

First-generation student success and the SD-FIRST program

Abstract

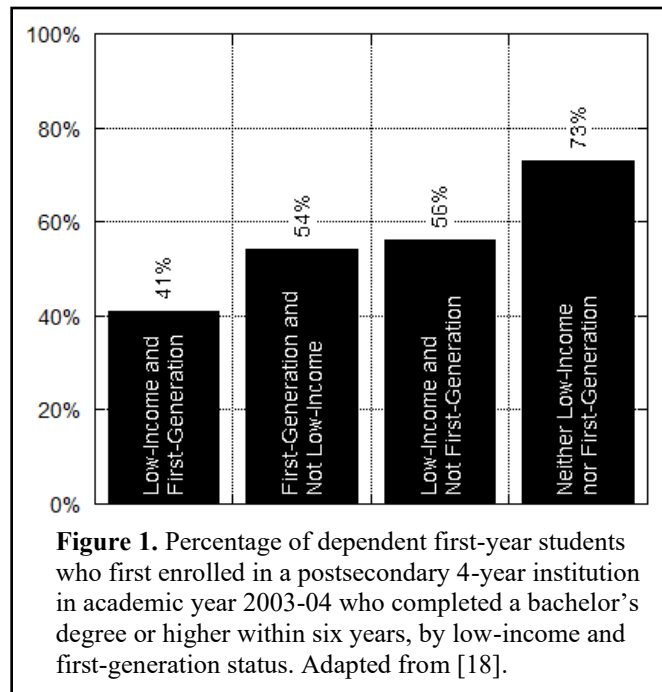
The higher education system can be nebulous – from entrance to graduation, processes involved with financial aid, work study, faculty office hours, forming student connections, career fairs, and more can be intimidating for many students. For first-generation students, whose family members have no or limited experience with the process, these hurdles can seem almost insurmountable. The SD-FIRST program will help fill in the gaps of first-generation students' home-to-college transition, provide a robust support system by connecting existing campus resources, and provide guidance for staff and faculty on interactions and unique challenges with this student population. Programmatic elements specific for first-generation students, driven by evidence-based resiliency research, aim to provide academic, social, and economic support. The expected outcome of the SD-FIRST program is to achieve a sustainable increased retention and graduation rate, and an increase in emotional intelligence for students participating in the program. The initial cohort of SD-FIRST scholars began in the fall 2021 semester, and the details of the program as well as initial implementation are included in this paper.

Introduction and Motivation

As universities around the nation are faced with directives to increase both enrollment and retention, many have developed programs aimed to attract specific groups of students [1-8]. The success of the population of first-generation students in college environments has been the focus of many studies [9-14]. The U.S. Department of Education defines first-generation students as *“students whose parents have never earned a bachelor’s degree but may have some postsecondary experience”* [15], which is the definition used by the SD-FIRST program. Because first-generation students do not have familial experience to turn to, they often face specific, significant challenges when navigating the higher education system.

Recent studies have shown that more than 25% of the undergraduate population in the US are first-generation students [16, 17]. Moreover, in 2019, 62% of high school students would be first-generation college students should they enroll in college [18]. Among high school students who enroll in college, there is a 21% difference in those who are first generation (72% enrolled) and non-first generation (93% enrolled) [18]. First-generation students also tend to be more diverse in age, ethnicity, and socio-economic status (SES), are more likely to attend college within 50 miles of home, and are less likely to live on campus during their freshman year as compared to non-first-generations students [17, 19]. First-generation students comprise a much larger portion of the student population at SD Mines than the national averages; the incoming freshman class has been consistently ~33% first-generation students for the past six years. 42% of the SD Mines student population classify as low SES. Of the low SES students, 80% are first-generation students, 18% are minority students, 48% are South Dakota students, and 49% of the South Dakota population are from Rapid City (city where campus is located).

Persistence, retention, and success of first-generation students in post-secondary education have long been a topic of discussion [20-26]. Models of retention suggest that that integration and university environment are key for preventing student attrition [27-36], and retention of first-generation students in STEM can be particularly difficult [37-39]. The six year completion rates for four groups of students showed that income and first-generation status can drastically affect completion of a degree (Figure 1) [18]. Students with low income and first-generation status were twice as likely to leave postsecondary education without attaining a degree by their third year as those with neither low income or first-generation status [18]. Of first-generation students leaving college, 54% cited “*couldn’t afford going to school*” as the number one reason for leaving [40].



