

# First2 Network Response to Reverse Site Visit Recommendations

## Introduction

The First2 Network thanks our program officer and the review panel for their time and thoughtfulness in reviewing our progress-to-date on our goals and activities as an NSF INCLUDES Alliance. We especially valued the panel's willingness to hold free discussions with our team to gain a deeper view of our work beyond that delivered in our prepared remarks. It was certainly challenging for us as a team to decide what to highlight, and what to leave out. It was an educational experience to say the least, and the recommendations put forth by the review panel will strengthen and align our work moving forward.

The panel organized their recommendations by the three presentations given: Alliance Overview, Goals and Metrics, and Connections to the National Network, and we have chosen to organize our response likewise. There is a fourth section entitled Other Recommendations.

## 1. Overview Recommendations

1.1 Demonstrate how summer research immersion programs and other activities (campus clubs) impact self-efficacy and science identity of first-generation students.

First2 Network STEM retention strategies including summer immersion experiences and campus clubs reflect a solid body of research based on the ideas presented in situated learning theory and cognitive apprenticeships, which posit that learning happens best within the activity and context of a community of practice. This approach influences students' STEM identity, self-efficacy, and motivation, which in turn improves retention. Motivational theories like Social Cognitive Career Theory first proposed by Lent, Brown, & Hackett suggest that STEM persistence can be profoundly impacted by STEM self-efficacy, identity and interest.

Empirical data supports the connection between the development of STEM identity and self-efficacy and retention. The National Survey of Student Engagement (see for example: [http://nsse.indiana.edu/html/high\\_impact\\_practices.cfm](http://nsse.indiana.edu/html/high_impact_practices.cfm)) describes several "high-impact" practices that positively affect student learning and retention: Among them are service-learning courses, learning communities, internships, and research with faculty.

Within the First2 Network, first generation and other underrepresented students gain entry into STEM communities of practice as entering college freshmen through 2-week summer STEM research internships. Students participate in numerous activities, and the STEM research they engage in is a key component. They work with their peers, while mentored by an upper-level undergraduate STEM student and a research faculty member in a laboratory setting, on a real research problem. They engage in the scholarly and social activities of a research group. In 2019, four universities hosted 31 rising freshman STEM majors in summer research internships.

The evaluation team collected data on this first group of students, using the First2 Network Summer Research Internship Student Survey. The survey includes a series of validated subscales, taken from the First2 STEM-R Survey (DGE-1561517) that measure STEM self-efficacy and identity. The STEM career subscale asks respondents to indicate how certain they are about their decision to pursue STEM education and career. The STEM efficacy subscale measures students' expectations about how well they think they will perform in their STEM courses, and

the school belonging subscale assesses the extent to which students think they will feel connected to their college. The STEM identity subscale gauges students' sense of themselves as people who are engaged with STEM, and the STEM plans subscale assesses students' plans to pursue STEM education and career. **Short-term statistically significant gains were made in feelings of STEM self-efficacy, belonging and identity (N=27).**

Subscale	Pretest Results			Posttest Results			Statistical Results Mean Difference (Post – Pre)
	Number	Mean	Std. Dev.	Number	Mean	Std. Dev.	
Career	25	3.88	0.52	25	3.94	0.58	0.06
Efficacy	24	3.99	0.55	24	4.27	0.49	0.28*
Belonging	23	3.93	0.53	23	4.52	0.57	0.59*
Identity	23	3.78	0.63	23	4.17	0.72	0.39*
STEM Plan	23	4.43	0.66	23	4.65	0.44	0.22

\*Statistically significant at .05.

Figure 1: Pre-post results of 2019 summer intern participants

We recognize that short-term gains do not necessarily indicate long-term impact. Of the 31 2019 summer interns for whom we have data, 3 dropped out of college and 4 changed their major to a non-STEM field between their freshman Fall and Spring semesters, for an interim STEM persistence rate of 77%. Follow-up data are scheduled to be collected each spring through focus groups with students nearing the end of their freshman year, during which they will be asked to reflect on their internship experiences and how those may have contributed to their STEM persistence, as well as the factors that contributed to an exit from STEM. We will report freshman to sophomore STEM persistence in Q4 when data become available.

1.2 Strengthen broadening participation outcomes to clearly demonstrate the impact of First2 Network activities on creating a diverse, innovative STEM workforce.

