White Paper

Immersive Experiences Programmatic Findings

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One of the goals of the First2 STEM Success Alliance was to "Articulate a rigorous educational research project aimed at advancing understanding of the factors affecting rural students' entry into and persistence in STEM career pathways". During the NSF funded Design Development Launch Pilot (DDLP), two-week internships were implemented in two locations (Green Bank Observatory and Fairmont State University). This program was for rising college **freshmen** STEM majors and several upperclassmen who served as mentors. This activity departed from the norm in two ways: the duration of the experience was much shorter, and the students were much younger than is typical for research experiences for undergraduates. External evaluation revealed that this exposure had a **positive impact on students' motivation to persist in their STEM majors. Based on the success of this experience in the DDLP, the Summer Immersive Research Experience was implemented in the INCLUDES project and** was expanded to other higher education institutions in the state. In addition, technical assistance and funding to host these internships was provided to these institutions.

As researchers on the project, we wanted to investigate the programmatic, (i.e. conducting research, exposure to STEM professions), and non-programmatic, (i.e. creating friendships, visiting campus) aspects of the Summer Immersive Research Experience encouraged students to be retained in a STEM major. This paper will outline the steps researchers in the INCLUDES project are using to try to answer the following research questions as well provide findings from the data collected.

**Research Questions:**
*Q1: What programmatic aspects cause a student to want to continue to pursue STEM?*

*Q2: What programmatic aspects cause a student to question the choice to pursue STEM?*

*Q3: What non-programmatic aspects cause a student to want to continue to pursue?*

*Q4: What non-programmatic aspects cause a student to question the choice pursue STEM?*

**Methods**

*Participants:* The participants for this study were students who attended the First2 Network two-week Summer Immersive Research Experiences in the summers of 2018 through 2022. All participants had an interest in pursuing STEM majors in college when they started the program. Data collection took place after the participants had completed the summer immersive experience and had enrolled in a college in West Virginia. The students attended these

experiences at various locations around the state of West Virginia, including university settings, research sites, and companies. In the summer of 2020, participants attended these activities virtually due to the restrictions from COVID-19.

*In-depth Interviewing:* Intensive individual interviews were conducted with student participants from the pilot study after they had participated in the summer activity. These interviews were loosely structured to allow freedom for both the interviewer and the interviewee to explore additional points and change direction, if necessary. The interviews were used to better understand what factors influenced the students to attend college and study STEM. The interview questions also asked about family members who attended college. Additional questions that where asked had to do with the opportunities the students had available to them and which opportunities, they took advantage of while they were in High School. Although these topics were part of the interview they are not covered in this paper, but in other white papers submitted. However, Part of the interview explored aspects of their Summer Immersive Research Experiences and this topic is the focus of this paper.

*Analyses of Interviews:* Classical content analysis was used to analyze interview data. The interviews were recorded and transcribed. After the transcription, the transcripts were broken down into smaller chunks of the data and a code was placed on each chunk. These codes were then placed into similar groupings and counted. Three coders were used to ensure consistency and cross-checking.

*Survey:* A survey was developed based on the coding of the in-depth interviews of participants. The survey was designed to capture ideas that were uncovered during interviews. The questions covered influences to attend college and study STEM, family higher-education experiences, high school opportunities, and summer immersive program factors.

*Data Collection:* In the summer and early fall of 2019, the research team interviewed eleven students from the First2 DDLP Summer Immersive Research Experience. In October of 2019, the survey that had been developed from the interviews was emailed to all students who participated in the summer immersive experiences in summer 2018 (Pilot) and summer 2019. The same survey was sent in September 2020, 2021, and 2022 to students who participated in a summer immersion experiences. Table 1 shows the number of surveys sent, the number of surveys completed and the response rate.

Table 1: Respondents to the Student Survey

| Year | Sent | Responded | Response Rate |
|---|---|---|---|
| 2018 (Pilot) | 26 | 7 | 27% |
| 2019 | 27 | 14 | 52% |
| 2020 | 69 | 34 | 49% |
| 2021 | 56 | 21 | 38% |
| 2022 | 43 | 24 | 56% |
| **Total** | **221** | **100** | **45%** |

The students who participated in the immersion experience indicated which West Virginia Higher Education institution they were attending. The total number of students from various West Virginia higher education institutions are listed in Table 2 below.