First-generation tracking at SD Mines began in 2014, giving information for the 2010 cohort and beyond, and since then, freshmen classes were ~33% first-generation students. Over the last four years, the average 5-year graduation rate for the SD Mines campus was 49%, which is lower than other institutions in our Association of Public and Land-grant Universities (APLU) cluster, possibly owing to SD Mines offering only science and engineering degrees. In contrast, the average 5-year graduation rate for first-generation students from these cohorts was just 24% (Figure 2). In addition to lower resiliency, first-generation students are more likely to have minority status and face financial challenges [41]. Based on FAFSA information from the past four years, 24% of students over all household income brackets identified as first-generation. Moreover, 36% of all students who qualified for a status of “*below SD median income level*” or lower (less than \$52,000) were first-generation students.

Academically, first-generation students often have less rigorous high school academic preparation, leading to a need to take remedial courses upon entering college [42]. A 2005 study showed that a majority (55%) of first-generation students took remedial courses during college, while only 27% of non-first-generation students took remedial college courses [13]. The most common remedial courses were math courses, a particularly large hinderance for STEM majors. Positive student-faculty/staff relationships and interactions have been found to successfully prevent attrition of groups such as first-generation students [31, 43-46]. Students themselves have a large role in their own success, and several have suggested that the onus is on the student to adjust to expectations of the university [14, 29, 47]. For first-generation students, this can be a particularly daunting challenge with no familial experience to turn to, but meeting institutional expectations is still crucial for their success [48]. First year GPA is known to be a significant predictor of a student's return for the second year of college, and in a 2013 study [49], first-

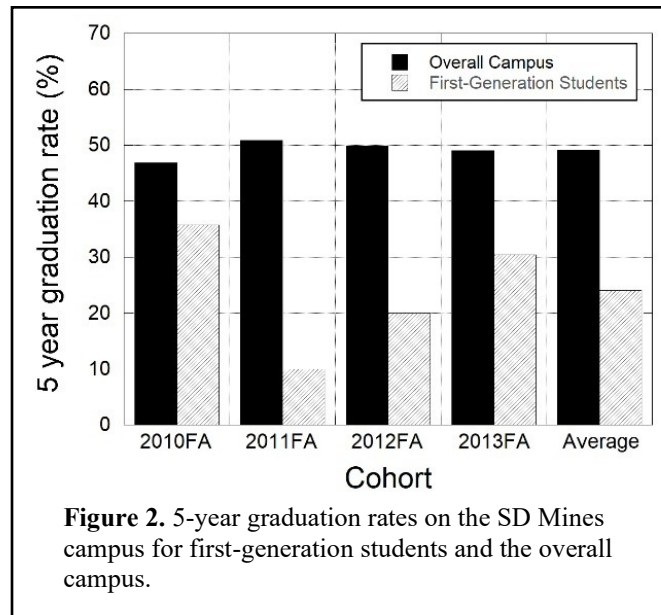
generation college students earned significantly lower first year GPAs than non-first-generation students. Barriers associated with lower first year GPA are greater financial responsibility, lack of academic preparation, lower prior GPA, no declaration of a major, and staying in-state for college [19, 49, 50].

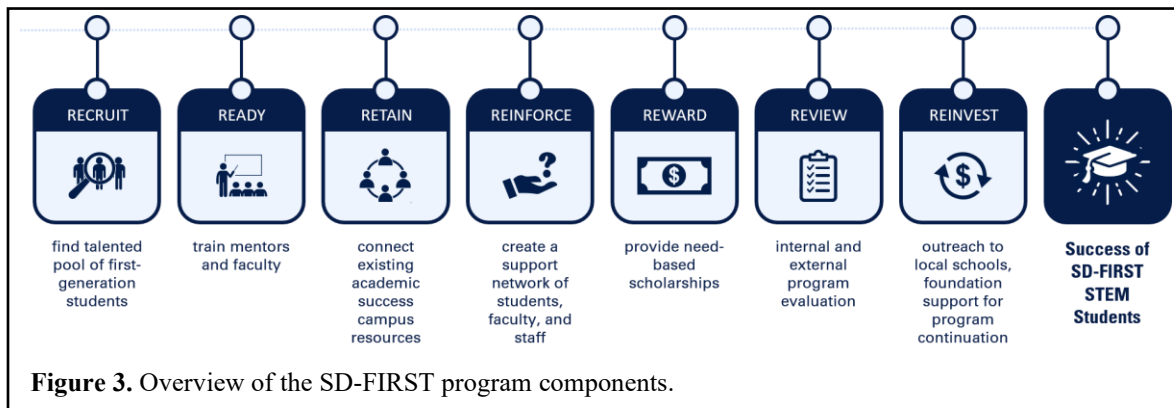
Socially, students who feel they do not belong and who struggle adjusting to normal academic challenges in college are more likely to face attrition [15, 44]. First-generation students are often included in a list of student groups who are likely to face these hurdles, and are more at risk for non-completion of college degrees, along with ethnic minorities, academically