Our strategies to address this recommendation are embedded in other responses below, and include: aligning our logic model outcomes with our goals, aligning First2 metrics at the micro, meso and macro level with goals and outcomes, and completing our strategic plan for sustainability.

1.3 Strengthen stakeholder partnerships with K-12, government, industry, and higher education decision-makers.

The First2 Network has grown from 16 partner organizations to over 50 since the inception of our Alliance. We have cast a wide net to bring interested parties to the table.

Our next steps will strengthen these partnerships. We have, over the last 6 months, begun to require MOUs between First2 Network and collaborative partners that require the participation of institutional decision makers. Many of the subsequent Reverse Site Visit recommendations relating to workforce provide us with clear opportunities to engage partners intentionally to accomplish mutually beneficial well-defined tasks.

As part of our strategic planning, we recently engaged our Capacity Building work group and Steering Committee in discussions on building and strengthening partnerships. We clarified our long-term goal around partnerships and identified indicators of strong partnerships and action items in the next 6-12 months and 2-3 years to reach our goal. Next steps (as part of the strategic plan development) include further brainstorming on action steps, creating a timeline with key milestones and evaluation metrics, and assigning roles for implementation.

#### 1.4 Engage experts, researchers, and organizations to better understand student success of underrepresented and underserved populations in STEM.

The First2 Network enjoys the expertise represented by all of the members within the NSF INCLUDES National Network. We will continue to learn from their projects related to student success in STEM. We have invited other INCLUDES Alliance PIs to First2 Network Conferences, and will continue to find ways to engage with the membership to broaden our knowledge. In addition, the MOU process is ongoing to bring multiple institutions into our research. Member institutions collecting data already encompass a significant majority of STEM students in the state.

It must be said, however, that there is very little in the way of an extant research base on the success of **Rural First-Generation STEM** students, and that is why we have knowledgeable research and evaluation teams, with relevant experience in rural education research. The First2 Network research team includes deep expertise in discipline-based education research and instrument development including education researchers in mathematics and physics departments and a social scientist with over 20 years' experience.

## 2. Goals, Metrics and Evaluation Recommendations

### 2.1 Assessing undergraduate research outcomes would bring great opportunity and strength to the research.

The evaluation team agrees that documenting the research to which First2 Network students contribute will assist the First2 Network team to learn from such efforts and to inform others about tactics for broadening participation. To this end, the evaluation team will continue to employ multiple methods to evaluate student research experiences. These methods include review of documents associated with First2 Network research opportunities and follow-up focus groups with students approximately 9 months after their first summer internship experience. Additionally, in response to this recommendation, the evaluation team will identify and add to the intern survey a subscale whereby students rate the meaningfulness of their research experiences. Together, these three methods will enable the evaluation team to describe research opportunities in which First2 students participate, investigate student perspectives on such opportunities, and quantify the value of these experiences to students.

### 2.2 It may be useful to consider mapping the stated goals of the project to the Logic Model in a more formal manner.

During quarter 4 of this year, the measurement and evaluation teams will facilitate a process to help the First2 Network leadership revise the logic model. This will likely involve at least one work session and several iterative revisions via email. This process will ensure that the evaluation plan provides for the collection of data associated with each major logic model outcome. However, in response to this recommendation, work has already begun to align the project's goals with the current version of the logic model. Our Measurement Team has also audited our shared measures document to align them to our stated goals and to identify gaps in data collection.

Progress will be reported in the next quarterly report. All of these efforts: to align our goals and logic model outputs and outcomes, to revise our logic model, and to align our measurement portfolio with our goals, are co-requisite to the development of our strategic plan for sustainability.

2.3 It may be useful to design a table that allows the team to look holistically at the overall performance of the cohorts of students and the placement over time. For example, a table that tracks students from K-12, community college, undergraduate, graduate, PhD, Post-doctoral, Faculty, Internships, and STEM jobs on a year by year basis. A dashboard table like this may support future assessment.

Work on this is underway for all First2 Network students. We are currently in the process of establishing a disaggregated data dashboard that will link from our sustaining backbone's website, with these and other data of interest to the network such as STEM retention through the first and second years of college.