Table 2: Institutions that Students Attended

| Institution | Number Responding to Survey | Percentage |
|---|---|---|
| Blueridge Community & Technical College | 4 | 4.00% |
| Fairmont State University | 7 | 7.00% |
| Glenville State University | 1 | 1.00% |
| Marshall University | 16 | 16.00% |
| Shepherd University | 1 | 1.00% |
| University of Charleston | 8 | 8.00% |
| West Virginia State University | 7 | 7.00% |
| Wesleyan University | 2 | 2.00% |
| West Liberty University | 4 | 4.00% |
| West Virginia University Institute of Technology | 5 | 5.00% |
| West Virginia University | 48 | 48.00% |
| Total | 100 | 100.00% |

As seen from the table, over half of the students (53%) planned to attend West Virginia University (WVU) or West Virginia University Institute of Technology (WVU-IT). This allowed us to do some comparison on retention at WVU for this group versus overall STEM majors at WVU and say something about the retention of a larges subset of this population.

**Findings**

Students who completed the survey were asked to indicate what programmatic factors encouraged them or discouraged them to study STEM. Table 3 shows the students' perceptions of the factors. When reviewing the information provided by the participants, 90% of the participants indicated that conducting research was an encouraging factor, while 86% indicated doing hands-on experiences was an encouraging factor. The factor least encouraging was visiting STEM-based companies, however, over half of the participants (53%) still indicated it was encouraging and only 2% said it discouraged them. It should be noted that while many did, not all summer research sites included a visit to a STEM-based company.

Table 3: Perceptions of Programmatic Aspects (N = 100)

| Activity | # Encouraged | % Encouraged | # Discouraged | % Discouraged | # No Response | % No Response |
|---|---|---|---|---|---|---|
| Conducting research | 90 | 90.00% | 4 | 4.00% | 6 | 6.00% |
| Doing hands-on experiences | 86 | 86.00% | 0 | 0.00% | 14 | 14.00% |
| Doing activities related to my major | 83 | 83.00% | 1 | 1.00% | 16 | 16.00% |
| Learning about STEM job opportunities | 78 | 78.00% | 3 | 3.00% | 19 | 19.00% |
| Being exposed to new STEM technology | 74 | 74.00% | 3 | 3.00% | 23 | 23.00% |
| Visiting STEM-based companies | 53 | 53.00% | 2 | 2.00% | 45 | 45.00% |

Students who completed the survey were asked to indicate what non-programmatic factors encouraged or discouraged them to study STEM. When reviewing the information provided by the participants related to non-programmatic aspects that caused them to want to continue to pursue STEM, 88% of the participants indicated that both being with students with the same interests and learning skills they could use in college were encouraging factors. Eighty-four percent indicated meeting faculty was an encouraging factor. The factor least encouraging was learning about their campus, however, over half of the participants still indicated it was an encouraging factor. It should be noted that while many were, not all summer research sites were held on the campus where the students would attend.

Table 4: Perceptions of Non-Programmatic Aspects (N=100)

| Activity | # Encouraged | % Encouraged | # Discouraged | % Discouraged | # No Response | % No Response |
|---|---|---|---|---|---|---|
| Being with students with the same interests | 88 | 88.00% | 1 | 1.00% | 11 | 11.00% |
| Learning skills I can use in college | 88 | 88.00% | 1 | 1.00% | 11 | 11.00% |
| Meeting faculty | 84 | 84.00% | 1 | 1.00% | 15 | 15.00% |
| Working in a team environment | 82 | 82.00% | 2 | 2.00% | 16 | 16.00% |
| Making friends | 81 | 81.00% | 1 | 1.00% | 18 | 18.00% |
| Doing after-hours fun activities | 71 | 71.00% | 0 | 0.00% | 29 | 29.00% |
| Learning about my campus | 68 | 68.00% | 4 | 4.00% | 28 | 28.00% |

Due to the pandemic, students in the 2020 cohort participated virtually in a summer research internship. This prompted the researchers to see if there was a difference in the programmatic and non-programmatic aspects that encouraged these students to study STEM. Of the 100

participants who completed the survey during the five years of the grant, 66 attended a face-to-face research experiences and 34 attended a virtual research experience.

