2020 survey, however, cited the need to improve



knowledge management and ensure a strong connection between working group efforts and the core Network aim of improving STEM persistence, and the need to become more strategic by planning for sustainability and focusing on the most important issues rather than operational details. This difference in comments suggests that, whereas the Steering Committee was concerned about startup issues during Year 1 (such as member burnout, as-yet undetermined governance procedures, and competing demands), by Year 2 the Steering Committee was able to focus on longer-term issues such as sustainability and how to maximize Network learning.

The third open-ended item on the survey asks respondents how Steering Committee processes and structures could be improved to ensure that it achieves its goals. Replies to this question in March 2019 focused on clarification of the Steering Committee's role and the establishment of a Leadership Team for operational purposes, more streamlined communication, and improved meeting efficiency. In June 2020, however, some issues persisted. Communication about Network activities and learning was key to one respondent, who wrote

It will be good if the Steering Committee reports, etc. can feed into the comprehensive communication plan, especially to members inside of our network, including students. There should be a better report out from Steering Committee to the larger network, and a way for the larger network to ask questions or know how to interact with the Steering Committee, including students.

Similarly, according to another respondent, some governance and procedural issues were still unresolved: "Really clarifying the by-laws would help. And that is a role for LT [Leadership Team]. We don't even have a clear process for starting a working group, or for maintaining the membership list somewhere easy to see and update. Stronger minutes process would help also, with clear action items." Role clarity remains an issue for another Steering Committee member, as does the need for a clear onboarding process and material for another respondent.

The final survey item prompts Steering Committee members to share any additional information about which the survey did not ask. In March 2019, four respondents reported that the First2 Network and the Steering Committee had potential to generate important outcomes, and three respondents noted issues with overwork and burnout. In June 2020, only three members replied, but all three comments were positive, two praising the work of the Steering Committee in keeping the Network "on track" and for its "hard work and leadership," and one stating that "the support from backbone in the last six months has been a tremendous boon to the Steering Committee and the Network."

### 2.5.1. Steering Committee Survey Summary

In sum, data from this survey suggest that members have observed considerable and consistent progress over time in the work of the Steering Committee. Although some governance and operational issues remain to be resolved, respondents tended to think that governance and communication had improved since the Network's first year. Steering Committee members also reported that they had fully achieved their role in leading working groups and championing the Network by communicating about it widely to others and were making progress toward achieving goals associated with other Steering Committee roles.



### 2.6. November 2019 Conference Survey

The First2 Network held a fall conference on November 9-10, 2019, at Stonewall Jackson State Park, WV. The first day included an open session for all First2 Network members, and the second day included sessions for working group members. A total of 89 participants were registered for the conference, and 48 participants completed a feedback form for the main conference and 47 participants completed a feedback form for the post-conference sessions.

#### 2.6.1. Main Conference

This feedback form included an agreement scale of 1 (strongly disagree) to 5 (strongly agree) for respondents to rate 16 items. Table 8 presents the response frequency percentages and descriptive statistics (means and standard deviations) for all 16 items, arranged by mean score (highest to lowest). The highest mean rating was 4.45 (standard deviation or SD of 1.00), that participants were enthusiastic about participating in the First2 Network. The lowest mean rating was 3.56 (SD 1.20), that sufficient time was provided for general networking with other Network members.

Respondents were also asked to rate six items (one per session) using a value scale of 1 (not at all valuable) to 5 (very valuable). Table 9 presents the response frequency percentages and descriptive statistics (means and standard deviations) for all six items, arranged by mean score (highest to lowest). The highest mean rating was 4.88 (SD 0.33), for the keynote presentation by Dr. Jenkins. The lowest mean rating was 4.15 (SD 0.94), for the session on how to get involved with the First2 Network.



## **Table 8. Response Option Frequencies and Descriptive Statistics for Agreement Items: Main Conference**

	R	Descriptive Statistics					
[Items are arranged from highest to lowest mean scores.]	(1) Strongly disagree	(2) Disagree	(3) Neither disagree nor agree	(4) Agree	(5) Strongly agree	Mean	Std. Dev.
I am enthusiastic about participating in the First2 Network. (n=47)	4%	2%	4%	23%	66%	4.45	1.00
I accept my responsibilities as a First2 Network member. (n=46)	2%	0%	9%	30%	59%	4.43	0.83
I am committed to doing the work associated with the First2 Network. (n=47)	4%	0%	9%	30%	57%	4.36	0.97
The event was of high quality overall. (n=46)	4%	0%	9%	33%	54%	4.33	0.97
The event included meaningful sessions. (n=48)	4%	0%	10%	29%	56%	4.33	0.98
Participants integrated student input into their discussions about the First2 Network. (n=47)	4%	4%	2%	34%	55%	4.32	1.02
Students were offered multiple opportunities to share their perspectives during the event. (n=48)	4%	2%	10%	29%	54%	4.27	1.03
The event was organized in a useful manner. (n=47)	4%	0%	9%	40%	47%	4.26	0.94
I have an active role in the First2 Network. (n=48)	4%	6%	10%	21%	58%	4.23	1.13
After the event, I have a better understanding of how I can be involved in the First2 Network. (n=46)	4%	0%	20%	33%	44%	4.11	1.02
I understand what my role is in the First2 Network. (n=48)	4%	4%	10%	42%	40%	4.08	1.03
I will be able to apply what I learned in my ongoing involvement with the First2 Network. (n=48)	4%	0%	17%	42%	38%	4.08	0.96
The event goals were fully met. (n=45)	2%	4%	22%	31%	40%	4.02	1.01
My understanding of topics covered during this event improved. (n=47)	4%	4%	19%	34%	38%	3.98	1.07
Sufficient time was provided for participants to share observations and ask questions. (n=47)	4%	17%	19%	36%	23%	3.57	1.16
Sufficient time was provided for general networking with other First2 Network members. (n=48)	4%	19%	21%	29%	27%	3.56	1.20

Notes:

Percentages may not equal 100% due to rounding. The number of individuals who responded to each item is indicated by the  $(n=_)$  notation in each row. -

-The N/A responses were excluded from the frequency percentages and descriptive statistics.



## Table 9. Response Option Frequencies and Descriptive Statistics for Value Items:Main Conference

	R	Descriptive Statistics					
[Items are arranged from highest to lowest mean scores.]	(1) Not at all valuable	(2) Not very valuable	(3) Neutral	(4) Somewhat valuable	(5) Very valuable	Mean	Std. Dev.
Keynote by Dr. Jenkins (n=48)	0%	0%	0%	13%	88%	4.88	0.33
Spotlight (Student Work and Roles) (n=47)	0%	0%	4%	15%	81%	4.77	0.52
Promising Practices Spotlight (n=47)	0%	0%	6%	43%	51%	4.45	0.62
Research (n=46)	0%	2%	11%	30%	57%	4.41	0.78
Welcome, Measurement for Learning (n=45)	0%	2%	16%	40%	42%	4.22	0.80
How to Get Involved with First2 Network (n=46)	0%	7%	17%	30%	46%	4.15	0.94

Notes:

- Percentages may not equal 100% due to rounding.

The number of individuals who responded to each item is indicated by the (n=\_) notation in each row.

The N/A responses were excluded from the frequency percentages and descriptive statistics.

The feedback form also included five open-ended prompts for gathering participants' insights. Brief syntheses are provided below. When asked to identify the high point of the event, 42 participants provided comments, which clustered around two primary themes—student involvement and the keynote presentation by Dr. Jenkins. There were also a few idiosyncratic comments. Sample quotes include:

- "Hearing from the students was very powerful."
- "Getting to talk to everyone as a student about my experiences."
- "The high point of this event for me was the keynote speech made by Dr. Jenkins. Dr. Jenkins offered such powerful advice for all students and educators."
- "Dr. Jenkins' presentation was phenomenal."
- "The venue was great! Conference space, meeting rooms, food breakouts and food quality were much better this time."
- "The time we spent as a working group in NILS. It was the first time I felt like I could navigate the site with some sense of purpose."

When asked to identify what did not go as well, 31 participants provided comments, five of which indicated that all had gone well. By far the most common theme focused on organization, structure, and timing of the conference. Another emergent theme was not attending to students' needs. Sample quotes include:

- "I wish we had more opportunities to ask questions of presenters."
- "The time management."
- "The part that did not work so well for me was that students didn't have much time to complete schoolwork. As STEM students we have a large workload and even though we were promised time to work, very little of that time was seen."
- "We have all of these students, all of whom have real needs for advising and financial aid issues sitting in the same room as folks from their institutions who have those



answers ... but didn't create an intentional space for them to connect with those resources, and we should have."

- "It seemed a bit misinforming. I did not expect some of the events that took place to be so involving. I felt under-prepared to participate in so many in-depth conversations—I am still new to the organization."
- "I am still struggling with the concept of the 'continuous improvement' and what that really means 'on the ground'—like what I do and how I design my research goals/ methods."

Twenty participants identified information that was needed related to their work with the First2 Network. Six of those comments were positive in nature, indicating no additional information was needed. The only common theme that emerged was a few comments about NILS. Sample quotes include:

- "Better use of the NILS site and hub zero; and organization of the shared Google drives."
- "Our group has been lucky to have the tutelage of Erica to guide us through the First2 site and NILS. It is not intuitive, but it can be learned."
- "Future expectations and goals. It wasn't adequately covered."
- "What can I do to get more professors involved?"
- "I need more information about connecting with high schools."
- "How to start First2 Network on other campuses."

Seventeen participants identified support they needed from the First2 Network to become more involved; seven respondents indicated they needed no further support. The remaining comments were all idiosyncratic in nature. Sample quotes follow.

- "Coming from a small school, I feel like some of the solutions won't work for me as they do at MU or WVU; so, I would like some recognition of the role/opportunities/challenges at small schools."
- "I need First2 Network to understand that this is a very big journey for the students. We are trying to find ourselves and find what we want to do with the rest of our lives. A strong morale support group is so important to us."
- "Where and how to find the support?"
- "Guidance and feedback on immersive experience and a previous successful application."

Finally, 17 participants provided additional comments about the conference. Most comments were positive in nature. Sample quotes follow:

- "I really enjoyed meeting with my working group and the students, but I'm not sure if newcomers understood how to get involved."
- "I loved the passion that poured out from every single person at the conference."



- "The event was well-organized, and left us reassured that we would conquer this, we could do this, and we were all struggling on some level but that was okay. We had help if needed."
- "Very fun! Enriching experience for everyone."
- "Please add more breaks and free time for students."
- "Would love more time to network."

#### 2.6.2. Post-Conference

This feedback form included an agreement scale of 1 (strongly disagree) to 5 (strongly agree) for respondents to rate five items. Table 10 presents the response frequency percentages and descriptive statistics (means and standard deviations) for all five items, arranged by mean score (highest to lowest). The highest mean rating was 4.30 (SD 0.79), that the working group reportout session helped participants better understand what was happening across the First2 Network. The lowest mean rating was 3.91 (SD 1.00), that sufficient time was provided for the working group planning session.

## Table 10. Response Option Frequencies and Descriptive Statistics for Agreement Items: Post-Conference

	R	Descriptive Statistics					
[Items are arranged from highest to lowest mean scores.]	(1) Strongly disagree	(2) Disagree	(3) Neither disagree nor agree	(4) Agree	(5) Strongly agree	Mean	Std. Dev.
The Working Group report-out session helped me better understand what is happening across the First2 Network. (n=46)	0%	2%	13%	37%	48%	4.30	0.79
The Networking Time for Working Group members was a productive use of time. (n=46)	2%	0%	13%	46%	39%	4.20	0.83
I increased my knowledge as a result of the SRI session on "The 3 A's of PDSA Cycles." (n=45)	2%	4%	11%	42%	40%	4.13	0.94
During the planning session, my Working Group was able to complete plans for the subsequent report out. (n=46)	2%	9%	13%	44%	33%	3.96	1.01
Sufficient time was provided for the Working Group planning session. (n=47)	0%	17%	2%	53%	28%	3.91	1.00

Notes: - Percentages may not equal 100% due to rounding.

- The number of individuals who responded to each item is indicated by the (n=\_) notation in each row.

- The N/A responses were excluded from the frequency percentages and descriptive statistics.

Respondents were also asked to rate four items (one per each session) using a value scale of 1 (not at all valuable) to 5 (very valuable). Table 11 presents the response frequency percentages and descriptive statistics (means and standard deviations) for all four items, arranged by mean score (highest to lowest). The highest mean rating was 4.67 (SD 0.52), for the Working Group Meet to Dive In session. The lowest mean rating was 3.95 (SD 0.92), for the SRI session, Three A's of PDSA Cycles.



Table 11. Response Option Frequencies and Descriptive Statistics for Value	
Items: Post-Conference	

	R	Descr Stati	iptive stics				
[Items are arranged from highest to lowest mean scores.]	(1) Not at all valuable	(2) Not very valuable	(3) Neutral	(4) Somewhat valuable	(5) Very valuable	Mean	Std. Dev.
Working Group Meet to Dive In (Saturday, 4:15) (n=45)	0%	0%	2%	29%	69%	4.67	0.52
Working Group Report-Outs (Sunday, 9:00) (n=46)	0%	4%	11%	41%	44%	4.24	0.82
Networking Time for Working Group Members (Saturday, 7:00) (n=43)	0%	7%	16%	28%	49%	4.19	0.96
SRI Session: "The Three A's of PDSA Cycles" (Saturday, 3:15) (n=41)	0%	7%	22%	39%	32%	3.95	0.92
Notes:							

Percentages may not equal 100% due to rounding.

- The number of individuals who responded to each item is indicated by the (n=\_) notation in each row.

The N/A responses were excluded from the frequency percentages and descriptive statistics.

The feedback form also included five open-ended prompts for gathering participants' insights. Brief syntheses are provided below. When asked what about the post-conference sessions worked well for them, 32 participants provided comments, which clustered around two primary themes—having face-to-face time to meet with their Working Group members and being able to hear about plans from other Working Groups. There were also a few idiosyncratic comments. Sample quotes include:

- "I am so glad we had working group time—side by side—even though we later learned we need to be in NILS to make changes from one computer! To pound out our ideas and wordsmith them to be meaningful is best in a group and we left feeling we could do this part of the grant work (reporting) successfully."
- "Ability to meet with other members in my working group, especially the students."
- "Hearing the plans that the different working groups had for First2 Network made me feel very confident in the direction that the program is going."
- "Hearing from other groups."
- "I loved having a voice as a student and getting to speak during the conference. I also loved getting to meet other students around the state. Lastly, I liked getting tutored by the professors."

When asked to identify what did not go as well, 27 participants provided comments, six of which indicated that all had gone well. Several of the comments clustered around the students, and several others around time. Most of the comments were idiosyncratic in nature. For the student theme, participants expressed concern about overloading students; time-based comments focused on being rushed and presentations going over the allotted time. Sample quotes include:

• "I feel as though the students were very burned out and had a lot on their plate and we needed to address that they have so much more work to do outside of this conference. We need to be more conscientious of their time."



- "I felt so bad for the students that they were so stressed out. It made me question whether we are really helping them."
- "Saturday afternoon working group planning session could have been longer."
- "Too many interruptions while trying to work in groups. Sometimes the student integration is disruptive because it seems last minute. Perhaps planning this in advance would be better for planning. Group Time is sometimes cut short because presentations go over."
- "By Saturday evening, energy levels were rapidly falling especially among those that had been there Friday night. It might have been nice to have a quick session to recruit new members to the working group at the end of the conference. Something like 'Stick around for another 30-60 min, meet members of whichever WG [working group] you're interested in, see what they've been doing and how to get involved.' A short session that wouldn't delay travel too long."
- "Not everyone consistently participated. Some of the Leadership was not present on Sunday morning, for example. It doesn't set a good tone and is noticeable."