In addition, the evaluation team has established a data agreement with HEPC Division of Policy and Planning to provide data to First2 Network on key outcome variables from **across the state**:

- percentage of ACT/SAT test-takers who are considered STEM ready
- average ACT and SAT composite, math, and science scores
- annual STEM retention rates [freshman to sophomore, sophomore to junior]
- STEM graduation rates (4-year and 6-year)

HEPC will provide these data for the state overall, as well as disaggregated by:

- Rural and nonrural
- Pell eligibility status
- Gender
- Race/ethnicity
- Rural/nonrural x Pell status.

HEPC does not provide first-generation status data due to FAFSA privacy laws, so we will rely on such data emerging from institutions signing MOUs with the Network to analyze STEM persistence amongst rural, first-generation students. Until we obtain these data, we will employ Pell eligibility status as a proxy for first-generation status, recognizing that it is an imperfect substitution (e.g., it is likely that not all first-generation students are Pell-eligible, so our proxy measures may underestimate first-generation status).

2.4 Consider creating a database of students, who are in the aforementioned status, that employers in the West Virginia Area could access for recruitment.

We agree that it is important in growing a vibrant STEM economy in our state to connect STEM employers with STEM talent. Our Capacity Building team will work with our Industry partners

and industry associations to explore existing platforms like LinkedIn and [Tallo](#) that might accomplish this recommendation. The Network's aim, as proposed to the NSF, is first and foremost to improve our first generation students' chances of attaining that BA/BS degree in a STEM field.

2.5 Document, measure and assess the PDSA projects. They seem to be something special about the project. Describe how these projects promote STEM. List the titles, the faculty, the student (as appropriate), the problem statement, the process, and the outcomes.

We think we're doing a good job of meeting this recommendation. The First2 Network documents all PDSAs. All PDSA projects are eventually curated on the online Networked Improvement Learning and Support (NILS™) platform developed by the Carnegie Foundation for the Advancement of Teaching. The purpose of NILS is to allow the growth of Improvement Science through sharing of PDSAs.

Some working groups use this platform extensively, others record PDSAs on digital templates and then transfer them to NILS. Some examples of PDSA documentation from NILS and our own digital forms are available for review in our [Response Supplements Folder](#).

Assessment of PDSAs is ongoing. The Measurement Group recently conducted a thorough audit of the PDSAs entered into the NILS system in order to assess their fidelity to the Carnegie Foundation intent. They identified several areas of concern that warrant additional professional development to improve our expertise in designing and implementing PDSAs. PDSA coaches have been assigned to each working group, and have scheduled or conducted virtual PDSA workshops.

We agree that disseminating both the lessons we are learning as a network relatively new to improvement science, and highlighting PDSAs that improve persistence outcomes would be valuable to others. We will add this objective to the Communication plan being developed by our sustaining backbone organization (HEPC-DSR).

2.6 Make sure that the IRB approval takes into account all network institutions, and has been approved by every institution.

All Network institutions that sign an MOU with the First2 Network enter into an IRB arrangement with West Virginia University to allow the research team to collect data from students at participating institutions. WVU provides assistance in gaining Institutional Review Board (IRB) approval via the IRB Authorization Agreement (IAA) with WVU or their own institution, if necessary, to collect the necessary data.

2.7 It may be helpful to investigate research methods from other social sciences literature.

Questionnaires that have reliable R-squares and other validation measures should be considered.

The First2 Team did an inadequate job of communicating the robustness of our Evaluation and Research methods during our Reverse Site Visit, and hope to clarify that here:

**2.7.a. Research.** As proposed, the quantitative retention research builds on the NSF-funded EHR Core Research project STEM-R: Modeling STEM Retention and Departure across Physics, Mathematics, and Engineering (DGE-1561517). Many survey items used were taken from published works and have been shown to be valid and reliable. These were cited in the proposal.<sup>1-4</sup> The quantitative research team, as proposed, is developing needed additional scales

around career decision making for the age group targeted in First2. Validity and reliability analyses of these new scales will be published in peer-reviewed journals. STEM-R and INCLUDES/STEM-R-based research is being published in highly respected journals.<sup>5-7</sup> Survey-specific results are published in peer-reviewed conference proceedings,<sup>8-13</sup> the first journal paper is currently under review.