When reviewing the information provided by the participants related to programmatic aspects that caused them to want to continue to pursue STEM, both the face-to-face and virtual participants indicated that conducting research and doing hands-on experiences were the most encouraging factors. Other than being exposed to new STEM technologies, the order of programmatic aspects that caused them to want to continue to pursue STEM was very similar. This indicates that the First2 partners worked very hard to make the virtual experiences meaningful for the students involved. See Figure 1 for comparisons and Tables 5 and 6 for the perceptions for each factor.
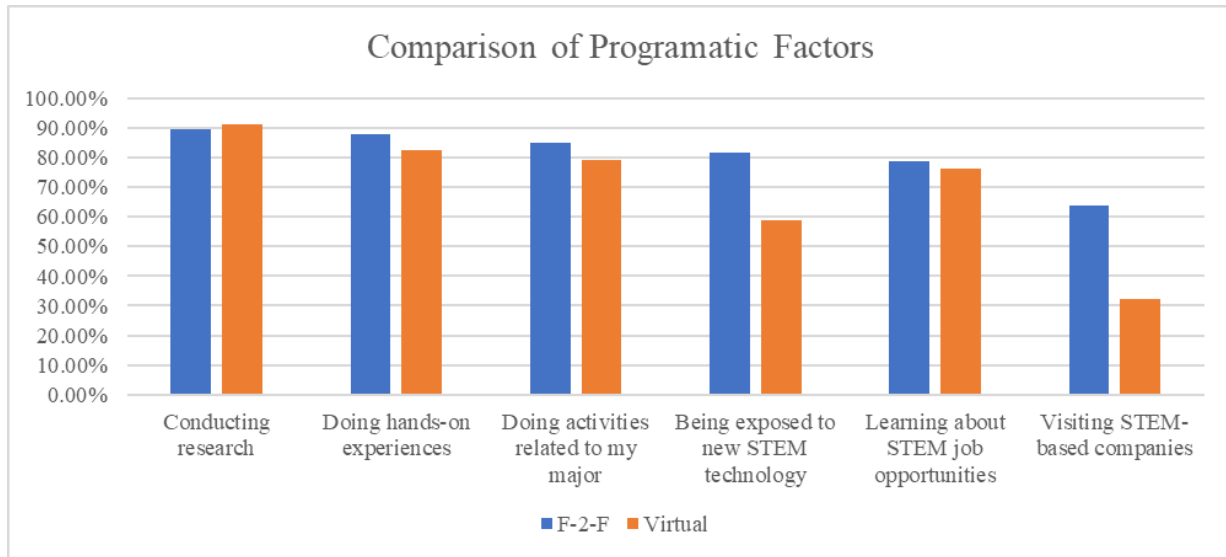


Figure 1. Comparison of Programmatic Factors that Encouraged Students to Study STEM (Face-to-Face versus Virtual)

Table 5: Perceptions of Programmatic Aspects (Face-to-Face Participants, N=66)

| Activity | # Encourage | % Encouraged | # Discouraged | % Discouraged | # No Response | % No Response |
|---|---|---|---|---|---|---|
| Conducting research | 59 | 89.39% | 3 | 4.55% | 4 | 6.06% |
| Doing hands-on experiences | 58 | 87.88% | 0 | 0.00% | 8 | 12.12% |
| Doing activities related to my major | 56 | 84.85% | 1 | 1.52% | 9 | 13.64% |
| Being exposed to new STEM technology | 54 | 81.82% | 2 | 3.03% | 10 | 15.15% |
| Learning about STEM job opportunities | 52 | 78.79% | 2 | 3.03% | 12 | 18.18% |
| Visiting STEM-based companies | 42 | 63.64% | 2 | 3.03% | 22 | 33.33% |