disadvantaged students, students with disabilities, students of low SES, probationary students, and students with mental illness [14, 44]. First-generation students are less likely to be involved in extracurricular activities in college, but these activities can have a greater outcome benefit for this population of students, better connecting them to campus [37]. For students in these groups of high risk for non-completion, developing a sense of belonging is critical for success [48].

Financially, first-generation students tend to come from lower income families and have greater financial responsibility. This means they may have limited financial support from their family and may be required to hold a job outside of their college class load [28]. While there is some debate about the correlation of academic performance and working while enrolled in both positive [51, 52] and negative [27] manners, the findings that first-generation students are less involved on campus and less connected with peers can be further impacted by heavy employment workloads and associated time commitment [28].

Nationally, attention has been drawn to first-generation students through a variety of avenues, including centers, conferences, and dedicated recognition events [53]. The SD-FIRST program will be the first concerted effort aimed at the success of first-generation students on the SD Mines campus. The program will enhance these students' home-to-college transition, provide a robust support system by connecting existing campus resources, provide guidance for staff/faculty interactions and the unique challenges with this student population, and ultimately, lead to first-generation students persisting and graduating. A graphic overview of the SD-FIRST program is shown in Figure 3.





Program Development and Recruitment

Program development began January 2021 and included development of the application process to recruit talented students, fundraising for scholarship matching, hiring a program coordinator, and creating workshops and activities for students to connect them with campus resources and promote their success. A program website was developed (<https://www.sdsmt.edu/first-generation/>) to house program information and the scholarship application. Application to the SD-FIRST program required a complete application form, a letter of recommendation from a math or science instructor (high school or college level), an essay discussing the applicant's interest in science and engineering, career goals, and school, community, and other activities that demonstrate leadership potential, and a completed FAFSA. The program was advertised through several venues: media outlets, communication with accepted first-generation students, and promotion through local high schools. The project team also participated in two "Go To Mines" recruitment events to educate and recruit first-generation students and their families for the 2022 cohort and beyond.

As a result of these efforts, the SD-FIRST program had 59 applicants during the first application cycle. As an NSF S-STEM award, the SD-FIRST program allowed for 15 scholars in the first cohort and awarded \$5,000 per year, renewable for 4 years, per scholar. During this time, the team was able to work with the SD Mines Center for Alumni Relations and Advancement (CARA) to secure a donation to the school in the form of a gift of 10 additional scholarship positions (a total of \$5,000 per year, renewable for 4 years, for 10 scholars). With this generous donation, the SD-FIRST program was able to award scholarships to 25 total students. All 59 applications were reviewed by the project team for demonstrated passion, drive, and potential from the essay, letter of recommendation, and overall application package. In addition, each applicants' unmet financial need was considered and only students with unmet financial need were selected for program acceptance. 25 students were selected from the applicants and comprised the inaugural SD-FIRST cohort and all began pursuing a STEM degree at SD Mines in the Fall of 2021. Requirements for the selected scholars to continue in the SD-FIRST program included being enrolled in a STEM major, attendance at all monthly workshops and events, regular meetings with the peer mentors, academic advisors, and the program coordinator, demonstrated involvement in a campus activity, and maintaining a 2.5 (3.0 for students funded through donor money) GPA.