Twenty-one participants identified what additional support they needed to carry out their responsibilities as a working group member. Five of those comments were positive in nature, indicating no additional support was needed. The only common theme that emerged was related to technology issues. Sample quotes include:

- "Easier navigation of online resources."
- "Better organization of materials available online."
- "Less focus on PDSAs and more focus on the work and networking."
- "Respect for the amount of time it takes to do things, less pressure to keep adding new PDSAs when we really just need new members who can take on tasks."
- "Stronger network backbone."
- "Help on milestone planning and evaluation of where we are compared to plan and getting ready for quarterly and annual reports."

When asked what their working groups accomplished during the Saturday planning session, 35 participants provided comments. Two themes emerged: work on PDSAs and getting student feedback and input. Sample quotes follow:

- "Verifying measures of PDSAs and sharing with each other."
- "Solidified drivers and change ideas, developed PDSA."
- "Feedback from students on how to prioritize."
- "We as students got to have a voice, and they took advantage of that since they do not get to hear from us much."
- "We learned how to navigate NILS and left with a better idea of how the First2 site was [organized], and Google Drive to helps us prepare and put things in NILS."



Finally, 21 participants identified their key takeaway from the Working Group Report-Out session. Several comments clustered around two themes: the amount of overlap among working groups and that progress is being made. Sample quotes follow.

- "How much overlap there is between WG's and the need for coordination/informationsharing to avoid reinventing the wheel; but I find it hard to work through the online resources to find things."
- "We have common plans with Faculty-Student Engagement and need to work with them on some of our goals."
- "I feel like we made a lot of progress. I have a clear idea of next steps."
- "We are actually getting things done."
- "That many of the high school experiences in West Virginia are not ideal. There needs to be way more support for college readiness from higher authority."
- "I believe our working group left with a better understanding of our milestones, goals, and identified the objectives we must meet to be successful this year."

#### 2.6.3. Event Survey Summary

In sum, participants rated the main conference highly, with 13 of 16 agreement items rated at a 4.0 or above on a 5-point scale. Respondents reported enthusiasm for participating in the First2 Network and were committed to doing the work associated with the Network. Respondents found all of the conference sessions to be somewhat to very valuable. Respondents identified the level of student involvement and the keynote presentation by Dr. Jenkins as the high notes of the conference.

And, respondents rated the post-conference sessions highly, with three of five agreement items rated at a 4.0 or above on a 5-point scale. Respondents reported the sessions helped them understand what is happening across the First2 Network, that sessions were productive, and that they increased their knowledge of PDSA cycles. Respondents found all of the post-conference sessions somewhat to very valuable. Respondents identified having face-to-face time with their working group members and learning about other working groups as top features of the post-conference.

## 3. Systems Targeted by the First2 Network

The First2 Network aims to improve persistence by testing and learning from improvements both at the individual and systems levels. This section discusses early findings about changes in the systems targeted by the First2 Network. Such systems include higher education, K-12 schools, and business and industry. Data from interviews with backbone organization staff, administration of the Network Value Survey, and review of project documents and reports are discussed in the following subsections.



## 3.5. Backbone Organization Interviews

One systems change sought by the First2 Network is the establishment of a sustainable backbone organization for the Network, with the capacity to provide backbone support to other initiatives across the state should the need arise. As noted earlier in this report, backbone organizations provide centralized coordination and support of day-to-day operations and implementation of collaborative work. To build HEPC DSR capacity to serve as the First2 Network backbone organization, the Network employs a dual-backbone model in which another organization provides backbone mentorship and other support to the HEPC DSR team, with a gradual release of responsibility to that team over the course of the grant.

To investigate progress in the development of HEPC DSR capacity to serve as the Network's backbone organization, the external Evaluation Team at ICF conducted individual telephone interviews in June 2020 with five staff from HEPC DSR who have been involved with the First2 Network over the past year (July 2019 – June 2020). Interviews focused on the First2 Network goal of building capacity for HEPC DSR to serve as a sustainable hub or "backbone" organization for the Network.

Interview prompts were organized into three main categories, which is how the findings are summarized below. The first category focuses on the types of capacity-building activities that HEPC DSR staff were involved in over the past year, which activities were most and least valuable in building their capacity, the extent to which the activities met HEPC DSR's needs, and the remaining areas in need of increased capacity for HEPC DSR to serve as a successful backbone for the First2 Network. The second category focuses on the tasks that HEPC DSR staff carried out over the past year in fulfilling its backbone responsibilities, the facilitating and impeding factors, and needed modifications to ensure HEPC DSR has or gains full capacity to serve successfully in this role. The third category focuses on miscellaneous comments that respondents shared about their experience with HEPC DSR serving as the backbone for the First2 Network.

#### 3.5.1. Activities to Build Capacity

#### Capacity-Building Activities/Supports Provided to HEPC DSR

One of the main topics of discussion under this prompt was the reallocation of HEPC DSR staffing (formerly spread across four HEPC DSR staff members) to support one full-time First2 Network program coordinator whose time is dedicated 100 percent to the First2 Network. That position was filled in April 2020. In addition, a new director for the DSR at HEPC was hired in January 2020. Moving forward, a small percentage of time for the new director and a communications manager will be covered by the First2 Network, along with the full-time program coordinator.

In describing the capacity-building activities or supports that HEPC DSR was provided or involved in over the past year, respondents first noted that there had been a staffing change (late 2019/early

And I think now it's much more clear what the role of HEPC is supposed to be, although not 100% clear. It went from like 20% obvious to 70% obvious.


2020) for the staff member of the backbone mentoring organization who had been providing capacity-building support to HEPC DSR staff. Respondents agreed that support had improved over the past year, and several provided explanatory comments, as shown below.

- "It's been a little complicated for us in this role and I think we're in a much better place now."
- "The support seems to be stronger than it was, which is a good thing, and it's definitely helping us figure out what to do in a backbone role."
- "We've still got some more defining to do but I think this past year was really a big step forward."
- "I think things are moving in the right direction finally and I believe the [SRI staffing change] has brought some new I'll call it clarity and new enthusiasm working with the national hub. I think that gives us a better feel for what that mentorship role is and what our ultimate role is as a backbone."

Identified activities and supports include weekly meetings with the backbone mentoring organization, planning for the First2 Network Leadership Team to develop a strategic plan, and participating in mock strategic planning sessions. One individual recognized that as HEPC DSR capacity increases to serve in this role, mentoring support will "naturally sort of taper off." This person added, "At some point, she's going to have to kick the bird out of the nest so to speak and let us run with what we've been discussing."

One staff member also noted attending a Collective Impact Forum backbone workshop, *Champions for Change*, in October 2019 that helped provide more clarity about the role of a backbone and how to function as a backbone organization. During that conference, this interviewee learned about the recommendation for three full-time people to support an organization serving in a backbone role, and this helped inform the HEPC DSR staffing reallocations that occurred over the past year.

# Most and Least Valuable Activities/Supports

All respondents perceived that the staffing adjustments made within HEPC DSR and the backbone mentoring organization were the most valuable in building HEPC DSR capacity to serve as the First2 Network backbone. Regarding HEPC DSR staff changes, interviewees noted that reallocating resources to support a full-time First2 Network program coordinator enabled the project to "get the attention they needed" and that the staffing transitions were "the most significant thing because up until then, for the most part, our division felt very unconnected to the whole project." One interviewee perceived that these staffing changes will lead to more connection within the larger HEPC organization, beyond DSR, which "will be really good for us and the INCLUDES project."



Regarding staff changes within the backbone mentoring organization, interviewees reflected on how the current staff member is "a really great mentor . . . and helps me understand what the role of a backbone organization is" and her

I think it's more than just a change of person. I think there is a whole change in the understanding of what that relationship was supposed to be. It's probably closer to what people imagined now than what it was earlier.

"feedback and facilitation has helped us decide how to move forward." Staff noted that mentor meetings are now more frequent and more in-depth.

Only two interviewees identified least valuable activities or areas that required attention. One noted that the First2 Network program coordinator position was new, so there is not much to draw from about what the role entails. Another individual reflected that the Leadership Team could be clearer "in identifying what needs to be done for the Network to be sustainable" and then "coming up with a mechanism for how this could work."

#### Extent Activities/Supports Met HEPC DSR Needs

Respondents agreed that HEPC DSR's needs were better met this year than the previous year. Several illustrative comments follow.

- "Much better, much better."
- "I think it's a vast improvement over last year."
- "We're in a good place now so that this next year will be a little bit smoother."
- "Much more efficient."
- "Things are improving drastically."

Several respondents perceived that in the previous year there was much uncertainty about the nature of HEPC DSR's role, and staff obligations and time allocations made it difficult to commit

to taking lead on particular tasks. For example, one reflected on how, in the first year, HEPC DSR staff were reluctant to "commit to . . . or didn't take a lead on some things" but that now the full-time First2 Network program coordinator was

We're not in the process of doing the work of the project but making sure that the project is being managed well and getting the resources it needs. More as a real backbone and not just a back office for doing daily stuff.

able to take on those responsibilities. However, this interviewee also noted that "people are still trying to figure out what the roles are" and so at times people might identify tasks as "an HEPC backbone role," to which HEPC DSR is responding, "Well, maybe it is, maybe it isn't." Another interviewee also noted that HEPC DSR now has a clearer understanding of what it should be doing. Several respondents noted that at first, when it wasn't clear who should have responsibility for particular activities, tasks were "dumped" on HEPC DSR, such as conference planning and the collaboration portal. Finally, one individual focused on how there is now a better understanding of the First2 Network throughout DSR, which is "really important when you're talking about building the Network and being the sustainable backbone organization."



### Remaining Areas of Need to Build HEPC DSR Capacity

HEPC DSR interviewees provided a variety of remaining areas of need; five areas were mentioned by two individuals each and the remaining areas were idiosyncratic in nature.

Two staff identified the need for more integration of the First2 Network across HEPC. According to one individual, "We're just beginning to reach out and make connections with other stakeholders in HEPC who could be of great benefit to the project." Similarly, another noted the intent "to bridge that gap that's always been there [between DSR with the larger HEPC entity]. Even though it may not be officially part of First2, it's totally part of our long-term sustainability as a backbone once the project is over. We need those connections. If HEPC is ever going to take over a bigger role, then this needs to start now."

Two staff identified the need for improved communications, both within and outside the Network. One individual noted a communication plan was being developed and that the First2 Network was currently switching from one website platform (HubZero) to another (WordPress), but noted the need for clarity to address communication "disconnects." According to this respondent, "A lot of people within the Network don't use the First2 website for communication, which ideally would be the main mode of communication." A second individual noted there was still a bit of "over-communication" and "under-communication." Over-communication resulted in so many messages that it became difficult to identify the "really important things" and undercommunication occurred when "information isn't being filtered back down to the right people or isn't being communicated across all groups that needed to have that knowledge. It's just that things are kind of happening in siloes all over the place."

Two staff identified the complexity of the First2 Network, with "five PIs" and "a whole lot of captains," which makes it difficult at times "to get people all on the same page" and knowing "who has the final say in things or who's paying for what." Another need identified by two respondents was having more clarity about the role of the HEPC DSR staff person charged with communications. One individual recognized the forthcoming communication plan will help address this issue and the other focused on the need for ensuring this individual has access to sufficient details to carry out this work. And, another need identified by two respondents was forming alliances with other agencies across West Virginia and formalizing those "partnerships/ relationships."

Idiosyncratic needs identified by single respondents included the need to form a First2 Advisory Board, which is currently underway; how to curate "best practices" that are agreed upon as best practices, and by whom; how HEPC DSR in a backbone role can "lay down the law that needs to be laid down" to keep things moving forward; setting up a system for collecting donations and funding, which is currently underway; and perhaps not a need, but a concern about whether having one full-time staff member assigned to the First2 Network will be sufficient.



# 3.5.2. HEPC DSR Activities

# Tasks Carried Out by HEPC DSR

Interviewees provided a rich depiction of the activities that HEPC DSR had carried out in its backbone role over the past year. These tasks are organized below by management, collaboration, and outreach.

**Management.** These activities revolved around some aspect of administrative responsibilities, including financial management in terms of conference planning as well as ensuring a "constant influx of cash to sustain the Network and the different facets of the Network." This involves accepting money on behalf of the program, ensuring the Network has a tax identification number, and other related tasks to ensure that HEPC DSR can provide financial support as the backbone organization of the Network. Other tasks included development of processes and products, such as a white paper on backbone organization responsibilities, a communications

plan, an onboarding process for partnerships, and a job description for the First2 Network program coordinator position. Also underway is the curating of "best practices" into a digestible package for others to use in replicating similar networks in other states.

I really feel good about just the progress the Network has been making in terms of the long-term sustainability of the Network and in producing the things that future EPSCoR states can replicate.

**Collaboration.** These tasks involved interactions within the First2 Network, such as serving on Network teams (Capacity Building, Leadership, Steering Committee) and forming a small group of HEPC DSR and backbone mentoring organization staff that currently meets weekly to discuss backbone roles, identify priorities, and establish ways to move forward. Another task that HEPC DSR has been involved in over the past year is the planning for and development of a strategic plan for the First2 Network, as well as updating the First2 Network logic model.

**Outreach.** Tasks involved forming connections with potential industry partners/sponsors (such as Toyota) and making linkages between HEPC's DSR and other HEPC divisions—for example, appointing the HEPC interim chancellor to the First2 Network Advisory Board. Also within this category is responsibility for Network communications, both within and outside the Network. Several respondents noted this is an area still needing attention, because at times the Leadership Team seems to be "doing the communication themselves." One interviewee suggested that "there's a lot of 'do it yourself' in the First2 Network to make it happen faster, even though it may not necessarily be your job." Another mentioned the communication form, currently being revised, that should help document what needs to be communicated and streamline securement of needed information before communications are developed and distributed.

### Supportive/Challenging Factors

Interviewees all indicated one of the most supportive factors over the past year was the reallocation of HEPC DSR staffing to support a full-time First2 Network program coordinator position, which helps put the infrastructure in place to help sustain the Network. One individual



commented that "just in general having one person in our office dedicated to this project makes it all a lot easier." Another noted "we really needed that, and I think the Network definitely needed that, too, and I think that brought a sense of relief for everyone who has seen the backbone as the piece that has just been very stalled." Another supportive factor included the new director of DSR, who "is so well-versed in just all things science and research and EPSCoR and INCLUDES and NSF and NASA . . . to have that knowledge and be involved in First2 is just a total benefit." Other supportive factors included the support and mentoring from SRI as well as the ability to "leverage the weight of being the Higher Education Policy Commission" in support of the Network.

A number of challenges were also identified. Two individuals noted that communications "might still be a little bit of an issue," but one added that "I suspect that will be the case regardless just because ... this is such an unusual way to work." Several staff

We need more people and we need for them to have a defined role so that they know what it is they're supposed to be doing rather than sitting there looking at this giant organism and trying to figure out which part they're supposed to do something about.

acknowledged that the COVID-19 pandemic had curtailed any in-person meetings; one commented "it would be different to see how much better it would have been with the ability to travel and see each other." Other challenges included the very nature of the Network ("so many moving pieces" and "moment-by-moment" changes), gaining more clarity on backbone roles and responsibilities and the appropriate support to build HEPC DSR capacity, prioritizing "the best way for the resources of the backbone to be used," and budget constraints that support only one full-time First2 Network staff position.

### **Needed Modifications**

Interviewees identified several needed modifications. One individual offered several suggestions, including the need to be more intentional about membership so that the Network doesn't rely so much on someone joining after attending a First2 Network conference. This

Probably the biggest barrier that we would have to overcome is even when things just pop up unexpectedly, when we have emergent items that need our attention, just making sure that we still follow a process. For however the situation is handled, we still have a clear, cohesive process for how things are dealt with.

individual reflected that "we haven't gone out and gotten somebody from every institution in West Virginia so that we make sure First2 covers the whole state." The interviewee also suggested more discussion was needed about what tasks fit within HEPC DSR's backbone responsibilities and that more members are needed because "the leadership team is just doing an astounding amount of the work themselves."