Table 6: Perceptions of Programmatic Aspects (Virtual Participants, N=34)

| Activity | # Encourage | % Encouraged | # Discouraged | % Discouraged | # No Response | % No Response |
|---|---|---|---|---|---|---|
| Conducting research | 31 | 91.18% | 1 | 2.94% | 2 | 5.88% |
| Doing hands-on experiences | 28 | 82.35% | 0 | 0.00% | 6 | 17.65% |
| Doing activities related to my major | 27 | 79.41% | 0 | 0.00% | 7 | 20.59% |
| Being exposed to new STEM technology | 20 | 58.82% | 1 | 2.94% | 13 | 38.24% |
| Learning about STEM job opportunities | 26 | 76.47% | 1 | 2.94% | 7 | 20.59% |
| Visiting STEM-based companies | 11 | 32.35% | 0 | 0.00% | 23 | 67.65% |

When reviewing the information provided by the participants related to non-programmatic aspects that caused them to want to continue to pursue a STEM degree, there were some noted differences between the face-to-face and virtual participants. A higher percentage of the face-to-face students rated being with students with the same interest as encouraging whereas a higher percentage of the virtual students rated learning skills they could use in college as the biggest encourager. See Figure 2 and Tables 7 and 8 for comparisons.
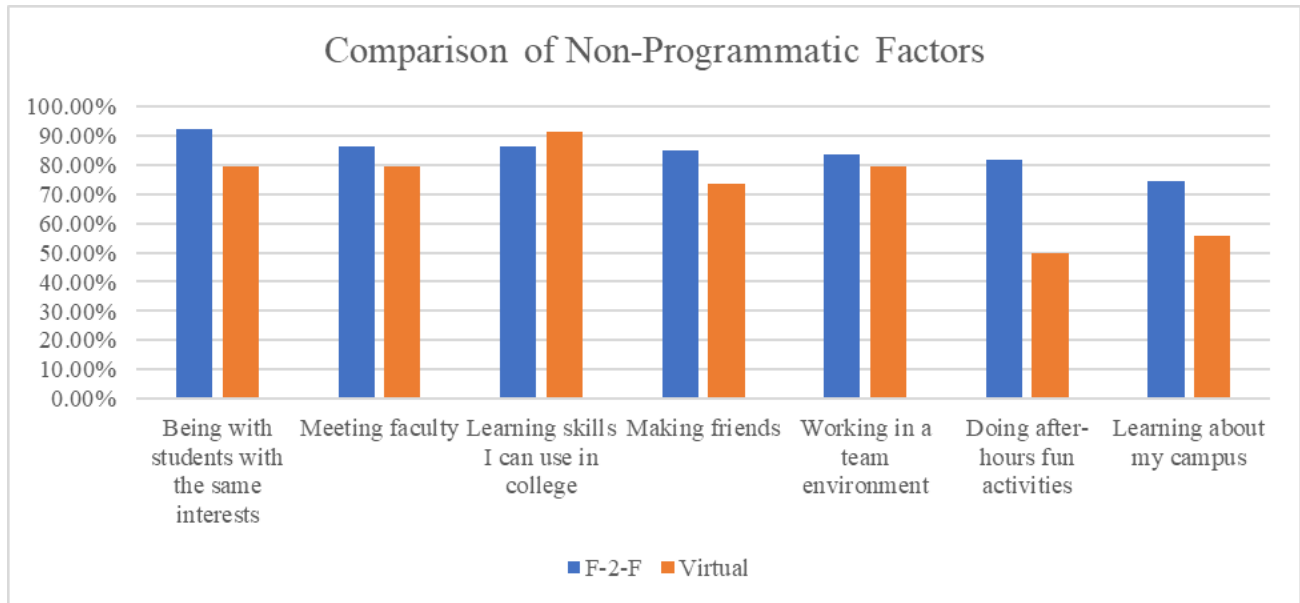


Figure 2. Comparison of Programmatic Factors that Encouraged Students to Study STEM (Face-to-Face versus Virtual)

Table 7: Perceptions of Programmatic Aspects (Face-to-Face Participants, N=66)

| Face-Face Participants N=66 Activity | # Encourage | % Encouraged | # Discouraged | % Discouraged | # No Response | % No Response |
|---|---|---|---|---|---|---|
| Being with students with the same interests | 61 | 92.42% | 0 | 0.00% | 5 | 7.58% |
| Meeting faculty | 57 | 86.36% | 0 | 0.00% | 9 | 13.64% |
| Learning skills I can use in college | 57 | 86.36% | 1 | 1.52% | 8 | 12.12% |
| Making friends | 56 | 84.85% | 1 | 1.52% | 9 | 13.64% |
| Working in a team environment | 55 | 83.33% | 1 | 1.52% | 10 | 15.15% |
| Doing after-hours fun activities | 54 | 81.82% | 0 | 0.00% | 12 | 18.18% |
| Learning about my campus | 49 | 74.24% | 4 | 6.06% | 13 | 19.70% |