The qualitative research team is using traditional Social Network Analysis (SNA) methods to answer the research questions “What types of meaningful networks are forming among entities within the state?”, “What are the structures of the relationships that are forming?”, and “What are the best ways that the network can share knowledge and resources to assist student persistence in STEM?” as proposed. Social network studies seek to observe, characterize, and draw conclusions from patterns of connections among associates in some setting of interest. Examples range from patterns of play among school children<sup>14</sup> to strategic alliance and competition among corporations on the international economic stage.<sup>15</sup> Many studies use SNA for analysis of educational networks. Baker-Doylea and Yoonb<sup>16</sup> use SNA for understanding and facilitating teacher collaboration in STEM professional development. Kezar<sup>17</sup> does a review of research that looks at higher education change and social networks. Ma, Herman, West, Tomkin, and Mestre<sup>18</sup> are using SNA to study STEM faculty communities of practice. These and similar published studies are being used as a basis for how the data being collected is analyzed.

The qualitative research team developed surveys using standard social network survey questions. These questions were reviewed for validity by the leadership team, the evaluation team and the quantitative research team. The data is preprocessed for input to the free SocNetV tool. This tool provides a vast range of analysis methods, including Information Centrality,<sup>19</sup> Average Graph Distance,<sup>20</sup> global Clustering Coefficient,<sup>21</sup> and local Clustering Coefficient<sup>22</sup> to analyze and graphically depict the data.

Two new measures, “social conductivity” and “robustness” were created and compared with other measures as a master’s thesis.<sup>23</sup> Social conductivity for a pair of actors is a number that represents all the paths between those two actors. Robustness between actors takes the social conductivity measure and deletes any direct connection between them. Network values for these measures are the average of the measure over all actors in the network.

Other proposed questions “What does it mean to be rural and non-rural in WV?” and “What does it mean to be a first-generation college student?” are both more nuanced than is captured in the most common ways of measuring these statuses. Students from the pilot year were interviewed. Content analysis<sup>24</sup> of interview data was used. Student interview transcripts were coded by a team of coders to identify patterns. Thematic analysis<sup>25</sup> was used to determine emerging themes to develop a survey to be used with a broader population.

Existing definitions of rural seem unlikely to capture the information in terms of characteristics that encourage student participation in STEM, such as the availability of resources that are potentially inspiring, such as museums or libraries or technology-based industry, transit systems, post-secondary schools, and cultural and STEM activities. It is here that West Virginia’s small size provides an advantage as we can create an asset map and compare to models built based on data more accessible to institutions. This research may allow institutions to capture data impacting retention needs with a few additional items on a college application.

Spiegler and Bednarek<sup>26</sup> summarized over 70 research articles and reports on first-generation students from several countries and found an issue in this research is the differences in how

first-generation students are defined. To begin to answer the proposed research question “What does it mean to be a first-generation college student?” and inform a refined definition of first generation, the team developed and implemented an interview that was administered to a cohort of students, currently in their second year as undergraduate STEM majors, who were involved in a summer immersive experience with the First2 STEM Success Network before college. While the U.S. Department of Education defines a first-generation student as someone whose parent(s) and /or guardian(s) do not have a bachelor's degree, based on the interview data we have identified the following levels of first-generation that may have differing effects on students’ persistence in college and/or STEM; (1) Parents or guardians attended some college; (2) Siblings attended or completed college; parents did not attend; (3) Extended family (grandparents, aunts/uncles, cousins) attended or completed college; parents or siblings did not; (4) No one in immediate or extended family attended college. Ongoing research will seek to apply these levels and compare impact on persistence, controlling for a large number of college readiness and success metrics including College GPA, High School GPA, ACT, SAT, AP classes, transfer classes, and success in critical core classes and school level characteristics including the fraction of future STEM majors, AP classes offered, and socioeconomic variables.

**2.7.b. Evaluation:** The First2 Network evaluation employs extant, psychometrically sound instruments as part of its multimethod approach. For instance,

**Intern Survey.** This survey, administered to student participants in the network’s immersive research experiences before and after their participation, includes five subscales adapted from extant instruments. The STEM career subscale asks respondents to indicate how certain they are about their decision to pursue STEM education and career.<sup>1</sup> The STEM efficacy subscale measures students’ expectations about how well they think they will perform in their STEM courses, and the school belonging subscale assesses the extent to which students think they will feel connected to their college<sup>2</sup>. The STEM identity subscale gauges students’ sense of themselves as people who are engaged with STEM, and the STEM plans subscale assesses students’ plans to pursue STEM education and career<sup>3,4</sup>.