Another interviewee suggested the need to ensure the First2 Network "can be replicated in other EPSCoR states," noting "we should not still be building infrastructure in Year 4 and Year 5. At that point,

I think that the biggest change would be just making sure that we have the support needed to put the infrastructure in place so that First2 is a well-oiled machine.

we should have this blueprint for other people to follow. We should have a list of best practices." And, one respondent reflected back on the Collective Impact Forum recommendation for three full-time positions in a backbone organization, noting, "I don't even know that it's a recommendation so much as like a concern going forward—is one full-time person enough? It's better but I don't know that sustainability, as far as sustainability goes, whether it's still enough for optimal."

#### 3.5.3. Miscellaneous

Universally, final comments provided by the HEPC DSR respondents were positive in nature, and focused on the support and enthusiasm of the First2 Network members, the importance of the Network goals, and how they appreciate being part of this endeavor—yet they also acknowledged the complexities of the Network as an undertaking. Illustrative comments follow.

- "I have absolutely loved my time working with HEPC in this role. The people I work with, not only in the Division of Science and Research, but in the entire HEPC, as well as the First 2 folks, are extremely supportive like nothing I have ever experienced. It's just really incredible to work with so many people who are just so willing to help."
- "My experience in the Network has been very positive. I'm happy to be part of it and I think it's really important for the state that the First2 Network is sustainable, so I really want to help them try and achieve that. It's been a pleasure working on it even though sometimes it's very confusing."
- "We're still learning and figuring out how to best serve the Network in our role as a backbone. It is definitely a struggle because there are lots of people, lots of opinions, lots of conversations that go on, but we want to do the best that we can to make it successful and I think we're doing better at that now than we were this time last year."
- "People are really passionate and care and the end goal is to improve access to STEM and postsecondary STEM education for first-generation students is very important. I think everybody is all in the same boat there as far as making sure we can do something for those kids [but] it's messy and it's tough."

#### 3.5.4. Backbone Organization Summary

In sum, HEPC DSR respondents perceived that considerable progress had been achieved during the year in terms of improved staffing configurations for serving as the First2 Network backbone organization, the support being provided by the backbone mentoring organization, and improved clarity about roles and responsibilities. Remaining areas of need included 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.



# 3.6. Network Value Survey

The Network Value Survey was administered to all First2 Network members in July 2019 and again in June 2020, inviting respondents to use a four-point scale to rate the value of aspects of the Network across 23 items organized across five sections: (1) activity, (2) output, (3) application, (4) outcome, and (5) impact. This survey is based on research suggesting that what people value about the networks in which they are engaged evolves in a roughly developmental manner.<sup>42</sup> According to this research, networks tend to generate five progressive levels of value to their members over time, each of which is aligned with the five survey sections:

- 1. Immediate value: Activities and interactions (e.g., network events, new relationships)
- 2. **Potential value**: Knowledge capital (e.g., acquisition of information and skills that can be applied later)
- 3. Applied value: Changes in practice (e.g., employment of new knowledge and skills)
- 4. **Realized value**: Performance improvement (e.g., achievement of network goals, such as improved STEM program persistence rates in this case)
- 5. **Reframing value**: Redefining success (e.g., development of new, more ambitious network goals)

Early in the Network's lifecycle, we would expect to observe that its value to members centers on immediate value—that is, on the creation of new relationships and shared network experiences. As Network members undertake core activities, such as participation in PDSA cycles and joint efforts, we would anticipate that members cite network value as leading to applied value (changes in practice) and realized value (improved outcomes, including higher rates of STEM persistence).

The first set of five items on the Network Value Survey assesses the extent to which members value the networking and community-building generated by Network participation (Activity). The next four items ask respondents to rate the extent to which they value gaining new knowledge from Network participation (Output). The third set of items (with a total of five statements) asks members to rate the value of opportunities for applied learning and practice that the Network offers (Application), whereas the next set of items (four statement) requests that members rate the value of possibilities for performance improvement generated through Network participation (Outcome). The final section of five items invites members to rate the extent to which they value the Network for its contribution to their ability to refocus and redefine success (Impact). In addition, open-ended questions ask members to share examples of how the value acquired through Network participation manifested in their own work.

### 3.6.1. Characteristics of Respondents

Forty-nine of the estimated 283 members responded to the Year 2 Network Value Survey, for a response rate of 17% (47 of 144 members replied to the survey in Year 1, a response rate of 33%). The majority were faculty and staff (59%) and the remaining eleven respondents identified as student members. Approximately 90% indicated that, in addition to their primary position, they served on at least one First2 Network working group. We found that no significant differences across Year 1 and Year 2 in the distribution of student or working group member



respondents exist. However, there is a slightly higher number of total completers (48 and 37, respectively) and a slightly higher percentage of those who indicated they are working group members (90% and 84%, respectively) in Year 2 compared to Year 1.

The survey asks respondents to indicate which working group they serve. The majority of Year 2 respondents indicated they served as members of the Immersive Experiences working group (44%); this is followed by those who indicated participation in the Faculty-Student Engagement working group (29%). Figure 12 displays these results, highlighting nearly all respondents serve in some type of working group. In Year 1, Capacity Building had nearly 32% of all respondents but those working group tasks have recently been redistributed to the backbone organization, so that number is notably lower in Year 2, as shown in Figure 12. Additionally, in Year 2, the College Readiness met as a working group and experienced some changes; this may explain the decrease from 35% in Year 1 to 10% of responders in Year 2.



Figure 12: Working Group Representation in Network Value Survey

Network members were invited to respond to the Network Value Survey in the Spring of 2019 and 2020, rating the extent to which they agreed with statements associated with each component. The response option scale ranged from 1 = Strongly disagree to 4 = Strongly agree.

Mean component scores from 2019 and 2020 are presented in Table 12, as well as mean scores for items associated with each component. In both 2019 and 2020, ratings indicate that members most value the ways in which the Network supports networking and community-building (Activity), with mean component ratings of 3.28 in 2019 and 3.25 in 2020.

Component mean ratings decreased slightly between 2019 and 2020. The largest decrease was associated with the Outcome component, declining by 0.24 points from 2.70 in 2019 to 2.46 in 2020. Put another way, members valued the extent to which the Network facilitated improved performance outcomes somewhat less in 2020 than they had in 2019. The smallest mean rating decline, from 2.86 to 2.84, was associated with Application. In other words, members tended to



value practice changes they were able to make as a result of Network participation similarly in both 2019 and 2020.

The highest rated individual item across all components, with a mean of 3.38 in both years, was *I made connections with colleagues around shared goals*. The lowest rated item was 2.46 in 2019 for *I observed data indicating that my organization's performance improved*; this item was also the lowest rated item in 2020, declining to 2.17.

Most items associated with components declined over time, albeit only slightly. The largest decline was associated with the item *I encountered evidence that the Network has advanced its reputation*, which decreased by 0.36 points from 3.03 to 2.67. On the other hand, the mean ratings associated with several items increased over time, although minimally. The largest mean rating increase was for the item *I engaged regularly with the Network*, which was 3.14 in 2019 and 3.26 in 2020.



Торіс	Item	Y1-2019	Y2-2020	Change
8	Made connections with colleagues around shared goals	3.38	3.38	0.00
ng and Buildir ity)	Gained access to professional relationships that change my perspective or understanding	3.29	3.10	-0.19
	Engaged regularly with the Network	3.14	3.26	0.12
orki nity ctiv	Participated in Network activities that were meaningful	3.31	3.26	-0.05
Netw ommu (A	Interacted with students or student groups as contributing members of the network	NA	3.21	NA
ŭ	Activity (Mean)	3.28	3.25	-0.03
	Acquired a new skill or new knowledge	3 05	2 9/	-0.11
lew lge t)	Gained insight about a person or group I can turn to for information or support	3.03	3.17	-0.11
ning N owlec Dutpu	Gained access to new tools, information, or processes I would not have access to otherwise	3 18	2 98	-0 20
Gai Kn ((	Saw opportunities for learning that I did not see before	3.33	3.02	-0.31
	Output (Mean)	3.21	3.03	-0.18
pu	Applied skills or practices learned through the Network to accomplish a goal	2.92	2.83	-0.09
n) a	Leveraged a Network connection to accomplish a task	2.92	2.92	0.00
rnir ces atio	Used a document produced or made accessible by the Network	2.95	3.00	0.05
Lea acti olica	Made changes in my organization based on Network work	2.64	2.63	-0.01
olied Pr (App	Used knowledge or skills obtained through the Network to better understand problems or issues impacting first-generation student groups	NA	3.10	NA
Api	Application (Mean)	2.86	2.84	-0.02
	Observed practice/policy improvements at my organization resulting from Network work	2.54	2.48	-0.06
nce nent	Observed data indicating that my organization's performance improved	2.46	2.17	-0.29
forma roven utcon	Observed evidence of improvement in the key student outcomes the Network is pursuing	2 76	2 54	0.22
mp (O	Encountered evidence that the Network has advanced its reputation	2.70	2.54	-0.22
_	Outcome (Mean)	3.03	2.67	-0.36
	Engaged previously uninvolved stakeholders in Network efforts	2.70	2.40	-0.24
ing	Contributed to a new framework or system for achieving Network aims as a	2.94	2.70	-0.24
d Redefini :ess act)	result of new understandings	2.89	2.79	-0.10
	Used what I learned from Network work to develop a new strategic direction at my institution	2.50	2.46	-0.04
e an Succ Imp	Reflected anew on what it takes to achieve success	3.19	3.02	-0.17
) )	Demonstrated an understanding of the complexity of elements important to rural students' pursuit of STEM careers (e.g., served on a panel, facilitated a		2.22	
Infl	session)	NA	3.00	NA
	Inipact (medi)	2.88	2.74	-0.14

# Table 12: Network Value Survey Item Mean Ratings, Y1 and Y2

N/A: Members were asked three additional survey items this year; as a result, no data for these items are available from Year 1. Appendix B contains a reproduction of the Network Value Survey.



# 3.6.2. Immediate Value: Networking and Community-Building (Activity)

With respective component means of 3.28 in 2019 and 3.25 in 2020 on the four-point response scale, members tended to agree that they derived value from the networking and community building afforded by their participation in the First2 Network (see Table 12).



# Figure 13: Immediate Value: Mean Ratings by Member Type

Students tended to rate items associated with the Activity component somewhat lower than did non-students, with an overall mean rating of 3.00 compared to 3.36 among non-students (see Figure 13). Student members reported the greatest value emerging from *interacting with students or student groups as contributing members of the network* (mean = 3.25), followed by *making connections with colleagues around shared goals* (mean = 3.13).

When asked to elaborate on the value of networking, student respondents reported the greatest

value in their connections with both peers and mentors during their First2 internship experiences. As one student put it, "I met amazing people and gained awesome connections." In two

Overall, the success of my first year was enhanced by early engagement through First 2 Network.

cases, students described value emerging through their service as mentors to other students. On the other hand, one student described disappointment in the support received through the First2 Network's campus club meetings, reporting, "I never got the support that was necessary for me to flourish."

Non-student members found the most value in *making connections with colleagues around shared goals* and *engaging regularly with the Network*, with a mean of 3.50. Asked to comment on the value of such connections, non-student members most frequently discussed professional connections and student involvement. As one such member noted, "I personally enjoyed working on my PDSA forms and comparing my results to other members as well as having a wide range of recommendations and suggestions to consider. I also enjoy having shared



literature and being overall informed about teaching practices and involving students in the process."

Asked to describe a meaningful activity or connection they experienced via the Network, nonstudent respondents praised the opportunity to connect with and support first-generation students. There was also mention of the value in collaborative efforts to revamp the website, prepare materials for the NSF reverse site visit, and develop PDSA resources for working groups. Other commonly mentioned activities included the STEM for All video showcase, conferences, science and math teacher workshops, and INCLUDES meetings.

Overall, only a minority of members thought the networking and community-building value derived from their Network participation was limited. For these individuals, it is possible that their lower ratings were informed challenges associated with virtual meetings; as one member put it, "I am sorry, but it is hard to have a meaningful conversation online."

# 3.6.3. Potential Value: Gaining New Knowledge (Output)

Overall, students and non-students valued the new knowledge acquired via Network participation similarly, with respective subscale means of 3.03 and 3.04 on the 4-point rating scale (see Figure 14). In terms of individual subscale items, students rated two of the items associated with the Output component more highly than did non-student members: *gained access to new tools, information, or processes I would not have access to otherwise* (mean = 3.18) and *acquired a new skill or new knowledge* (mean = 3.10). One student member shared that s/he is more resourceful and confident as a result of new information acquired through Network participation: "[I know how] to get ahold of advisors and the financial aid office. Also, to remain more positive about my education."

Non-student members rated the remaining two items more highly than did students: *gaining insight about a person of group they could turn to for information or support* (mean = 3.25) and *saw opportunities for learning that I did not see before* (mean = 3.09).

Asked to describe a specific resource developed by the Network and why they thought it might be useful, one non-student respondent elaborated that s/he gained increased understanding of PDSA

The shared knowledge and resources of information has been the most beneficial for me.

cycles "through resources that have been very helpful in continued training of network working groups." Other respondents used terms like *focus*, *flexibility*, *excitement*, and *motivation* to describe their reactions to new knowledge obtained through Network engagement. When describing a working group book study, one member explained, "It is helpful in providing new insights and offering varying perspectives that are relevant to our work."





# Figure 14: Potential Value: Mean Ratings by Member Type

#### 3.6.4. Applied Value: Applied Learning and Practices (Application)

Students and non-students valued the way in which Network participation afforded them opportunities to apply what they learned to their own practice, with respective means of 2.84 and 2.93 on the 4-point scale (see Figure 15).

In terms of the individual items associated with this component, non-students rated four of the five items more highly than did students, with both students and non-students valuing *use of a document produced or made accessible by the Network* equally, with a mean rating of 3.0 among both groups. Non-students most valued *use of knowledge or skills obtained through the Network to better understand problems or issues impacting first-generation students*, with a mean rating of 3.17. Both groups were least likely to report they *made changes in their organization as a result of Network participation*, with mean ratings of 2.55 among students and



2.67 among non-students. A few respondents elaborated on their ratings when invited to describe how they applied what they learned though the Network to their practice and what it enabled that might not have happened otherwise. Several members reported that they had an increased understanding of organizational processes and research practices. As one such member explained when describing a decision made on behalf of the First2 Network, "I used knowledge of the Network culture and values." In another instance, a member noted their appreciation of individual team members' skills being applied to First2 Network processes to advance the mission. According to these respondents, the Network allowed them "use of a whole different skill set" than afforded by previous roles or jobs. Several respondents also mentioned the value emerging from First2 Network encouragement to apply lessons learned from the student perspectives to enhance their role as a mentor or faculty member. Said one such member, "We've put/gotten back to a real focused effort to continue to connect with our

participants who have matriculated to college." A few members also reported sharing their new knowledge about firstgeneration student experiences and PDSA cycles with colleagues, in classrooms, and other meetings beyond

# We have started using the "adopt, adapt, or abandon" and "change idea" language in our K.I.D.S. programs [and other partner groups].

the Network. As one respondent shared, "We are using improvement science practices to improve public outreach activities."



Figure 15: Applied Value: Mean Ratings by Member Type



# 3.6.5. Realized Value: Performance Improvement (Outcome)

Students rated the value of performance improvement emerging from Network participation slightly more highly than did non-students, with a mean of 2.56 compared to 2.46 on the overall Outcome component (see Figure 16).