Next, the team completed the hiring process for a program coordinator who was hired June 2021. The hired program coordinator has significant experience working with various groups in higher education and mentoring students. In addition, program coordinator has extensive background using the EQ-i^{2.0} emotional intelligence assessment instrument that the program is deploying. Because of her passion for this project, the program coordinator is now pursuing an EdD in Educational Leadership focused on the success of first-generation students alongside duties as the SD-FIRST Program Coordinator.

Finally, workshops, events, and activities for the Fall 2021 and Spring 2022 semester were developed to bring the SD-FIRST scholars well-balanced exposure to various campus resources, STEM-confidence, and social aspects of college life to guide their success. These events are described in more detail below.

2021-2022 Cohort Demographics

The initial Fall 2021 cohort of SD-FIRST students was comprised of 25 students (14 male, 11 female), who each received a \$5,000 scholarship for the 2021-2022 academic year. Upon acceptance, the students had the following majors:

- 2 Biomedical Engineering,
- 1 Business Management in Technology,
- 3 Chemical Engineering,
- 2 Civil and Environmental Engineering,
- 1 Computer Engineering,
- 3 Computer Science,
- 1 Electrical Engineering,
- 1 undecided (later switched to Mechanical Engineering),
- 1 Industrial Engineering,
- 7 Mechanical Engineering,
- 1 Metallurgical Engineering, and
- 2 Pre-Professional Health Science majors.

Students in the cohort had hometowns across several states (South Dakota, North Dakota, Nebraska, Colorado, Minnesota, Montana, Iowa, Pennsylvania, and Florida) and had an average unmet financial need of \$14,904. Two students participated in campus athletics, one in ROTC, and one is a veteran. All but two students lived on campus.

First-Semester Implementation

Implementation of the SD-FIRST program began during the Fall 2021 semester and consisted of required monthly workshops as well as regular faculty advisor, peer mentor, and program coordinator meetings. The workshops and student support meetings are described in greater detail in the following sections.

Workshops

Students in the SD-FIRST program attended required workshops that were designed to provide connections to campus resources, understanding of and ways to improve emotional intelligence,

hands-on experience and confidence in STEM, and opportunities to engage in professional networking. Specific to this objective were the following workshops with the listed desired outcomes:

- Student/parent orientation – designed to welcome students and their families to the SD Mines campus and the SD-FIRST program during move-in week, provide SD-FIRST program details and requirements, and answer any questions families have.
- Faculty mentoring session – designed to give students an overview of the academic advising process, general degree requirements, and the course registration method used on campus.
- Emotional intelligence workshop – designed to teach students about the EQ-i^{2.0} instrument, the results they might expect, and how to use their result to implement SMART goals for personal development.
- Hands-on blacksmithing event – designed to provide students with an opportunity to build confidence in areas they might not otherwise be exposed to, gain hands-on experience and skill-building, and socialize with other students and faculty. Photos from this event are shown in Figure 4.
- National first-generation celebration event – designed to provide a speaker who can share their first-generation success story as well as an opportunity to network with the speaker and other first-generation students, faculty, and staff on campus. The advertisement flyer from the event is shown in Figure 5.
- Finals study group – designed to provide tips and tricks to students before their first finals week and to help students form study groups within the SD-FIRST cohort.
- Career fair preparation workshop – designed to provide students with information and advice on attending the Spring 2022 Career Fair.

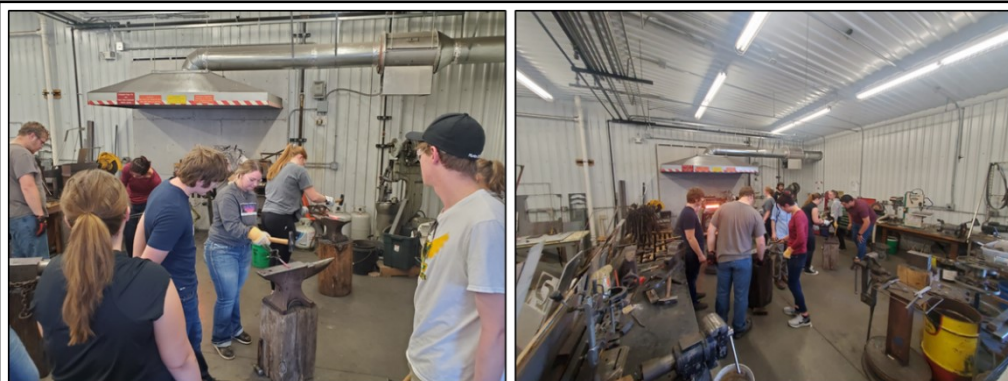


Figure 4. Hands-on blacksmithing event for SD-FIRST students held on the SD Mines campus. This event allowed students to build confidence with activities outside of their comfort zone.