**Working Group Self-Assessment.** This instrument is administered online to members of working groups semi-annually to evaluate the extent to which each is making progress toward the implementation of key working group functions. The self-assessment asks First2 Network members to rate 33 indicators across a total of eight dimensions – collaborate, plan, do, study, act, disseminate, equity, and capacity. To assess collaboration, ICF modified an existing validated collaboration assessment tool (CAT)<sup>5</sup>. The next four dimensions utilize 20 indicators to assess the PDSA (plan, do, study, act) cycles that guide processes of improvement. The remaining three dimensions incorporate indicators of dissemination, equity, and capacity.

Working group assessments employ a rubric rating system to identify areas of weakness and strength in the group’s working capacity to engage in improvement efforts and achieve goals. Specifically, the self-assessment instrument uses a scale of weakness and strength in which working group members are asked to determine whether each indicator is a strength or a weakness by marking an “X” in the cell that reflects their understanding of the group’s status. For the lower threshold the working group member would select that the indicator “is more a weakness than a strength for our working group.” For the higher threshold, the member selects the language “This is a strength for our working group.”

The other evaluation instruments were developed to align as closely as possible with specific First2 Network needs and contexts; no extant instrument met our needs. We calculate reliability statistics for the quantitative instruments we developed to help ensure their psychometric soundness.

### 3. Connecting to the National Network Recommendations

3.1 Plans for future activities are ambitious. The panel advises First2 to be strategic and focused about which plans receive their attention in the coming years. A well-developed organizational model and 10-year plan, with clear assessment indicators, will assist First2 in reaching their long-term goals. The panel encourages the Alliance to clearly define the changing roles of SRI and HEPC, in both the short and long term.

This is a timely recommendation. Both backbone organizations are currently engaged in:

- establishing HEPC-DSR's leadership within the network. This includes onboarding of the newly hired First2 Network Coordinator, and the reassignment of distributed management roles to HEPC. SRI and HEPC are also developing a plan to clarify roles as HEPC transitions to serving as the lead backbone organization.
- aligning Network goals and metrics with the First2 Network Logic Model
- facilitating the work of the leadership team and working group co-chairs to begin the strategic plan process. The plan will address three priorities for sustainability: **backbone infrastructure** to support First2 goals and activities, the capacity of member **institutions** to implement First2 initiatives and effective **partnerships**. The plan will be organized by the 5 elements of collaborative infrastructure as outlined in the Logic Model. Components for each priority include:
  - Indicators: What would it look like if we achieved this goal (i.e., what are measurable indicators?)
  - Key Focus Areas: What are the key activities/areas that need to be addressed to reach this goal?
  - Actions in 2 years: what actions do we need to take in the next two years to make progress toward the goal
  - Actions in 6-12 months: what actions can we take in the next 6-12 months to make progress toward the goal.

Initial work has included an interactive presentation to the steering committee by SRI on using a systems approach to build for sustainability, brainstorming sessions with leadership and the Capacity Building working groups on the components described above, and meetings with the backbone organizations to outline a process and timeline for developing the strategic plan.

In the next several months, we will be developing a draft strategic plan, which will be reviewed by an external advisory committee comprised of key WV stakeholders representing organizations including:

- TechConnect West Virginia, a non-profit organization focused on driving innovation and creating greater economic diversity in West Virginia.
- NASA West Virginia Space Grant Consortium comprised of 12 academic institutions and 9 corporate partners aiming to build research infrastructure and promote Science, Technology, Engineering and Math education in West Virginia



- Education Alliance, a coalition of business and community leaders advancing policies and practices to continually improve public school student achievement in West Virginia.
- Higher education and K-12 decision makers.

Although a comprehensive plan may take up to a year to complete, we will implement it in stages to maintain momentum.

3.2 The work of the network, even during its development, should be published in peer-reviewed journals and presented at conferences. Other states are interested in (or are currently) developing state-wide STEM networks and would benefit from learning about this example in West Virginia.

We agree. Describing our processes, failures and successes as we learn in near-real time is not only valuable to others developing STEM networks, but this frank sharing promotes a culture of sharing which is what collective impact is all about, but difficult to accomplish. To date, Network members have disseminated First2 initiatives through papers and presentations accepted to **22 national conferences and/or publications**. However, with a few notable exceptions, our dissemination efforts have not focused on process.

We will ensure that this recommendation is addressed within the communication plan being developed by our sustaining backbone organization (HEPC-DSR).