In terms of individual subscale items, students rated three items more highly than did nonstudents. With mean ratings of 2.75 for both items, students valued equally that they had observed practice/policy improvements at their organization resulting from the Network and had observed evidence of improvement in the key student outcomes the Network is pursuing. However, a mean rating of 2.75 on the 4-point scale indicates that some students did not agree with such statements. Amongst non-students, the highest rated item concerned encountering evidence that the Network has advanced its reputation, with a mean of 2.75.

Asked to explain how participation in the Network affected their success, some members reported that they had experienced personal and professional growth through active engagement in the First2 Network. As one member explained, "Being encouraged to attend events and particular activities that are of an interest to me has helped me personally to be more engaged, and professionally to seek these opportunities and grow throughout them." Another member agreed that participation provided leadership development and enhanced their overall performance at their organization. In both student and non-student examples, members described a relationship with their peers that had grown such that they were perceived as an advisor. As one member put it, "They want to learn" and continued to say, "They pick my brain." Another member stated her/his involvement had limited the time available for work in her/his primary role or job. Another indicated a professional struggle with advancing research goals. S/he stated, "The research aims/goals and interaction between the state-wide and local side is very confusing. I've not found that anyone understands what and how the two sides are supposed to interact and connect."



Figure 16: Realized Value: Mean Ratings by Member Type



On the other hand, some respondents indicated that they did not experience performance improvements given the contingencies of the COVID-19 pandemic and associated public health restrictions. As one such member stated, "The unexpected shift to online education in the spring semester hindered application and assessment of some of my planned improvements."

# 3.6.6. Reframing Value: Influence and Redefining Success (Impact)

Overall, students rated the value of the Impact component—that is, the reframing value of redefining success—lower than did non-students, with a student subscale mean of 2.58 compared to a non-student subscale mean of 2.88 (see Figure 17). Accordingly, student mean ratings of the items associated with the Impact component were lower than those of non-student members on all but one item (*used what I learned from Network work to develop a new strategic direction at my institution,* with a student mean rating of 2.64 and a non-student mean of 2.42.

With means of 2.82 for both items, students most valued that they *reflected anew on what it takes to achieve success* and *demonstrated an understanding of the complexity of elements important to rural students' pursuit of STEM careers*. Non-students, too, valued this item most highly among the five subscale items, with a mean of 3.11.

Respondents were invited to reply to the following prompt: *Sometimes participation in a collaborative effort changes your perspective, direction, strategy, or understanding of what success is. If this has taken place, please describe it here.* Many of those who replied reported that the Network had reshaped their understanding of the experiences of first-generation STEM students. Others cited new appreciation for the power of multiple and student voices:

- "It was important for them to know their voice was important and should be heard as well as to encourage them to take ownership of their education."
- "I have a much greater appreciation for the idea of "getting better at getting better" and involving multiple voices in conversation."

Several members described how First2 Network participation provided them opportunities to improve in both personal and professional capacities such as curriculum and course development, improvement science, and self-directed learning. Said one such member, "I think the success for me is to fully implement a plan and revise the plan to provide more accurate results. I have received assistance in building a survey and adjusting the survey to allow me to have better assessment for the students."

Another member shared that Network participation transformed her/his view of her/his own firstgeneration student status, writing, "Through the network, my perspective on being a struggling first gen student changed as the people involved supported me. My attitude shifted from negative to positive as I found new resources to succeed further." For another respondent, Network experiences facilitated personal growth: "I am getting clearer about my own personal goals at the same time as I am working to improve my emotional intelligence. These are skills I have needed for a long time and the network work and interactions have helped make that clearer to me." One member reported that the Network encouraged all members to "feel more comfortable with putting out work and ideas."



A few respondents reported new insights about the complexity of the Network itself. Said one such member, "Decentralization has significant challenges, but taking on the work is too big for any one organization." Another member commented, "the Network is very complex and there are many different interests."

Although a few members reported that the use of online meeting platforms like Zoom were challenging to use, they also described their use of such tools via the First2 Network as helpful preparation as they shifted to online teaching and learning amidst the COVID-19 pandemic.



# Figure 17: Reframing Value: Mean Ratings by Member Type

# 3.6.7. Network Value Survey Summary

In sum, mean ratings for all five components on the Network Value Survey declined between 2019 and 2020, although only slightly, suggesting that Network members tend to value the various benefits of participation similarly across both years. As in 2019, members in 2020 tended to value most highly the networking and community building, and knowledge acquisition, activities associated with Network engagement. Per the research on which the survey is based, Network participants tend to value such benefits of engagement more highly in the Network's early year. Over time, one would expect to observe higher participant ratings of the applied, achieved, and reframed value afforded through Network involvement. In addition, it is notable that students generally tended to rate the value of various components somewhat less highly than did non-members.



# 3.7. Document Review

Latham's<sup>43</sup> framework for evaluating change in human service delivery systems is a useful schema for understanding the ways in which the First2 Network influences West Virginia systems to improve the persistence of rural, first-generation STEM students. This framework conceptualizes systems as *pathways* (progression through school levels and STEM programs, in this case) and *structures* (such as state education policies, resource flows, relationships and connections, and power dynamics).<sup>44</sup> Ultimately, systems change "is about changing the structures that shape our ability to improve pathways" (p. 13).<sup>45</sup>

Positive systems change, in the case of the First2 Network, involves improvements to structures—such as establishing incentives for using STEM instructional practices that increase persistence—and to pathways—such as increasing coordination between state K-12 and higher education subsystems to ensure that rural, first-generation students have adequate math preparation to succeed in STEM majors.

In this framework for assessing systems change, Latham suggests the following types of pathway improvement:

### • Increased pathway capacity

- Improved quality: In which the quality, or number of high-quality programs, increases, through adherence to quality standards or the use of continuous improvement methods
- Improved scale: Through better outreach and recruitment, accessibility, and supply of services
- Improved comprehensiveness: By addressing service gaps and ensuring that the right programs are available to diverse target groups

### • Increased pathway connections

- Improved linkage: In which transitions between programs or steps along a pathway are made easier through enhanced coordination
- Improved alignment: In which entities align their efforts to achieve shared goals
- Improved cross-system coordination: Through partnerships and leadership coalitions, complementary programs sustain coordination over time

Analysis of First2 Network documents, such as working group reports and meeting minutes, indicates that working groups and members have sought to improve pathways in various ways (see Table 13 for examples).



Element of pathway improvement	Evidence of pathway improvement efforts
Improved quality	<ul> <li>Faculty-Student Engagement working group: Assists faculty to improve engagement with students in their STEM programs so that students have improved STEM program experiences and outcomes (e.g., testing improvements to office hours processes)</li> <li>Faculty-Student Engagement working group: Members conducting PDSAs on the use of metacognitive strategies to improve program quality</li> </ul>
Improved scale	<ul> <li>College Readiness working group: Proposal assistance to partners to implement new STEM projects, including proposals for funding from Small Business Innovation Research, National Institutes of Health Science Education Partnership Aware, and Department of Defense programs</li> </ul>
Improved comprehensiveness	<ul> <li>Immersive Experiences working group: Offers early research experiences and peer, mentor, and faculty networking to familiarize first- generation students with STEM work and campuses</li> <li>Student Leadership working group: Provides peer support and campus clubs to help first-generation students acclimate to STEM majors</li> </ul>
Improved linkage	<ul> <li>College Readiness working group: Developing opportunities to improve student knowledge about the range of STEM careers so they can envision possibilities and plan more effectively for transition to college STEM majors (e.g., NASA Educator Resource Center to add STEM majors and careers information to student workshops)</li> </ul>
Improved alignment	<ul> <li>College Readiness working group: Members trained HSTA teachers and 4-H extension agents to integrate activities that build STEM research skills into programming</li> </ul>
Improved cross-system coordination	<ul> <li>Integration of First2 Network into other state STEM collaboratives: HSTA, 4-H extension, NASA West Virginia Space Grant Consortium, West Virginia Academy of Sciences, West Virginia Science Teachers Association</li> </ul>

# Table 13: Evidence of First2 Network Pathway Improvement Efforts

Latham's framework for evaluating systems change also offers a schema for understanding structural improvement, as follows, framed in terms of the First2 Network aim.

- **Reduction in barriers:** Identification and removal or mitigation of incentives, disincentives, or constraints that jeopardize STEM persistence
- **Development of enablers:** Establishment and implementation, or enhancement, of incentives and opportunities that promote STEM persistence

Some of the ways in which the First2 Network has sought structural improvement are presented in Table 14.



Element of structural improvement	Evidence of structural improvement efforts
Reduction in barriers	<ul> <li>Student Leadership Team and High Rocks (a First2 Network lead organization): Assisted students to obtain computers and internet access via campus and other resources so they could participate in online instruction during the COVID-19 pandemic, removing the structural barriers imposed by lack of access to hardware and broadband</li> <li>Student Leadership Team and High Rocks: Sought to change power dynamics that discourage students from communicating needs to authority figures by providing entrée to legislators and state education leaders, and structuring opportunities for students to present challenges to all Network members (e.g., at Network conferences, via the Pandemic Poem shared on the website)</li> </ul>
Development of enablers	<ul> <li>Student Leadership and Capacity Building working groups: Promoted Network efforts to build policymaker awareness and support of efforts to improve STEM persistence</li> <li>First2 Network member Kathryn Williamson launched a new West Virginia University Honors course, Ambassadors for Change, to learn about first-generation issues, serve as ambassadors to other current and potential first-generation STEM students, and develop communications about how to support such students</li> <li>Through partner GlobalMindED, First2 Network offered funding to academic coaches to learn how to employ Lifebound coaching during June, July, and August 2020 trainings</li> </ul>

# Table 14: Evidence of First2 Network Structural Improvement Efforts

Some of the efforts identified above have generated immediate dividends (such as broadband access for students during the COVID-19 pandemic), whereas the effect of others is being tested (via PDSAs) or will require time and additional work to produce effects (such as policymaker support for STEM education policies, programs, or funding). In addition, some First2 Network efforts at systems change focus on improving practices, which in turn may improve pathways. Nonetheless, document review confirms that the Network is pursuing a variety of systems changes using multiple approaches.

### 3.7.1. Document Review Summary

Review of First2 Network documents reveals some evidence of efforts to improve the systems that can enable or constrain the early STEM persistence of rural, first-generation students in West Virginia. Many efforts have focused on improving the pathways, and the linkages among such pathways, along which students travel across their academic experiences. The principal way in which the First2 Network sought to better pathways was through the facilitation of PDSA cycles in working groups to identify, test, and refine discrete improvements on a small scale. In addition, documents indicate that the First2 Network 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 helping students obtain internet and computer access. The Network also sought to alter the power dynamics that dissuade students from communicating their needs to authority figures by providing entrée to legislators and state education leaders,



and by structuring opportunities for students to discuss their STEM persistence challenges to all Network members. Enabling activities included communicating about the Network with state policymakers as a way 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. The Evaluation Team will monitor these systems change efforts over the coming years to examine their durability, scalability, and effectiveness.

# 4. Impact of the First2 Network

Impacts are the broader, long-term changes occurring as a result of short- and medium-term outcomes. The desired impact of the First2 Network over the next 10 years is to double the graduation rate (from 30% to 60%) of students in West Virginia who enter college with a declared STEM major and who complete a STEM degree within 4 years. According to the First2 Network logic model, necessary components of that impact include increasing STEM graduation rates, building the knowledge base about first-generation STEM persistence, and expanding a sustainable network. This section explores First2 Network impact to date via social network analysis, pre- and post-test administrations of the intern survey, student focus groups, and STEM persistence data from the project and HEPC.

# 4.1. Social Network Analysis

Social network analysis (SNA) permits the analysis of network size, and the number and strength of connections amongst network members. Thirty-two Network members completed the annual social network survey in December 2019/January 2020, based on their Network activity over the past year. The composition of Network members' organizations is provided below in Table 15. Of the 32 respondents, 69% were female, 56% had achieved a doctoral degree, 34% were between 55-64 years of age, 38% had been at their organization for six or more years, and 34% had a primary role of faculty member/lecturer/ teacher.



	Organization Name	Number of Respondents	Percent of Respondents
Lead First2	West Virginia University	11	34%
Network	Fairmont State University	3	9%
organizations	Higher Education Policy Commission	1	3%
	High Rocks	2	6%
	Green Bank Observatory	1	3%
Other	Marshall University	2	6%
organizations	West Virginia State University	3	9%
	West Virginia Wesleyan College	1	3%
	Davis & Elkins College	1	3%
	West Virginia Department of Education	1	3%
	Pierpont Community & Technical College	1	3%
	Pocahontas County Schools	1	3%
	TechConnect West Virginia	1	3%
	Others (not identified)	3	9%
Total		32	100%

# Table 15. SNA Survey Respondent Organizational Affiliation

Note: Percentages may not equal 100% due to rounding.

Respondents identified up to 10 members of the First2 Network with whom they communicated on issues relevant to their work in the Network. And, for each individual identified, respondents assigned a code describing the level of engagement with each individual (1 for *less strong relationships* up to 5 for *strong collaborative ties*). The five levels<sup>46</sup> include:

- 1. **Networking:** Aware of organization, loosely defined roles, little communication, independent decision-making
- 2. **Cooperation:** Shared information, formal communication, somewhat defined roles, independent decision-making
- 3. **Coordination:** Shared information frequently, defined roles, some shared decisionmaking
- 4. Coalition: Frequent communication, shared resources, shared decision-making
- 5. **Collaboration:** Frequent communication, shared resources, mutual trust, coordination on most or all decision-making

The number of individuals identified, along with the average collaborative scores, are shown in Table 16 and Figure 18. As anticipated, the collaboration score is higher for the first two individuals identified by the Network respondents, and collaboration scores generally decrease throughout the remaining individuals identified although there are some slight fluctuations. The overall score is 3.34, which is at the Coordination level. While this is the same overall level as the previous year, the mean overall score has increased from 3.11 to 3.34, showing some increase in collaboration.



Individuals Identified	Number Identified	Average Collaboration Score
Member #1	32	3.94, Coalition
Member #2	31	3.80, Coalition
Member #3	28	3.38, Coordination
Member #4	25	3.67, Coalition
Member #5	23	3.09, Coordination
Member #6	21	3.38, Coordination
Member #7	18	3.22, Coordination
Member #8	18	3.11, Coordination
Member #9	14	2.79, Coordination
Member #10	13	3.00, Coordination
Overall Score		3.34. Coordination

# Table 16. Network Members Identified as Collaborators in the First2 Network



### Figure 18. Levels of Collaboration by Individuals Identified

The survey asked respondents to select one person out of those individuals identified whom they considered to be of exceptional importance (in terms of resources, information, or guidance provided) to their role in the First2 Network. As anticipated, the first person identified was most frequently identified as the key contact. Respondents were also asked to identify whether the individuals they identified were prior acquaintances, with whom they were in contact prior to their Network involvement. Again, as might be expected, the first few individuals identified were prior acquaintances. For example, for the first member identified, 59% were prior acquaintances; for the second member identified, 42% were prior acquaintances.



In terms of the actual structure or configuration of the Network, based on the 32 respondents, the graph shown in Figure 19 depicts the connections among those individuals identified as collaborators within the Network for both Year 1 and Year 2. Each circle (or node) depicts an individual, and the size of the node corresponds to the number of times a person was mentioned (the larger the circle, the more often the person was identified as a collaborator). The line width (edges) corresponds to the strength or level of collaboration (the thicker the line, the higher the level of collaboration). The five key organizations involved with the First2 Network are identified with different colors, and all other organizations are depicted as white circles.<sup>1</sup>



# Figure 19. SNA Maps of Connections in the First2 Network Year 1 and Year 2

The overall shape of the Year 2 network map is star shaped, with most frequent collaborators coming from WVU, MU, and FSU. One FSU individual is currently the person most linked to others within the Network, while there are a number of individuals from other organizations appearing most often on the periphery of the map and reflecting mostly incoming linkages. Three WVU members appear in a triangle shape within the map, and appear to be serving as conduits of information, with linkages both within and across organizations. As anticipated, this map differs from last year's map, showing not only more collaborators, but also more collaboration among members and at higher levels.