Table 8: Perceptions of Non- Programmatic Aspects (Virtual Participants, N=34)

| Virtual Participants N=34 Activity | # Encourage | % Encouraged | # Discouraged | % Discouraged | No Response | % No Response |
|---|---|---|---|---|---|---|
| Being with students with the same interests | 27 | 79.41% | 1 | 2.94% | 6 | 17.65% |
| Meeting faculty | 27 | 79.41% | 1 | 2.94% | 6 | 17.65% |
| Learning skills I can use in college | 31 | 91.18% | 0 | 0.00% | 3 | 8.82% |
| Making friends | 25 | 73.53% | 0 | 0.00% | 9 | 26.47% |
| Working in a team environment | 27 | 79.41% | 1 | 2.94% | 6 | 17.65% |
| Doing after-hours fun activities | 17 | 50.00% | 0 | 0.00% | 17 | 50.00% |
| Learning about my campus | 19 | 55.88% | 0 | 0.00% | 15 | 44.12% |

## Student Retention

The researchers were able to collect retention data for participants who attended WVU and WVU-IT. In this paper we define retention of a student in STEM as a student who participated in the Summer Immersive Research Experiences and who was still enrolled in a STEM major or had graduated with a STEM degree as of the time we acquired the data Spring 2023. Since over half of the participants (53 of 100) in our data were from WVU or WVU-IT, we looked to see if the programmatic and non-programmatic factors that encouraged or discouraged participants to study STEM were similar for all the participants as to those who attended WVU and WVU-IT. There was little difference between factors identified by the entire group and just the subgroup from those two institutions.

According to Dr. John Stewart, Physics Education Researcher from WVU (including WVU-IT), the overall WVU STEM persistence rate through graduation in 2019 was approximately 27%. Considering the 53 students from WVU and WVU-IT who participated in the Summer Immersive Research Experiences, we found their overall retention rate was higher than this overall graduation rate. Of the 53 participants, 35 (66%) of the students who participated in the Summer Immersive Research Experience either graduated or persisted in STEM as of 2023. For purposes of this paper, majors such as Environmental Soil and Water Science, Plant Pathology, Environmental and Energy Resources Management, were majors identified as STEM adjacent. Thirty-nine (74%) of the students either graduated or persisted in STEM or STEM adjacent majors as of 2023.

We then looked to see if the numbers were different for those that participated in the face-to-face or virtual summer experiences. Overall, we found the numbers to be similar. Thirteen (62%) of the virtual students and 22 (69%) of the face-to-face participants persisted in STEM, whereas 15 (71%) of virtual and 24 (75%) of the face-to-face persisted in a STEM or STEM adjacent major. Table 9 shows the comparison of these percentages.

Table 9: Comparison of Retention Rates, Overall, Virtual and Face-to-Face

|  | N | Number Persisting in STEM | Percent Persisting in STEM | Number Persisting in STEM or STEM Adjacent | Percent Persisting in STEM or STEM adjacent |
|---|---|---|---|---|---|
| Overall | 53 | 35 | 66% | 39 | 74% |
| Virtual | 21 | 13 | 62% | 15 | 71% |
| F2F | 32 | 22 | 69% | 24 | 75% |

**Summary**

When considering programmatic aspects of the Summer Immersive Research Experience that encouraged participants to study STEM, conducting research was the factor that was most encouraging to all the participants, whether they participated in a face-to-face or virtual experiences. In addition, overall, very few students indicated that any of the programmatic or non-programmatic factors discouraged them from studying STEM. It should also be noted that a preliminary look at the retention indicates that the percentages of students who are persisting after being in the Summer Immersive Research Experiences is more than double the STEM graduation rate at WVU from 2019. We anticipate that this program will have a lasting impact on the final graduation rates for these students.