The panel advises that future MOUs should include financial and administrative support, as well as identifying anchors at the participating institutions and clear connections to backbone organization.

We are pleased to report that on this recommendation, we were able to improve seven MOUs with participating institutions by requiring each institution to name a liaison to the network at the Dean/Provost level. These institutional decision makers will meet quarterly with network representatives including First2 Students. Future MOUs will include financial or substantial in-kind resources. An example MOU can be found in the [supporting documentation](#).

Deepening the involvement, commitment, and capacity of partner institutions is a major focus of our strategic plan, and we will continue to leverage MOUs, guidance documents, relationship building, and other mechanisms to strengthen these partnerships.

#### 4 OTHER Recommendations.

4.0 Changing the Built Environment: Deepen K-12 / higher education / industry relationships and connections. Expand beyond the student-centered ambassador approach to establish productive relationships between professionals to (re-)design engaging STEM learning spaces, curriculum, course content and learning activities.

This is indeed a major effort within the First2 Network, and we fell short in communicating our progress in establishing and deepening cross-sector connections. In the past year, STEM faculty across the Faculty-Student engagement groups launched a professional development workshop on metacognition techniques and began to employ these in the STEM courses, conducting plan-do-study-act improvement cycles. K-12 teachers worked with college faculty to strengthen students' college readiness through honest collaboration. K-12 math teachers are teaching network members how to do Plan-Do-Study Act cycles. The First2 Network advertises opportunities for cross-sector exchanges to enhance learning by stepping into different STEM spaces to pick up best practices and innovative ideas.

This work continues and continuously improves through all of our working groups and their engagement in improvement science Plan-Do-Study-Act cycles.

4.1 Stakeholder Alignment & Career Pathways: Identify STEM-to-industry verticals that will foster alignment of goals and expectations between key STEM ecosystem stakeholders including K-12, West Virginia colleges and universities, and West Virginia employers (private and public sector). This should also help to illuminate career pathways for STEM majors pursuing careers in local/regional STEM industry

This is an excellent project suggestion, and First2 Network may well need to seek grant funding to complete such a project. For example we could fund recent graduates of the First2 Network who have proposed a “Young alum network” that could provide a bridge to graduate school and industry, and serve as a link between K-12 and career pathways.

In the meantime and on a smaller scale, industry partners in partnership with First2 Network students can develop and document STEM-to-industry verticals. It is within the scope of the First2 Network to engage students with industry mentors, and industry representatives are interested in this kind of career mentoring. Such an approach would be student driven, and the data would build over time.

4.3 Data and Research: There is a need for more outcomes data that indicate productivity and yield for STEM majors by industry. With regards to productivity, we would like to see more data and analysis on job/workforce attainment by job family and level across West Virginia industries. Also, would like to see more analysis on post-baccalaureate advanced degree attainment – Masters and PhD level – e.g. How many West Virginia undergraduate STEM majors complete and move on to complete MS and/or PhD in STEM?

While this is a sensible recommendation, we’re not sure we can completely address it within the scope of our project. Our aim is to make an impact in BA/BS degree attainment in STEM fields. Certainly, for students that the First2 Network has touched, we can report degree attainment by discipline and match that to STEM jobs in the state through extant data collected by industry associations. We can make these workforce connections more transparent. A near-term goal will be to connect existing data sources, and solicit the advice and assistance of organizations who collect these kinds of data.

An example of a new partner is the West Virginia Higher Education Policy Commission Division of Policy and Planning. They collect and curate higher education data for the state through a portal called WV Explorer <http://www.wvhpec.edu/resources/data-and-publication-center/>. As Figure 2 illustrates, it is currently possible to follow student cohorts through education pathways, and filter by race, gender and high school course attainment and socio-economic status. Additional data will be collected. Refer to section 2.3 for a list of the new variables HEPC Policy and Planning will collect for our network.