Another way to envision the Network is through a radial representation, again where the size of the node indicates the number and strength of the connections. Those individuals with more

<sup>&</sup>lt;sup>1</sup> Network maps were also generated for each active working group and are depicted in Appendix C1. These maps should be interpreted with caution, given the small number of respondents involved for each working group.



connections are central to the figure and those with fewer connections are on the outer ring. To compare the results from 2019 with those from 2018, both radial graphs are depicted in Figure 20.



Figure 20. 2019 and 2018 First2 Network Radial Representation

In Year 2, the average shortest path length is 1.12, meaning that most people are directly connected (path length one), as compared to 1.63 in Year 1, meaning most individuals were connected either directly or by a path of length two. The graph density is 0.05 in Year 2, meaning that approximately 5% of all possible edges or connections are present, which decreased from Year 1's 0.13, most likely because more people joined the network. The Year 2 diameter (maximum distance between any two connected individuals) is 2, which decreased from Year 1's diameter of 4.

Further comparisons of the Year 1 and Year 2 SNA data are based on additional common SNA statistics. First is degree centrality, or how many connections a person has to others in the Network. The overall district centrality sum increased from 426 in Year 1 to 1,399 in Year 2, indicating on average that individuals were more connected. Closeness centrality is a measure of how close each individual is to all others in the Network. The closeness centrality sum increased slightly from 0.50 to 0.51, indicating minimal change.

### 4.1.1. Social Network Analysis Summary

In sum, the First2 Network has become more collaborative this year, showing an increase in the number of collaborators, and more collaboration at higher levels. Members are more connected this year, based on respondent feedback.



# 4.2. Intern Survey

The intern survey is administered to student participants in the Network's immersive research experiences before and after their participation to assess changes in their STEM efficacy, identity, and education and career plans; sense of school belonging; and knowledge of, attitudes about, and skills to conduct research. Nine sites offered virtual two-week research internship experiences in Summer 2020, which included 77 students, as listed below.

- Fairmont State University (July 19-August 1, 8 students): Students gained experience in analytical chemistry, solar cells, and microbial communities.
- Green Bank Observatory (July 19-August 1, 8 students): Students worked in teams to analyze archived Radio Frequency Interference (RFI) data to curate a categorized and searchable database that includes common RFI features.
- High Rocks (July 12-25, 7 students): Students conducted research on dendrochronology in collaboration with researchers from West Virginia University.
- Marshall University (July 19-August 1, 9 students): Students conducted research activities in chemistry, biology, computer science, and forensics.
- University of Charleston (July 19-August 1, 6 students): Students learned how to conduct tests on soil samples as part of a national program with the University of Wisconsin and Yale. The participants examined the unique Appalachian forest soils for novel antibiotic producing microbes.
- West Virginia School of Osteopathic Medicine (July 19-August 1, 7 students): Students gained research experience in areas such as bacterial protein toxicity, biomechanics, chemotherapy agents, and femur morphology.
- West Virginia State University (July 19-August 1, 10 students): Students assisted faculty to conduct research on neural networks, organic synthesis, integrated pest management, novel cancer treatments, and gene expression.
- West Virginia University (July 19-August 1, 13 students): Students participated in research on developmental biology addressing questions related to human and environmental health and geographical mapping of the socio-economic needs of Appalachia.
- West Virginia University Institute of Technology (July 19-August 1, 9 students): Students collaborated with faculty to develop programs or apps in virtual or augmented reality, inventory management, and computer assisted optimization of solar cells.

Students who were 18 years or older completed an online survey at the beginning and ending of the internship. At pretest, five respondents were not yet 18 and were exited from the survey; 69 of the remaining 72 students completed a pretest survey (96% response rate). At posttest, 59 students who were 18 or older completed a posttest survey (82% response rate). Results were aggregated across all nine sites for this analysis.

Sixty-seven percent of the respondents were female, and 81% were White (7% were Asian, 6% were Black or African American, 3% were Hispanic or Latino/a, and 3% selected "other"). Sixty percent qualified for a federal Pell grant, 58% considered themselves as first-generation college



students, and 48% described the place they grew up as rural (26% town, 22% suburb, and 4% city). Students identified a variety of majors they have or intend to declare, as shown in Table 17. Thirty-six percent reported Biology, Chemistry, or a dual Biology/Chemistry major (20%, 10%, and 6%, respectively) and 19% reported Engineering.

Major	Number	Percent
Biology	14	20%
Biology/Chemistry	4	6%
Chemistry	7	10%
Computer/Information Science	4	6%
Cyber Security	1	1%
Dental Hygiene	2	3%
Dietetics	1	1%
Engineering	13	19%
Environmental Science	1	1%
Exercise Physiology	5	7%
Forensics	4	6%
Immunology and Medical Microbiology	3	4%
Neuroscience	1	1%
Nursing	2	3%
Occupational Safety	1	1%
Physics	3	4%
Psychology	1	1%
Science Education	1	1%
Undecided	1	1%

# Table 16. 2020 Intern College Majors

Note: Percentages may not equal 100% due to rounding.

Results are shown in Table 18 for the five subscales of STEM Career, STEM Efficacy, School Belonging, STEM Identity, and STEM Plans (on a 5-point scale of Strongly disagree to Strongly agree), as well as the four subscales of Knowledge About Research, Attitudes and Behaviors About Research, Personal Skills, and Research Skills (on a 5-point scale of None to A great deal).<sup>47</sup> At pretest, the highest-rated subscale was for STEM Plans at 4.49 (SD 0.54); lowest-rated subscales were Knowledge About Research and Research Skills (means of 3.37 and 3.36; SDs of 0.68 and 0.70, respectively). At posttest, STEM Plans was again the highest-rated subscale at 4.45 (SD 0.63) and STEM Career was lowest at 3.74 (SD 0.61). The Knowledge



About Research subscale showed the greatest amount of change from pre to post (0.62). Figure 21 depicts the pre/post mean scores for all nine subscales.<sup>2</sup>

Table 18. 2020 Intern Pre/Post Survey Results								
	Pre	Pretest Results			Posttest Results			
Subscales	Number	Mean	Std. Dev.	Number	Mean	Std. Dev.	Difference (post – pre)	
STEM Career	69	3.78	0.59	59	3.74	0.61	-0.04	
STEM Efficacy	69	3.99	0.61	59	4.08	0.51	0.09	
School Belonging	69	3.94	0.62	59	4.24	0.71	0.30	
STEM Identity	69	3.80	0.67	59	4.01	0.76	0.21	
STEM Plans	69	4.49	0.54	59	4.45	0.63	-0.04	
Knowledge About Research	69	3.37	0.68	59	3.99	0.60	0.62	
Attitudes/ Beh. About Research	69	3.59	0.80	59	3.94	0.69	0.35	
Personal Skills	69	3.62	0.72	57	4.09	0.60	0.47	
Research Skills	69	3.36	0.70	59	3.82	0.66	0.46	

2020 1-4 . . 40 \_ ..... \_ 14

<sup>&</sup>lt;sup>2</sup> Cronbach alpha reliability estimates were computed for each subscale and for the overall set of rated items. At pretest, subscale values ranged from 0.71 to 0.90, with an overall value of 0.95. At posttest, subscale values ranged from 0.72 to 0.95, with an overall value of 0.96.





Figure 21. Pre/Post Mean Subscales Scores for 2020 Internship Survey

To investigate whether any of the pre/post changes were statistically significant, a matched pairs *t* test was conducted for each of the nine subscales. A total of 58 matched pairs (linking each individual's pre/post scores) was identified for eight of the subscales; 56 matched pairs were identified for the remaining subscale (Personal Skills). This analysis revealed statistically significant results for six subscales, as shown in Table 19, in which students' posttest scores were higher than their pretest scores, including School Belonging, STEM Identity, Knowledge About Research, Attitudes/Behaviors About Research, Personal Skills, and Research Skills.



Subscales	Ν	Post Mean	Pre Mean	Mean Diff.	t	df	Sig.
STEM Career	58	3.73	3.77	-0.04	-0.57	57	0.57
STEM Efficacy	58	4.08	3.98	0.10	1.40	57	0.17
School Belonging	58	4.23	3.94	0.29	3.44	57	0.00*
STEM Identity	58	4.01	3.73	0.28	3.30	57	0.00*
STEM Plans	58	4.44	4.51	-0.07	-0.67	57	0.50
Knowledge About Research	58	3.99	3.35	0.64	7.77	57	0.00*
Attitudes/ Beh. About Research	58	3.95	3.57	0.38	3.97	57	0.00*
Personal Skills	56	4.09	3.61	0.48	5.78	55	0.00*
Research Skills	58	3.82	3.29	0.53	6.04	57	0.00*

# Table 19. 2020 Intern Pre/Post Matched Pairs Survey Results

\*Statistically significant at .001 (using only matched pairs for the analysis).

When asked what they told family or friends about the internship, at pretest students most frequently noted their excitement about the internship, described the internship as an opportunity to help prepare them for college and career, or just said they were participating in an internship. Several students seem to have misinterpreted the prompt, and instead shared what their family or friends said to them. A sampling of illustrative quotes is provided below.

- "That I'm really excited about getting accepted and so ready to see what it's about."
- "Excited for the opportunity and to gain more experience in research before classes start this fall."
- "I tell them that it is a very interesting program that can lead me to a lot of opportunities that I might not have encountered. I say that I am hoping this program leads me in the direction of feeling comfortable with a major that I decide on."
- "I received an amazing opportunity to do summer research and build important and valuable connections throughout the state and different universities."
- "I am a member of a STEM research program which helps me prepare for college in multiple ways."



- "When I mention it to someone for the first time, I describe it as a STEM internship opportunity offered to minorities and first-generation students. When the internship comes up in conversation, I tell them how nervous I am but that I'm looking forward to it!"
- "They are proud of me and know I will succeed."

At posttest, responses were similar in nature, but were more descriptive about what they had experienced. Illustrative quotes are provided below.

- "I just finished this wonderful internship, that first2 network. It made me feel better about going into a STEM field."
- "That it is an amazing opportunity and stepping stone to further research I would want to participate in."
- "I'm conducting research in the name of citizen science, I'm doing something that I enjoy while getting rewarded for it."
- "That it was a wonderful experience that makes me excited for the STEM field."
- "It was fantastic! I loved it so much!"
- "I am an intern learning to do research so I can decide what type of career I want."
- "I've been lucky enough to begin researching before I've even begun college, and this has been a really fun experience!"
- "I say that I was accepted into a research internship that'll help me, as an inexperienced researcher, learn the basics and how to continue on doing research."
- "First2 helps first gen and underrepresented students, so they can achieve their goals in STEM. The people are very welcoming."
- "I spent two weeks during an internship that broaden[ed] my knowledge of the STEM field. The internship helped me build my network of mentors and peers that I can lean on to help me in my undergraduate career."

Students were also asked at pretest and posttest what job or career they expected to have in 10 years. As shown in Table 20, careers in the medical field were the highest at both time points, with such jobs as doctor, pharmacist, and a variety of other medical positions. Aerospace and engineering were tied for the second most common field at pretest. At posttest, research was the second most common field, followed by aerospace, engineering, and computer science.



Caraar	Pretest	t (n=69)	Posttest (n=59)		
Career	Number	Percent	Number	Percent	
Aerospace	6	9%	4	7%	
Animal science	2	3%	2	3%	
Computer science	2	3% 4		7%	
Cyber security	0		3	5%	
Engineering	6	9%	4	7%	
Environmental science	0		2	3%	
FBI/CIA/ crime lab	2	3%	0		
Forensics	3	4%	2	3%	
Medical	29	42%	42% 25		
Research	4	6%	6	10%	
Safety	0	2		3%	
Science	2	3% 0			
Wildlife conservation	3	4%	1	2%	
Miscellaneous	7	10%	2	3%	
Don't know	2	3%	2	3%	

#### Table 20. 2020 Intern Job/Career Expectations in Ten Years

Note: Percentages may not equal 100% due to rounding.

The posttest survey also included a set of 14 items about the internship components rated on a 5-point scale of Strongly disagree (1) to Strongly agree (5), 7 items about the usefulness of the internship components rated on a 5-point scale of Not at all useful (1) to Very useful (5), and three items about the usefulness of their favorite research project rated on the same 5-point usefulness scale. Table 21 depicts the results of those rated items.

Overall, respondents rated the internship experiences very favorably, with all mean scores at 4.0 or above on the 5-point scale. Nearly all (98%) agreed or strongly agreed they would recommend the immersion experience to others (mean 4.75, SD 0.48). Other highest-rated items were that the experience helped improve their research skills (mean 4.71, SD 0.46) and that it helped increase their knowledge of research within a STEM field (mean 4.71, SD 0.49). The lowest rated, unsurprisingly, was that the virtual structure of the immersion experience worked well for them, with a mean of 4.00 (SD 1.07); only 9% disagreed or strongly disagreed with that statement.



# Table 21. Response Option Frequencies and Descriptive Statistics for Rated Items: 2020 Intern Posttest Survey

	Response Frequency Percentages					Descriptive Statistics	
	(1) Strongly disagree	(2) Disagree	(3) Neither agree nor disagree	(4) Agree	(5) Strongly agree	Mean	Std. Dev.
The immersion experience met my expectations. (n=59)		3%	5%	39%	53%	4.41	0.75
This experience helped to improve my research skills. (n=59)				29%	71%	4.71	0.46
This experience helped me to increase my knowledge of research within a STEM field. (n=59)			2%	25%	73%	4.71	0.49
This experience helped me to increase my general scientific knowledge. (n=59)			2%	29%	70%	4.68	0.51
This experience helped me learn how STEM research is conducted. (n=59)			2%	32%	66%	4.64	0.52
This experience helped me see myself as someone who can do STEM. (n=58)			7%	38%	55%	4.48	0.63
result of this experience. (n=58)		5%	24%	24%	47%	4.12	0.96
me stay in my STEM major when my coursework is challenging. (n=59)			7%	36%	58%	4.51	0.63
I am more likely to pursue a STEM degree as a result of this experience. (n=59)		2%	14%	39%	46%	4.29	0.77
This experience will help me succeed in college. (n=59)				41%	59%	4.59	0.50
I would recommend this immersion experience to others. (n=59)			2%	22%	76%	4.75	0.48
The recruitment process made it easy for me to apply to this experience. (n=59)			14%	31%	56%	4.42	0.72
The recruitment information adequately prepared me for what to expect for this experience. (n=59)		5%	25%	31%	39%	4.03	0.93
worked well for me. (n=59)	2%	7%	25%	22%	44%	4.00	1.07
	(1) Not at all useful	(2) A little useful	(3) Neutral	(4) Useful	(5) Very useful	Mean	Std. Dev.
Research mentoring provided by undergraduate mentors (n=59)				29%	71%	4.71	0.46
Community- building mentoring provided by undergraduate mentors (n=58)			3%	29%	67%	4.64	0.55
Meeting/conversing with faculty members (n=59)			7%	29%	64%	4.58	0.62
Research oversight/training provided by faculty members (n=59)		2%	5%	27%	66%	4.58	0.68
Team-building activities (n=59)		2%	5%	34%	59%	4.51	0.68
College readiness activities (n=58)	2%		12%	21%	66%	4.48	0.84
Community-building activities (n=58)			12%	28%	60%	4.48	0.71
For the favorite research project worked on							
auring the internship:			20/	070/	<b>FO</b> 0/	4 50	0.57
The deta analysis required for that project, (n=59)			3%	31%	59% 62%	4.50	0.57
The presentation of your preject findings $(n=59)$			3% 70/	34%	610/	4.59	0.00
The presentation of your project indings, (n=59)			1%	32%	01%	4.04	0.03

Notes:

Percentages may not equal 100% due to rounding. The number of individuals who responded to each item is indicated by the  $(n=_)$  notation in each row.