Student Support Meetings

A student support network was developed to provide additional resources for students in the SD-FIRST program. Faculty advisors and peer mentors were identified for SD-FIRST students and were provided with information about first-generation student needs and the SD-FIRST program

before the Fall 2021 semester began. To ensure that students were receiving support from these sources, scholars were required to meet with their faculty academic advisor (1 time), their peer mentor (4 times), and the program coordinator (3 times) throughout the semester. These meetings had the additional benefit of allowing students to get to know the faculty, staff, and student resources available and the role that each contact point plays. Additionally, students who were struggling with academics were encouraged to meet with a Student Success advisor and to attend tutoring sessions through the Student Success Center, although these latter two meetings were suggested and not required.

Assessment Methods

To gain a holistic understanding of program effectiveness, both quantitative and qualitative assessment measures were used. The EQ-i^{2.0} assessment and a Student Satisfaction survey designed specifically for the SD-FIRST program were used to gather quantitative information regarding program metrics. The Student Satisfaction survey included several open-ended questions that allowed students to provide qualitative data as well. Students also engaged in three meetings with the SD-FIRST Program Coordinator where additional feedback was received regarding program participation and satisfaction. Each of these assessment methods is discussed in further detail below.

EQ-i^{2.0} Assessment

Emotional intelligence is a set of emotional and social skills that collectively establish how well individuals:

- perceive and express ourselves,
- develop and maintain social relationships,
- cope with challenges,
- and use emotional information in an effective and meaningful way.

Research has shown that students who reach a higher level of EI have been linked to higher grades, healthier study habits, and better navigation of meaningful relationships with the increased demands of student life.

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2021 First-Generation Celebration

Data Science

Join us as Francisco Javier Arceo shares his experiences in data science and path as a first-generation student. This event will provide students and faculty an opportunity to hear from a senior machine learning engineer while networking!

Who are First-Generation College Students?
College students whose parents did not complete a 4-year college degree.

First-Generation Celebration Day
Honors the anniversary of the signing of the 1965 Higher Education Act (HEA) to celebrate the identity and successes of first-generation students and graduates.

SD-FIRST
Provides support in academic, social and economic areas with the goal of helping first-generation students find success and ultimately graduate with a STEM degree from South Dakota Mines.

Contact
Questions about SD-FIRST?
Contact:
Cassandra Birrenkott
cassandra.birrenkott@sdsmt.edu
www.sdsmt.edu/first-generation

Francisco Javier Arceo
Francisco Javier Arceo is the Tech Lead Manager for Data and Machine Learning at Fast. He has spent over ten years applying his experience in data science, engineering, and technology to launch and scale digital products at Goldman Sachs, the Commonwealth Bank of Australia, AIG, and Ipsos. He holds graduate degrees in Data Science & Machine Learning and Economics & Statistics from Columbia University (New York City) and Clemson University, respectively.

Hosted by SD-FIRST
Monday, November 8th, 4-5 PM
CB 204
Refreshments provided!

Figure 5. Advertisement flyer for the national first-generation celebration day hosted by SD-FIRST on the SD Mines campus.

The EQ-i^{2.0} emotional intelligence assessment that was used for this program is comprised of an overall emotional intelligence score (Total EI), a composite self-perception (SP) score and 3 sub-categories within self-perception, a composite self-expression (SE) score and 3 sub-categories within self-expression, a composite interpersonal (IN) score and 3 sub-categories within interpersonal, a composite decision making (DM) score and 3 sub-categories within decision making, a composite stress management (SM) score and 3 sub-categories within stress management, and well-being (WB). The WB is not tested for validity but has some data for correlation to student well-being, happiness, and success. In Figure 3, the vertical scale numbers are derived from norm groups where 100 is the “average/NORM” within the norm group of 18-21 ages (traditional age college students).