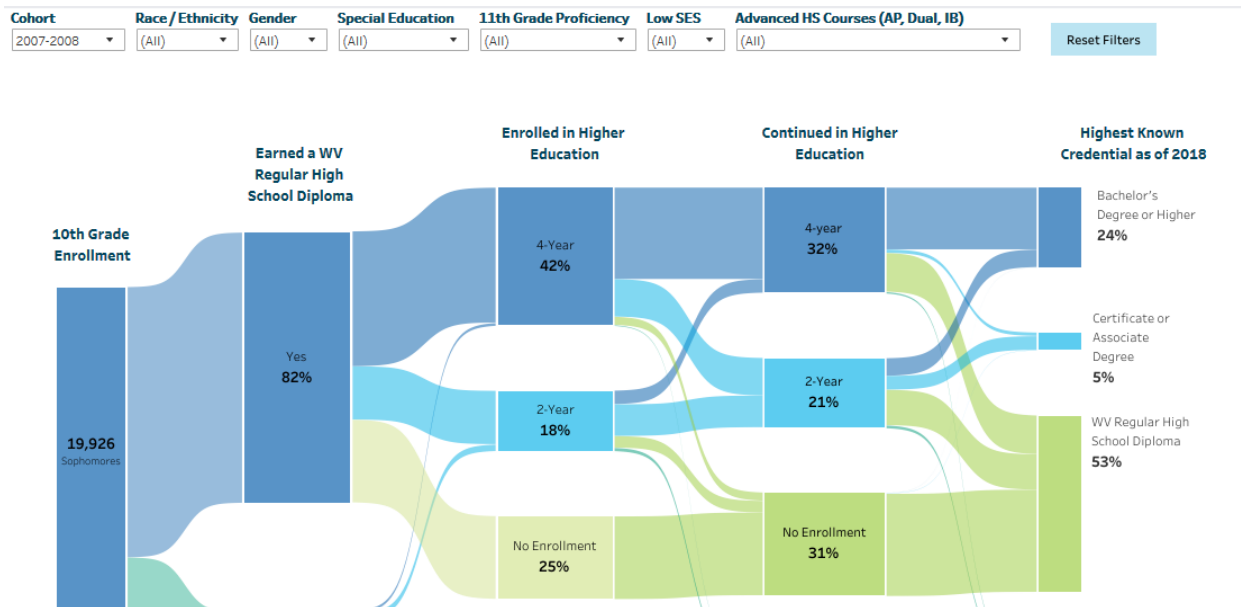


Figure 2. Education Pathways (<http://www.wvhepc.edu/resources/data-and-publication-center/pathways>)

4.4 The ability to thrive and grow is challenged by the smallness of your team, and reliance on that personal enthusiasm and energy. This forms a challenge within the award period, which will only be compounded thereafter. Respond to this concern, with specific approaches to reduce this fragility.

We think perceived fragility of the First2 Network might be more justly attributed to the pace at which we are trying to do so much, rather than the smallness of the team. Amazing people in all of our working groups are striving to change STEM culture in our higher education institutions, to create state-wide structures and processes by which first-gen students are paid to work in research labs instead of work at McDonalds, to teach K-12 students how to navigate a STEM pathway to a career, to sell the value and importance of STEM to our legislators, and to learn what's broken, try solutions and then try again as a networked improvement community, all while building network capacity where none existed before. Almost two years into the project, we think enough balls are in the air that we can and should turn our attention toward building our capacity for sustainability.

Our first strategy is to transition our sustaining backbone from a learning role to a leading role. With the advent of new leadership in both our mentoring backbone organization and our sustaining organization, this is moving forward quickly. In the past two months our backbone organizations have begun to take network organizational tasks off the shoulders of the leadership and steering committees, allowing them to focus on the working groups and developing our networked improvement community.

Our second strategy is to implement a communications plan which will attract new partners and expand our network. Our sustaining backbone organization will organize and lead communications within the network moving forward. We will report our communications plan to NSF no later than our annual report.

Our third strategy is to complete and implement a strategic plan, which will be our road map to sustainability. Our strategic plan takes a systems approach and focuses on three major outcomes and the steps needed to achieve them.

- Institutional Level: First2 **institutions** have the infrastructure and leadership to implement First2 initiatives.
- Network Level: First2 **backbone** has the infrastructure and leadership to support network goals and activities.
- Partnership Level: First2 **partnerships** are intentional, extensive, strong, and diverse to support STEM success

Finally, the Reverse Site Visit taught us the value of thoughtful external review, and our Network can benefit from review and advice on a more frequent cadence. We will share the RSV recommendations with an external Advisory Committee, composed of key WV stakeholders (see 3.1). The Advisory Committee will meet with First2 Network bi-annually to review our plans and activities with a focus on sustainability.

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