When looking at the items focusing on the specific research internship components, these seven items were also rated very favorably, with mean scores all above 4.45. Respondents rated the research mentoring component the highest, with a mean of 4.71 (SD 0.46). The two components rated lowest included college readiness and community-building activities (means of 4.48, SDs of 0.84 and 0.71, respectively).

Each of the nine sites carried out various research projects. When asked to identify their favorite project, respondents identified the following:

- Fairmont State University: water/soil testing
- Green Bank Observatory: pulsars
- High Rocks: fireflies
- Marshall University: water testing
- University of Charleston: soil testing
- West Virginia School of Osteopathic Medicine: water testing
- West Virginia State University: bumble bees
- West Virginia University: mapping
- West Virginia University Institute of Technology: database and pulsar (tied)

After identifying their favorite project, respondents were asked to rate three items based on that particular project. Respondents rated the data analysis the highest, with a mean of 4.59 (SD 0.56), followed by project activities (mean 4.56, SD 0.57), and presentation of project findings (mean 4.54, SD 0.63).

When asked which research project was least enjoyable, more than a third indicated they enjoyed all the research projects. Further, of the remaining comments, many focused not on a specific project but on some aspect of the internship, such as lectures, writing methods and procedures, making a PowerPoint, resume building, and the mini project. In looking at specific projects, most frequently identified as least enjoyable (but with only five or fewer mentions each) were fireflies, mapping, bumblebees, gel electrophoresis, pulsar, and zebrafish.

The posttest survey also included six other open-ended prompts to garner feedback about the research internship experience. Results are summarized below.

All 59 respondents provided comments about what they liked best about the internship program. The most common theme by far was the networking aspect, getting to meet their peers, mentors, faculty members, and like-minded people in general. Other emergent themes were college preparation and the various activities and research projects undertaken, along with a variety of idiosyncratic comments. Illustrative quotes for the networking aspect follow.

- "I enjoyed meeting researchers and learning from their experience in order to conduct my own research."
- "The amazing connections that I have built with my fellow students, as well as our mentors and teachers."



- "Making connections with both professors and fellow students for my time in college."
- "I enjoyed having the chance to meet like-minded individuals."
- "The community feeling and getting to know other science lovers."
- "... having the mentors around really made the experience less stressful! They were always very understanding and helpful and just all around great people."
- "My favorite part of the internship was collaborating and talking to the other interns and mentors in general."

Fifty-five respondents provided comments about how the internship program should be improved. The most common theme was that nothing should be improved, followed by holding the internship in person instead of virtually, making adjustments to specific activities or structures, and improving communications. Illustrative comments for each theme are provided below.

- "I honestly loved how this experience went, I wouldn't change a thing."
- "I think it was great! I don't know if the in-person internship had the nights with mentors but I think they should be kept. It was great hearing what they've learned about college life and giving us undergraduates life-saving tips!"
- "I thought it was really good for having to be online. It wasn't great having to sit in front of a computer screen for so long, but I feel like the leaders and mentors tried to limit our screen time as much as possible. The outdoor activities helped a lot."
- "Not doing it virtual, but I know with the current circumstances that wasn't an option."
- "In person would definitely have been a better experience, but I understand that this was completely circumstantial and if it could have been in person, it would have."
- "Make a computer friendly schedule, less of the website-wide meetings."
- "More in the field work."
- "More time for talking about time management."
- "Getting a schedule of events out to students before the internship even starts so they can better prepare for the pace and work load."
- "I got way too many emails during the internship from the main email person about updates and stuff. I would get an email to tell me someone posted a message or something small that doesn't need an email for."

When asked how they learned about the First2 Network program, all 59 respondents provided a response. The three most common methods were by First2 Network members, through email messages, and by high school counselors or teachers. Fifty-five respondents provided feedback about what worked best and what didn't work in terms of First2 Network recruitment. The most common theme was that students were unsure or had no comment. In terms of what worked well, respondents most frequently noted email messaging and talking with Network members or school staff. Several respondents noted that the First2 Network was "confusing" and several others noted the application process was "horrific" or "janky."



Fifty-eight respondents provided comments when asked what they found most enjoyable and most challenging about doing research. The most common enjoyable aspects included learning and conducting research and networking and collaborating with others. The most common challenges included the virtual nature of the internship, networking and collaborating with others, various data issues, and presenting their findings.

Respondents were asked last how the virtual experience could have been improved. Interestingly, only four respondents suggested having it in person instead of virtually, and four didn't have any suggestions. The most common theme was that no improvements were needed, given the virtual setting; illustrative quotes follow.

- "I think that the virtual experience was as best as it could be!"
- "It went well for a remote virtual experience."
- "Nothing! I enjoyed everything!"
- "I think you guys did great for what we had to work with!"
- "It was a very enjoyable experience."
- "It worked out beautifully in my opinion."

The second most common theme focused on suggestions for improving the structure of the internship; illustrate quotes follow.

- "More hands on things and less screen time. I also felt really pressured about being on meetings all day and night. I think I'd prefer to have all the meetings in the morning and time in the evening to myself to get work completed and to get away from the computer."
- "Get rid of website wide discussions and replace them with breakout rooms for the interns and mentors to talk freely in small groups. While [First2 Network staff] are amazing people, it is harder for interns to connect well with others while under their supervision. A good example would be talking on the phone with your school friends, but your mom is listening to everything said. It causes a filter to be placed on the discussion and limiting how people can connect."
- "Maybe not as long zoom calls, maybe break them up."
- "Have more time in which we could work on our own or away from the computer."
- "Less computer time, more interaction rather than just listening all day."
- "Allow for fewer meetings or more breaks."

### 4.2.1. Intern Survey Summary

In sum, the 2020 summer research internships seem to have been very successful. Approximately 80 students participated in these virtual experiences, of whom more than half were first-generation, Pell-grant eligible, and/or from rural locales. Six subscales showed statistically significant changes from pre to post, including School Belonging, STEM Identity, Knowledge About Research, Attitudes and Behaviors About Research, Personal Skills, and Research Skills. Of those, largest increases were found for Knowledge About Research and


Research Skills. Participants rated the internship experience very favorably, with high ratings for the experience improving their research skills and their knowledge of research within a STEM field. Specific internship components were also rated highly, especially the research mentoring provided by the mentors.

Respondents reported the best part of the internship program was the networking aspect and the most common suggestion for improvement was for an in-person rather than virtual experience (although students did recognize the necessity for the virtual setting). Suggestions for improving the virtual experience focused most frequently on structural adjustments such as less computer time and shorter zoom sessions. Students reported the most common ways of learning about the First2 Network and subsequent successful recruitment were through Network members, email messages, and high school counselors or teachers.

### 4.3. Student Focus Groups

To understand the experiences and perspectives of First2 Network interns, a member of the Evaluation Team conducted four online focus groups in April 2020 with Network students<sup>3</sup> from the four universities that held Network summer immersive research internships in the summer of 2019. The evaluator coordinated with the Network student lead at each university to reach out to prospective participants and to help determine the best date and time to conduct each session. Any students who had participated in any aspect of the First2 Network were invited to participate in one of the focus group sessions. See Table 22 for more details.

University	Date/Time Held	Number of Participants
Fairmont University	April 16, 2020, 12:00 p.m.	3
Marshall University	April 17, 2020, 11:00 a.m.	8
West Virginia State University	April 15, 2020, 6:00 p.m.	5
West Virginia University	April 8, 2020, 6:00 p.m.	7*

#### Table 22. Student Focus Group Details

\*Due to loss of internet service and a subsequent 15-minute period when the host was not able to rejoin the session, several participants dropped out of the focus group during that time.

As a warm-up activity, participants of each group were asked to share one word that described their experience to date in the First2 Network. Although not every participant provided a description, the overall impression given by students' responses indicate a positive perception of the Network, as depicted in Figure 22.

<sup>&</sup>lt;sup>3</sup> Students could be involved in the First2 Network in any number of ways, i.e., participants or mentors in the summer 2019 research internships, campus club leads, directors, mentors, peer tutors, Hometown Ambassadors, Legislative Ambassadors, and/or social media leads.





#### Figure 22. One-Word Description of Student Experiences with the First2 Network

Focus group prompts were organized into five categories, which is how the findings are summarized below. The categories include (1) Demographic Composition of Groups, (2) Initial Awareness and Joining the First2 Network, (3) Summer Research Internship Experiences, (4) Involvement in the Network, and (5) Wrap-Up.

#### 4.3.1. Demographic Composition of Groups

Overwhelmingly, most participants were first-generation college students (neither parent/ guardian had graduated from a four-year institution), were from rural areas, and had declared STEM majors. However, for two of the groups, one student each was unsure about their status, given one student's parent had just recently received her degree and another's parents had graduated from a higher education institution outside the United States. In a third group, one student did not identify as a first-generation college-goer. Further, one student in one group was not a STEM major (but had a STEM minor). Three participants arrived late for one group, so demographic information was not obtained from them.

#### 4.3.2. Initial Awareness and Joining the First2 Network

When asked how they had learned about the First2 Network, the most common routes identified were either by direct invitation from faculty members involved with the Network or by other students or mentors involved with the project. Several others reported learning about the Network through their high schools, HSTA, or at a college orientation.

Students identified a variety of reasons behind their decision to join the First2 Network. The most frequently cited reason was related to the immersive experience that provided them an opportunity to be involved in research and to help make the transition into college by meeting faculty members and other students. Others viewed First2 Network involvement as a benefit to their own college experience or as a way to help other STEM students succeed in college. A few noted that the financial stipend was a major factor in their decision to participate in the Network. A few illustrative quotes are provided below.



- "I did it . . . to see all the different branches of my major and figure out a particular path to go down."
- I think I really did it because it was very inspiring and I wanted to help incoming college students to be ready for college and have strong feelings to STEM majors because it's very easy to get scared in your first two years of college with all the STEM classes you have to take so I really wanted to inspire all these people."
- "For me it was the early research experience and getting the hands-on immersive experience so that I could be on campus before school actually started and gain new friends and get those connections."
- "I thought it kind of hooked me in just because it was almost like HSTA but for college, because I was like already used to being in this type of network that wanted to help firstgeneration and minorities. And, just being able to transfer from high school to college. I thought it was a really easy transition into First2."

Students were asked to suggest additional ways to spread the word about the First2 Network to other potential participants. Ideas focused on further outreach at both the high school and

I think it would be beneficial if even they helped middleschoolers, considering that's also a time whenever students express interest in STEM.

college levels: for high school, students recommended reaching out to all high schools in West Virginia and sharing information through the HSTA clubs statewide. At the college level, they

recommended continuing the First2 Network Ambassadors program, and through that, sharing information via email to the counselors at the schools visited, and asking those counselors to further disseminate that information to other counselors so as to broaden the reach. Other college suggestions were to have Network representatives and materials at student orientations and college booths, and to increase advertising efforts through the media. One student even suggested outreach to middle schools.

When participants were asked to recall their experience during the First2 Network application process, perceptions were mixed as to whether they found it easy or confusing. Two of the participants had applied in a previous time period (during the Network pilot) and their application consisted of emailing their interest to a Network staff member and then engaging in subsequent email exchanges. The remainder of the participants applied via the online system in 2019, and while a few of them noted it was easy or they did not really remember any issues with the application process, others provided a few comments about their experience. One individual

shared that the wording of the first email received about the Network made it appear it was a "scam or something"; another agreed, describing the email language as "a bit sketchy." Others noted

You got to do a 1 or 2 of how much you wanted to go to that campus, but they didn't tell you what was happening on that campus.

specific points of confusion in the application, such as not being sure how to write a cover letter, being unsure of what Network responsibilities would include, confusion about terminology (i.e., "Appalachia"), and not knowing which questions to answer if interested in applying as a scholar



or a student director. One student indicated, "I was unaware that we had to stay on the campus . . . that actually was a little bit difficult for me to try to balance my personal life." And one individual reported that the application process did not provide specific details about each research internship site.

In addition to identifying areas of confusion encountered during the application process, participants also made several specific suggestions for improving the process in the future. One individual suggested the online application be modified so that students could save partial information and then return to complete the application, rather than being required to complete it at one time. Another suggested a "how-to guide," especially related to things like cover letters that students might be unfamiliar with while another suggested clarifying some of the terminology. One participant noted the associated fee for an official transcript and suggested requiring a free, unofficial transcript instead. Two students noted functional improvements—one suggested a notification when the application was submitted (rather than just seeing the same application screen again) and receipt of that application via email. The other suggested a status update feature so that applicants could see where their application was in the process at various times (i.e., still in process, under review). Finally, one individual suggested that as the Network continues growing, have a personal touch built into the process, so that "mini" discussions could take place between applicants and current First2 Network student members in order to provide more concrete details about what the Network involves.

#### 4.3.3. Summer Research Internship Experience

Participants were asked a number of questions about their experience in the summer research internship, the first of which was the extent to which it met their expectations. Several students referred to their earlier comments about not knowing what to expect since few details were provided ahead of time. Overall, students were very positive about their research internships; illustrative quotes are provided below.

- "I think it was really good because going in, I had a little bit of time where I'm like, 'I don't know what I'm doing, I don't feel prepared at all for college, I don't know where anything's at.' So, being on campus . . . that experience was really helpful. . . . And then having mentors there and having the fun times. . . . I think having that free time for fun stuff to connect with the mentors was really important."
- "I definitely thought it was a really valuable experience. . . . Going onto a campus and meeting professors was really fun and a good experience."
- "I feel like it was better than what I thought. I thought it was just going to be peer work, but it turned out to be a lot of fun. We had a lot of great times. I thought it was going to be boring . . . but it was the exact opposite. I didn't want to leave. I was so ready for the beginning of the semester to start."
- "We were all just kind of like nervous because we really didn't know what to expect. . . . It took maybe a couple of days for us to actually figure out whether or not we were going to enjoy ourselves there, and we did."
- "I really liked the team-building exercises on the weekend . . . because it got us students to connect and get familiar with each other and so I would say we came out of the



internship all being super close and now that we're in college we're all constantly helping each other and encouraging each other along the way."

A few participants had constructive feedback for improving future internships. Several students noted that the chemistry research at one research internship turned out to be multiple smaller experiments rather than a more substantial single experiment over the two-week period. According to one of these participants, "It was just like we were doing labs that you do in General Chemistry. It wasn't really like actual research." Another student suggested that knowing ahead of time about industry sites would have led to application at a different site as well as the one attended, noting "I just wish I knew going in." And, one other student commented, "I wish there was some more activities."

Two of the participants had served as mentors during the 2019 research internships, and so had slightly different perceptions to share. One noted "it exceeded my expectations" and how they had

If we saw they weren't going to like something, we went a different route to keep everyone engaged and to make it fun.

made changes to the schedule during the internship to better meet students' interests. Another perceived that "it met the expectation of students depending on their major," noting that more opportunities and associated field trips were needed for a broader variety of STEM majors, including computer science.

When asked what part of the internship provided the most value to their college experiences, nearly all participants focused on the networking aspect, including fellow students, mentors, and faculty. Illustrative quotes are provided below.

- "I think just having a giant support system. We were able to meet everyone in First2 and really have friends."
- "Getting connected to the mentors because I've always been the type of person who gets along with people older than my age, so I really got along with them."
- "I would say it's the network of people that I've met because not only have I made my closest friends through the Network, but our mentors are really good resources for us if we don't know something coming up in [future] years."
- "We did a little bit of 'meet the professors' . . . just having that experience and seeing a different side of professors opened the door for me to have a lot better communication."
- "For me it was also networking . . . it made me more comfortable to talk with [professors] about my problems and then in the end I asked them for a letter of recommendation."
- "I would say for me it was networking and having a group of friends because everyone here is who I hang out with at college and then I met a ton of professors that I had in class or now have in class. We met our faculty advisor who has been great."
- "I think one of the very most valuable things was getting more friends and getting a chance to get inspired and inspire others. . . . This internship gave us all the opportunity to talk about our weaknesses and make us stronger and make incoming freshman ready for college."



A few others pointed out the value gleaned from visiting an industry site, in becoming familiar with the university campus before classes started, being involved in the research, and finding out about available support services. One individual described going to a research symposium near the end of the internship to see other university students present their research: "I thought that was cool because you got to see all the things that even though we only did math and chemistry, you could see some bio projects and things that were there and what other kids were doing that you could do."

Students were also asked how participating in the research internships affected their decisions about a STEM major, influenced their confidence in their ability to do STEM coursework, influenced their sense of self as a future scientist or mathematician, and continued to influence their programs in their STEM majors. Most noted they had already declared their STEM major but added that it did help them identify contacts within their major, strengthened their desire for

I wasn't really confident in myself, so I wasn't 100% sure if I wanted to go to college yet, so the summer internship was like . . . a confidence booster for me. . . . That was the thing that made me decide I can do this and I'm going to do this. a particular STEM major, opened their eyes to new areas of interest within their STEM majors, and provided insights into different fields and research within those fields. A few perceived that it did influence their decisions related to a STEM major.

Students also perceived the internships had influenced their confidence to do STEM coursework. Some noted it helped them know what to expect in some of their classes, gain some experience in doing those activities, and increase their confidence in their research topics. Others focused on learning how to work in a lab setting, forming relationships with upperclassmen and professors that they could go to later for help with their coursework, and increasing their confidence to do presentations. One individual had a different perspective, noting, "I wouldn't say it helped me . . . I wasn't familiar with that chemistry [during the internship]; I was more so being told what to pour, blah, blah, blah, that type of stuff."

Several students provided comments about the internship's influence on their sense of themselves as future scientists or mathematicians. One noted, "With the math project, we actually worked on a real problem for a company, and so I think that helped me see a different side of math . . . I got to see a different side of where math and science could take you." Another shared a similar perspective, "I got insight to see what it was really like doing research in a lab as a scientist because we did get to tour several labs in the chemistry department while we were there." One student described going to the West Virginia capitol and getting to "speak to people and also present; it made me feel powerful, honestly, and like I had a say. You know, being on the sidelines, they hear you but they're not being face-to-face with you."



When sharing how the internship had influenced progress through their STEM majors, students provided various examples. For example, one described taking a computer programming class in the first semester after the internship and how being exposed to that during the internship was helpful.

[First2 Network staff member] has provided a very supportive treatment in a very friendly way. You don't talk to her like you're talking to your boss or something, I always talk to her like I'm talking to my aunt or somebody who really cares about me. She's very loving and caring and I think that really gives you a feeling of connection and you feel confidence to reach out if you need help.

Another described how one of the internship mentors became this student's professor, "so I wasn't scared to go to his office because I knew him personally." Another shared how the First2 Network "allowed me to connect with a professor and I was able to do more research and actually be a part of other research opportunities such as making a light device for his lab." One student specifically called out one of the Network staff members as being particularly important in helping students continue their progress.

The last topic directly related to the research internship focused on what changes should be made to improve future internships. Most frequent suggestions included restructuring the chemistry research so that it was "a full-blown research experience" and offering more diversity in research topics. Other suggestions included providing more details prior to the internship (including any requirements for staying on campus), adding details on previous internships to the First2 Network website so future students could see that information, more peer mentoring, and extending the internship to allow more time for research and to improve the pacing so that information wasn't "squeezed" into a tight time period. Finally, one student suggested some interpersonal training for mentors and staff about how to deal with individuals making inappropriate comments.

#### 4.3.4. Involvement in the First2 Network

This part of the focus groups focused on the First2 Network in a broader sense, not just on the research internship. Students were first asked to describe the various ways in which they were involved in the Network, and they identified a number of different terms to describe the roles they played within the Network. The most common was as a scholar or a director, but students

seemed to use some words interchangeably (such as lead or scholar or director) while other terms were more singular in nature. However, within and across groups, there seemed to be a lack of clarity about exactly what the correct descriptors were to define

The roles were developed this year and we're also abandoning them this year. They didn't work out too well, and the Network saw that. So, our positions are kind of like no more. We're going to be moving to a different type of system where there are going to be campus leads who are then the directors.

their roles. One individual commented, "I've just been a student director even though that title has kind of changed over the past couple of years." Another said, "I'm a student leader and then I'm a student director." One individual seemed to capture the uncertainty of role titles, noting that the Network was moving to a new system of role descriptors. See Figure 23 for a depiction of the various terms used by participants to describe their roles in the Network.





Figure 23: Descriptors for First2 Network Student Roles

When asked how they were balancing participation in the First2 Network with their college responsibilities, much of the discussion focused on how their lives had changed as a result of the COVD-19 pandemic. Some noted the disruptions to their schedules; see sample illustrative quotes below.

- "Right now, it is hard to balance, just because we're out of [our] element now, being at home and trying to do work and I'm watching two little brothers. It's really hard to get my mind straight and try to do everything."
- "You're home, you're sitting on your bed, and you have your books, and some people are struggling with internet, so I think that has made it challenging for students to keep up with all this."
- "Kind of like living your life on hold because you don't know what's happening."

Other participants specifically noted how their Network involvement had decreased with the closing of schools, since there were now fewer Network meetings, no on-campus research, and no face-to-face interactions. Several students spoke about how, prior to

I said I could do X amount of hours per week on [Network] stuff but then they'll send it to you last-minute and then I have to scramble around the plan I already had set up because I hadn't heard anything so I didn't plan on doing anything. And then it's like 'quick, we need this done in the next 24 hours.'

schools closing, they felt like their Network responsibilities were challenging. One noted that



"they'll ask you to do something and then if you do something, they'll ask you to do more. And that just keeps adding up so it's like you really have to make sure to put your foot down. . . . I think you just really have to have a voice and . . . draw the line." Another added, "I think sometimes it's like last-minute things, too, that kind of get me. It throws off that [scheduling] balance."

I feel like a lot of times they listen to us, but there are also sometimes the students can voice our opinions, but it's pushed to the side. It's kind of hit and miss if they listen to you or not. Students provided a variety of insights about the extent to which they felt they individually had a voice in the First2 Network, and while in general most felt their individual voices were heard, a few perceived they did not have

much voice, or that even if their voices were heard, Network actions may not be affected. In other words, they believed that the First2 Network was still being controlled by non-students. Several students provided examples in which their voices were heard but their counsel was not heeded; illustrative quotes are provided below.

- One student reflected on the November 2019 conference that ran from Friday through Sunday and how students had indicated their difficulty in attending on Friday due to school commitments but perceived that Network members were upset about students not coming on Friday. This individual also noted that during that "long" conference, students had homework commitments and time for that activity was not honored. This student's final comment on this topic was that "it's like they're not listening to us."
- Another student described making a suggestion earlier for bringing together students across research internship sites, and "they kind of just blew it off," but that when other individuals made the same suggestion later, "they were like 'we definitely need to do that next year' . . . once it was their idea, it was an amazing idea that needs to happen."

In general, participants thought that students had less of a voice in the First2 Network, for a variety of reasons—for example, because students do not attend all Network meetings, or because they are unsure about with whom they might discuss Network issues. Another individual added that student voice was limited in Network convenings, even when their input was asked for, due to time constraints. However, several participants did perceive that students had an opportunity for their voices to be heard. One noted that "students' voices are prioritized" and another acknowledged that while students are "asked about their opinions frequently . . . not many people speak up for what they want to say."

The issue of equity among students and universities within the First2 Network also arose during this part of the conversations. One participant perceived that "our voices are heard a lot more than many other clubs and programs I've been in" but then went on to say that "some students' voices matter more than others," and that "as long as you get that idea to someone who has more voice, then we have a voice." Another perceived that "some students get more opportunities than others" and by getting a "step ahead," those students will have more opportunities in the future and "get further and further ahead." Yet another individual, who had not participated in a summer research internship, commented that "I wasn't given as many opportunities coming in as people who were part of the summer immersion sites." One student



perceived that students from smaller colleges have less of a presence in the Network and thus may "get left out" to some degree, while another in the same group noted that "it can be the other way, too." This individual noted how smaller colleges may be prioritized over larger universities, and how certain universities may be favored if co-chairs of committees are from those institutions.

When asked about how First2 Network involvement had influenced their ability to progress in their STEM program and persist with their STEM studies, nearly all respondents indicated their involvement in the Network had resulted in positive influences.

I've seen [this student] come out of her shell through the First2 Network and it's just been amazing. I remember meeting her and she was super quiet and now she's gone to these different conferences and meeting legislators. She's just been blowing my mind recently.

Examples included encouragement from First2 Network members, not being "alone" in the process, making connections, inspiring research, social empowerment, and being around "like-minded" people. When one student noted how "it's emboldened me to an extent because I'm not a very social person," another individual confirmed how the Network has influenced that individual. A few illustrative quotes are provided below.

- "No matter what you come to them about, they always try to answer and come up with the solution. Not only has it helped with helping me to stay involved in First2 and continue my networking and continue my research, but I think for other students I can safely say where there is support, it helps them to progress by keeping them in school."
- "No matter how tough my classes or whatever have been, someone from First2 has encouraged me to keep going, whether it was a student or faculty mentor or someone else from First2."
- "I think another thing about First2 is it makes you feel like you're not alone in the process . . . like you can relate to other people."

#### 4.3.5. Wrap Up

In closing, students were asked two final questions. The first was how the First2 Network could provide them with better support as they continued in their STEM programs. Students offered a variety of suggestions, but the most common themes were to continue expanding the Network and to diversify the disciplines within STEM majors. Two illustrative quotes are provided below.

- "I think the best thing right now is just continuing to expand because the more people and majors, the more connections we meet where we can support students."
- "I think we should work to diversify our disciplines. We have a bunch of biology and chemistry but we're lacking in engineering, mathematics, and computer science. I think that really hurts our students because some of our students are getting a lot of help and then there are others that are struggling to find some support in that aspect."

Other suggestions included more timely payments to students, direct deposit for student payments, better student advising, upperclassmen internship opportunities, graduate-level opportunities, and more face-to-face interactions across all universities in West Virginia to



increase involvement statewide. One individual suggested that the campus clubs serve as "brainstorming areas" and that issues raised there be taken to the First2 Network leadership for review and action. "I think that would help to get the overall opinion from students to leadership."

The second question was for students to identify one thing that the First2 Network was doing especially well for them. The most commonly identified themes were the networking aspect in general and the supplemental support being provided by the First2

Going to the conferences was very inspiring to me, all these amazing scientists and all the research they're doing and how interested they are in incoming kids . . . and I think it was really helpful to just see that encouraging and supportive environment, that if anybody else can do it, we can do it, too.

Network (such as offering daily debrief opportunities for students to connect to one another and providing community tutoring opportunities) in order to help students be successful academically, emotionally, and financially in today's online environment given the COVID-19 pandemic.

- "Honestly, for me it's networking. Having a support system in place. . . . I was contacting some friends who aren't involved in First2 and they're going a little stir crazy, but we have meetings every week to talk and make sure we're doing okay and just kind of get away from the craziness and just have some kind of normalcy."
- "I think the Network has been really good about helping us right now with all the transitions and all that. Their first thing was like, 'okay, how do we help people who don't have wi-fi?'. They thought like a parent would about us having to transition, compared to the university that had to do things that were right for safety."
- "They keep us accountable during these times . . . because they're pushing for us to be good in school. Basically, that's our number one priority right now is to get good grades and learn something during this crazy time."

To provide students an opportunity to share any additional feedback they may feel uncomfortable sharing verbally among their peers, participants were given a link to an online survey where they could provide comments anonymously. Across all four focus groups, only two

We also need more anonymous surveys for us to give honest feedback. I feel like I have to hide my opinions to not hurt someone's feelings. students provided any additional feedback, which aligned with what had been suggested during the focus groups. Both focused primarily on the need for the First2 Network to improve its payment

process. Their suggestions included paying students on time, using direct deposit rather than mailing checks, and employing additional staff (financial assistant, web developer, treasurer). These two individuals also suggested more student-led meetings, expanding the diversity of majors among professors, improving the schedule of Network activities ("I feel like we are always three steps behind when we should be two steps ahead"), and improving security of students' personal data (noting that storing such information on Google Drive made "it very easy for a security breach"). Finally, both students confirmed the ongoing need for an anonymous feedback loop so that students have a safe space to share their comments.



#### 4.3.6. Student Focus Group Summary

In sum, respondents most often joined the First2 Network for the immersive experience that involved them in research and eased the transition into college. Feedback about the research internships was positive, with students finding value in the experience and in the networking aspect of the Network. Respondents perceived their participation in the internships positively

influenced their confidence to do STEM coursework and their STEM major programs, and that Network involvement helped them progress and persist in their STEM studies. Students served in a variety of Network roles, yet some confusion

I just really appreciated this opportunity to reflect on our experience with First2 and I think it's really important that all the good stuff is being said as well as the bad stuff that we could improve on.

existed about the differences in those roles. Finally, most respondents perceived their voices were heard within the Network yet believed that students in general had less of a voice. Suggestions for better support included expanding the Network so that more connections could be made, diversifying the disciplines within STEM majors, and using direct deposit to ensure students received prompt payments.

## 4.4. Student Outcomes

#### 4.4.1. 2019 First2 Network Intern Early Persistence Rate

During the First2 Network's second year, Network team members collected data from 2019 interns about their college enrollment and STEM major status. Because Fall-to-Fall STEM reenrollment data are not yet available for the 2019 interns as of this writing, we report Fall 2019to-Spring 2020 re-enrollment instead. According to project records, only 24 of the 30 2019 interns we were able to track persisted in a STEM major between the Fall 2019 and Spring 2020 semesters, for an early STEM persistence rate of 80%. Two interns did not re-enroll in the Spring semester at all, and four re-enrolled but not in a STEM program.

Semester-to-semester STEM persistence rates against which to compare this early finding are difficult to locate. One proxy comparison is to the West Virginia rate of Fall-to-Fall reenrollment in a STEM major amongst rural STEM students eligible for a Pell grant (a proxy for first-generation status as HEPC does not collect this information), which was 78% amongst students who were freshman in 2016, 70% amongst 2017 freshman, and 74% amongst 2018 freshmen (see Appendix C).

In sum, the Fall-to-Spring STEM persistence rate of 2019 interns is slightly higher than the Fall-to-Fall STEM persistence rate of similar students who were freshman in 2016, 2017, and 2018.

#### 4.4.2. Statewide STEM Readiness, Persistence, and Completion Rates

One of the First2 Network shared metrics is the percent of STEM students across West Virginia persisting in their programs of study, regardless of their participation in Network activities. Because the Network also seeks to influence the readiness of STEM students for college and STEM program completion, this evaluation also reports STEM readiness and STEM completion rates.



These data are provided by HEPC and disaggregated by variables of interest to the First2 Network for which data are available. Data are organized by College Readiness (STEM readiness rate), STEM Persistence (retention rate), and STEM Completion (graduation rate). Appendix C2 provides more complete details by College Readiness (Tables 1-3), STEM Persistence (Table 4), and STEM Completion (Table 5).

These data provide point-in-time information as part of the examination of trends throughout the First2 Network. In general, several consistent trends are apparent in these baseline data:

- Pell recipients have significantly lower rates of readiness, persistence, and completion than their non-Pell counterparts.
- Minority youth have significantly lower rates of readiness, persistence, and completion than non-minority youth.
- STEM students have higher readiness and persistence rates than non-STEM students.
- Non-STEM students have higher completion rates than STEM students for the 2017 and 2018 cohorts.

Results by gender are less consistent, but most commonly females have lower readiness rates than males—but higher persistence and completion rates. Results by rurality indicate that rural youth from the 2016 freshmen cohort have similar rates of readiness, persistence, and completion as their non-rural counterparts. However, in general, rural youth from the 2017 and 2018 freshmen cohorts had slightly lower readiness and persistence rates than their non-rural counterparts. In sum, rurality itself does not seem to be an indicator of deleterious effects, but poverty and racism are contributing factors to disparities in rural locations.

To showcase areas of interest within readiness, persistence, and completion, Figures 24-29 are presented on the next several pages. Note that all these depictions focus on students based on whether they were a STEM major or a non-STEM major during their first year.

For College Readiness (Figures 24 and 25), Figure 24 shows that STEM students have higher rates of STEM readiness than Non-STEM students, regardless of rurality, for all three cohorts. Rural STEM and Non-Rural STEM students show an increase in STEM readiness rates from the 2016 to 2017 cohort, but then a slight decline from the 2017 to 2018 cohort. The Non-STEM groups (both Rural and Non-Rural) both show an increase in STEM readiness rates for each successive cohort, yet these rates are still considerably lower than their STEM counterparts.

Figure 25 shows that for STEM students, Pell recipients have lower STEM readiness rates than their Non-Pell counterparts, regardless of rurality, for all three cohorts. Non-Rural STEM Pell recipients show an increase in STEM readiness rates for each successive cohort, while the other three groups (Rural STEM Pell, Rural STEM Non-Pell, and Non-Rural STEM Non-Pell) all show increases in readiness rates from the 2016 to 2017 cohort and then either a slight decrease or remain the same from the 2017 to 2018 cohort.





Figure 24. STEM Readiness Rate (Percentage): Rurality by Major



Figure 25. STEM Readiness Rate (Percentage): Rurality by STEM Major by Pell

For College Persistence (Figures 26 and 27), Figure 26 shows that STEM students have higher retention rates than Non-STEM students, regardless of rurality, for all three cohorts. All four groups show a decrease in retention rates from the 2016 to 2017 cohorts, then an increase from the 2017 to 2018 cohorts, bringing the rates back to a close approximation of the 2016 rates.

Figure 27 shows that for STEM students, Pell students have lower retention rates than their Non-Pell counterparts, regardless of rurality, for all three cohorts. All four groups show decreases in retention rates from the 2016 to 2017 cohorts, followed by a slight increase from 2017 to 2018 cohorts. Only the Non-Rural STEM Pell recipients have a higher rate at 2018 than at 2016.





Figure 26. Fall-to-Fall Retention Rate (Percentage): Rurality by Major



Figure 25. Fall-to-Fall Retention Rate (Percentage): Rurality by STEM Major by Pell

For College Completion (Figures 28 and 29), Figure 28 shows that STEM students have lower graduation rates than Non-STEM students, regardless of rurality, for the 2017 and 2018 cohorts, but the 2016 cohort has higher graduation rates for STEM compared to Non-STEM students. Rural STEM students show a decrease in graduation rates for each successive cohort, while Non-Rural Non-STEM students show an increase each year in graduation rates.

Figure 29 shows that for STEM students, Pell recipients have lower graduation rates than their Non-Pell counterparts, regardless of rurality, for all three cohorts. However, Rural STEM Pell



recipients show an increase in graduation rates for each successive cohort, while the Non-Rural STEM Pell recipients show a decline in graduation rates for each cohort.



Figure 28. 4-Year Graduation Rate (Percentage): Rurality by Major





#### 4.4.3. Student Outcomes Summary

In sum, the First2 interns had slightly higher persistence rates when compared to West Virginia rural STEM Pell-eligible students. Further, in looking at West Virginia students in general, Pell-eligible and minority youth had lower rates of readiness, persistence, and completion than their counterparts. STEM students had higher rates of readiness and persistence than non-STEM students, yet lower completion rates. And, females had lower readiness rates yet higher rates of persistence and completion than their male counterparts.



# **III. Conclusions and Recommendations**

This section synthesizes findings from evaluation of the First2 Network's second year of implementation and offers recommendations based on those conclusions for Network leaders to consider.

## 1. Conclusions

## 1.1. Context in which the First2 Network Operates

The COVID-19 pandemic was (and continues to be) a significant contextual factor in the life of the First2 Network. Beginning in March 2020, Network members faced uncertainty about how to remain safe and healthy. Campuses around the state terminated face-to-face classes and asked faculty to transition the remainder of their courses to online formats. Participation in classes online proved to be a challenge for First2 Network students who lacked computers and access to robust broadband in their home communities. To address this need, the Network exerted considerable effort to ensure that students were safe, had access to a computer, and were able to connect to the internet. Network members also reconceptualized summer internships, transitioning to synchronous and asynchronous online experiences. As of this writing, it remains unclear how the next academic year will progress as institutions attempt to reopen safely while infection rates continue to climb.

COVID-19 aside, much about the context in which the First2 Network operates remained consistent between the project's first and second years. West Virginia remains poorer, less diverse, and less educated than the nation in general. According to data from the state's achievement assessment, fewer than half of 4th graders, slightly more than a third of 8th graders, and about half of 11th graders were proficient or higher in math in 2019. NAEP data indicated that only 29% of 8th grade students scored at or above proficient on the math assessment. On the other hand, graduation rates have improved since 2013 and average ACT scores increased slightly in 2019. Nonetheless, only a third (33%) of West Virginia high school graduates scored at or above the ACT Math Benchmark and only 34% scored at or above the ACT Science Benchmark.

West Virginia remains an EPSCOR state, one indicator of limited STEM capacity. 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.

## 1.2. First2 Network Structures and Processes

The First2 Network expanded in size from 144 members in Year 1 to 283 members by the end of Year 2, representing an increase of 97%. The number of interns also increased by 157%, rising from 30 in Year 1 to 77 in Year 2. Interns from both years are more racially/ethnically diverse than the general West Virginia population, with 9.1% of interns identifying as African



American (compared to 3.6% in the state) and 2.0% as Hispanic/Latinx (compared to 1.7% in the state).

The First2 Network made substantial progress toward full implementation of four of the five elements of collaborative infrastructure. Network documents and member feedback indicate that members embraced a shared vision, which they promoted across the state via conference presentations, legislative and hometown visits, and collaboration with other STEM stakeholders. The Network continued to expand its partnerships with ongoing outreach, the execution of MOUs formalizing institutional alliances, and new relationships with national STEM education and first-generation collaboratives. Adults and students alike were offered leadership development opportunities and leadership roles. The Network undertook strategic planning, establishment of an Advisory Board of state education leaders, and outreach to policymakers and other STEM education stakeholders to enable expansion and sustainability. However, although Network leaders defined shared metrics this year, communication about them was limited and most members remain unaware of them.

In terms of the functioning of working groups, activities associated with collaboration, dissemination, reflecting on equity, and building capacity were viewed by members as strengths. In addition, working group members rated activities associated with PDSA cycles—Plan, Do, Study, and Act—somewhat more highly in Year 2 than they had in Year 1. On the other hand, mean ratings associated with the Study phase varied widely across quarters, suggesting that working group members might benefit from additional training and support about this phase. In addition, although ratings of various dimensions of working group activity did not change dramatically between Year 1 and Year 2, the percent of respondents rating several individual items as strengths decreased over time.

According to members, the most important Network achievements thus far include the collaborative opportunities generated through the Network, the genuine promotion of student voice and leadership, provisions of multiple supports and resources for students, and rapid Network development and expansion. The most effective Network structures and processes this year, according to members, were opportunities for collaboration and the ways in which working groups facilitated focus on specific aspects of STEM attrition. Asked to discuss how the Network influenced their institutions, members reported that the Network had ensured that rural, first-generation STEM students had access to more support, resources, and connections on their campuses.

On the other hand, members experienced several barriers to Network progress, such as the shortage of sufficient time to engage in Network activities, education policies that prioritize accountability and assessment rather than instruction and curiosity, and lack of broadband access, particularly in rural areas. Members offered several suggestions for improvement, with recommendations for scheduling improvements, tightening Network goals and focus, and improving communications across the Network.

Just as Network members reported operational and functional improvements, so too did Network leaders. According to survey responses, Steering Committee operations have improved considerably since the Network's first year. However, some governance issues remain



to be resolved, such as the implementation of a comprehensive communications plan and improved role clarity.

## 1.3. Systems Targeted by the First2 Network

One of the systems changes sought by the First2 Network is the establishment of a fully functional, sustainable backbone organization housed at HEPC DSR. Substantial progress was achieved over the course of the Network's second year, with improved staffing, more targeted mentoring, and enhanced clarity about roles and responsibilities. Nonetheless, room for further development remains in terms of improved communications across the Network and to other STEM education stakeholders in the state and the formation of more partnerships. Another issue is the need to integrate the Network more deeply into the larger HEPC organization, given that the DSR is a distinct and relatively autonomous unit within HEPC. Embedding the First2 Network backbone more fully into HEPC will support its longer-term durability. Finally, work remains to be accomplished to clarify responsibilities and transfer the responsibility for identified activities from the Leadership Team to the backbone organization.

Another systems change pursued by the Network is the development of 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. Mean ratings from 2020 administration of the Network Value Survey were slightly lower overall than those from the 2019 administration, suggesting that Network members tended to value the various benefits of participation relatively similarly across both years. Network members continued to value most highly the networking and community building, and knowledge acquisition, benefits associated with their First2 Network engagement.

Members of the First2 Network undertook an array of efforts to improve the systems that can enable or constrain the early STEM persistence of rural, first-generation students in West Virginia. These included attempts to improve the pathways, and the linkages among such pathways, along which students travel across their academic experiences, by participating in PDSA cycles to identify, test, and refine discrete improvements on a small scale. In terms of structural change, the Network sought to alter the power dynamics that dissuade students from communicating their needs to authority figures by providing entrée to legislators and state education leaders, and by structuring opportunities for students to discuss their STEM persistence challenges with all Network members. The First2 Network also strove to create structural enablers to support improvements to STEM persistence. Such activities 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.

### 1.4. Impact of the First2 Network

An important impact of the First2 Network is the development of stronger STEM social capital across West Virginia. STEM social capital<sup>48</sup> includes the social connections between STEM



stakeholders—relationships, reciprocities, networks—that facilitate potential access to tangible resources, such as STEM educational opportunities, scholarships, internships, research projects, jobs, and funding. Compared to the project's first year of operation, the First2 Network has more members, more multidirectional relationships among members, and stronger collaboration, all indicating notable growth in the STEM social capital of members.

Focus groups with students illuminated the ways in which 2019 summer internship participation affected students. 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. In addition, students reported that internships improved their confidence to do STEM coursework and that ongoing Network support helped them progress and persist in their STEM studies. Although students served in a variety of Network roles, some students were unclear about the distinctions among roles. In addition, students thought that Network members genuinely cared about their perspectives and respected their voices during meetings—but students also tended to think that they had relatively less power to lead the Network and to offer suggestions that would be taken up. Suggestions for better support of students included expanding the Network so that more connections could be made, diversifying the disciplines within STEM majors, and using direct deposit to ensure students received prompt payments.

Students participating in 2020 summer internships demonstrated statistically significant growth between pre- and posttest on six measures. Thus, 2020 interns had a stronger sense of school belonging and STEM identity after participating in their 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 build their STEM social capital.

Because the Fall 2020 semester has not commenced for 2019 First2 Network interns, it is not yet possible to analyze their Fall-to-Fall persistence rates. The Evaluation Team instead analyzed Fall-to-Spring persistence, finding 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 freshman in 2016, 2017, and 2018.

## 2. Recommendations

The following recommendations for improvement are based upon findings and conclusions generated via the Year 2 evaluation of the First2 Network. Network leaders may want to consider these as they plan for the coming years.

• Continue proactive recruitment of members and interns: The Network achieved a growth rate of 97% in its membership between Year 1 and Year 2 and of 157% in the number of summer 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. Such communication strategies might include the development of a regularly updated data dashboard displaying progress over time, video summaries of new research and evaluation findings, and infographics summarizing the latest metrics.
- 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. Network leaders should continue to leverage the knowledge and skill of Measurement Team members to offer this assistance. For instance, in addition to developing a suite of materials about PDSAs, members of the Measurement Team serve as liaisons to each working group. As PDSAs progress, Network leaders might want to consider collaborating with the Measurement Team to identify or create materials and trainings about the later stages of improvement science processes, such as how to learn from iterations in multiple locations, how to identify and test additional processes or supports to ensure reliable implementation, and how to determine when a practice is ready for wide-scale adoption.
- 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. For instance, smaller percentages of working group members rated the following as strengths in Q4 than had in earlier quarters; these may be fruitful issues around which to engage members and offer assistance:
  - **Collaborate:** The working group...
    - includes rural first-generation students
    - ensures that student perspectives are considered
    - members establish norms of interaction that support collaborative decision-making and equitable participation in all phases of the work
  - **Disseminate:** The working group...
    - contributes to Network dissemination efforts



- shares results in ways that take into account the needs of relevant audiences
- develops and shares new tools and/or routines that can be adapted to support improvement work in other settings
- **Reflect on Equity:** The working group...
  - develops targeted strategies that specifically and differentially take into account underlying advantages that some people have, as well as challenges that other groups face
  - focuses attention on policies, practices, and culture that are reinforcing patterns of inequity in the state
- 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: Some Network members indicated that they were unclear about the time required to participate in the Network and what responsibilities members would be asked to undertake. Given this, Network leaders could post clear information about membership roles and responsibilities on the 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: Network members reported that they wanted regular, easily accessible information about Network activities, opportunities, and results. To address this need, staff of the backbone organization developed a communications plan and began the process of transferring responsibility for communications to the backbone. In the coming year, Network leaders should fully implement the 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: The Network engaged in several activities to bolster its durability. These included strategic planning, developing an Advisory Committee of prominent state education leaders, and meeting with legislators to promote the Network. Another issue is the need to integrate the Network more deeply into the larger HEPC organization, given that the DSR is a distinct and relatively autonomous unit within HEPC. Embedding the First2 Network backbone more fully into HEPC will support its



longer-term durability by ensuring that a wider group of HEPC staff are aware and supportive of its work. 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: The Network aims not just to improve the early STEM persistence of its summer interns—it also seeks to improve STEM persistence and program completion across the state. The principal method the Network employs to pursue change is via improvement science processes conducted in working groups. Many of the improvements tested via PDSAs are practices (such as helping students use metacognition strategies, improving office hours processes, implementing exam interventions, and facilitating campus clubs), which are entirely appropriate for improvement science iteration. Given that the Network also 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 development and alliance-building activities generated STEM social capital, as evidenced by a larger membership, a larger number of connections among members, and a larger percent of relationships among members that are considered collaborative (versus merely cooperative). Network leaders should plan how to invest such STEM social capital to advance its 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: Network members tend to agree that the Network provides students with genuine leadership and participation opportunities. Nonetheless, some students indicate that their suggestions for Network improvement are not enacted, an irony that highlights the conventional power differentials between students and faculty. Given that the elevation of student voice is a core Network value, Network leaders should address student concerns forthrightly and collaboratively, perhaps during a series of planning sessions.
- 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.



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<sup>3</sup> Southern Regional Education Board. (2019). West Virginia featured facts: From the SREB book on higher education. Retrieved from <u>https://www.sreb.org/sites/main/files/file-</u>attachments/westvirginia19\_finalweb.pdf?1563376170

<sup>4</sup> Turner, S., Merchant, K., Kania, J., & Martin, E. (2012). Understanding the value of backbone organizations in collective impact. *Stanford Social Innovation Review*. Retrieved from

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