For the SD-FIRST program, an initial EQ-i^{2.0} assessment was given to all 25 students at the beginning of the Fall 2021 semester. This data acts as a pre-survey and a baseline of the scholars before any programmatic elements were applied. Figure 6 shows the results of the SD-FIRST scholars compared to results from the EQ-i^{2.0} instrument applied to other students (a small selection, but general population) on the SD Mines campus. The data from the general SD Mines population is from 160 student responses of mixed academic levels, leadership, and first-generation status.

Student Satisfaction Survey

Sage Project Consultants, the SD-FIRST external evaluator group, designed a student satisfaction survey instrument that was distributed to the scholars via email by the consultants in October 2021. Twenty-five (100%) students completed the survey and will complete the same survey in Fall 2022 to assess gain and satisfaction of program elements.

The survey instrument had three sections. The first section was based on the Longitudinal Assessment of Engineering Self-Efficacy (LAESE). (see <http://aweonline.org/efficacy.html>) LAESE is designed to identify longitudinal changes in the self-efficacy of undergraduate students studying engineering. The LAESE undergraduate instrument has been tested and validated on male and female engineering students. The LAESE questions will be administered each fall to determine if self-efficacy increases as they progress through school.

The second section was based on the questions in the Clance Imposter Phenomenon Scale [54]. The Clance Impostor Phenomenon Scale was designed to measure the concept that individuals are successful by external standards but have an illusion of personal incompetence. The questions assess components of the phenomenon such as ideas about self-doubt and achieving success by chance.

The third section asked questions about the student’s advisors, student mentors, and program coordinator. Students were also asked for feedback and advice on the SD-FIRST program.

Program Coordinator Interviews

Students were required to attend three meetings with the SD-FIRST program coordinator that took place during September, October, and November/December of 2021. Two of the meetings

were in-person and were approximately 15 to 20 minutes in length. One meeting was done via email and consisted of seven questions that required students to provide written responses. All meetings addressed topics related to academics, relationships (family, friends, roommates, classmates), campus involvement, required meetings with faculty advisors and peer mentors, information and feedback regarding SD-FIRST programming, and an open-ended request for questions or suggestions.

Results

Overall

The project team views the overall results of the first semester implementation of the SD-FIRST program as positive. The persistence of the first-generation first-time freshmen scholars in the program was 88% (22/25 scholars retained from Fall to Spring semester), which is in line with other first-generation students on campus, but still lower than the general campus population. The three students who left the program after the first semester all transferred to other universities and are still pursuing degrees at this point. The average cumulative GPA for SD-FIRST scholars after their first semester of college was 2.99/4.0. Very few scholars in the 2021-2022 SD-FIRST cohort had a GPA less than 2.0 after their first semester (2 of the remaining 22 students who persisted). This is a significantly lower percentage than all first-generation first-time freshmen on campus or than the general campus population of first-time freshmen (see Table I). SD-FIRST scholar GPAs will be evaluated again after students complete the first year to determine scholarship eligibility for the second year.

Table I: Student persistence and percentage with a low ($>2.0/4.0$) GPA after the first semester. Persistence is defined as retention of students from first semester (Fall) to second semester (Spring).

Cohort	Sub-group	Persistence	< 2.0 CUM GPA after 1st Semester
2021	<i>all first-time freshmen</i>	95.54%	17.7% (108/608)
	<i>first-generation first-time freshmen</i>	88.64%	23% (45/195)
	<i>SD-FIRST first-time freshmen</i>	88%	9.1% (2/22)

EQ- $i^{2.0}$

The overall emotional intelligence score for the SD-FIRST 2021 cohort is lower than that of the general campus population. SD-FIRST students also scored lower in all sub-categories of SP, SE, and SM. In the IN category, SD-FIRST students scored lower in all sub-categories except empathy, where they scored similar to the general population. In the DM category, SD-FIRST students scored only slightly lower in all sub-categories except impulse control, where they scored higher than the general population.

The main take-away from this preliminary data is that the SD-FIRST scholars in the 2021 cohort have higher impulse control with lower emotional expression, interpersonal relationships, and self-regard than the general campus population. This data suggests that SD-FIRST scholars

may have difficulty expressing themselves, sharing their ideas, or telling people what support they may need, especially in group situations (see Figure 6).

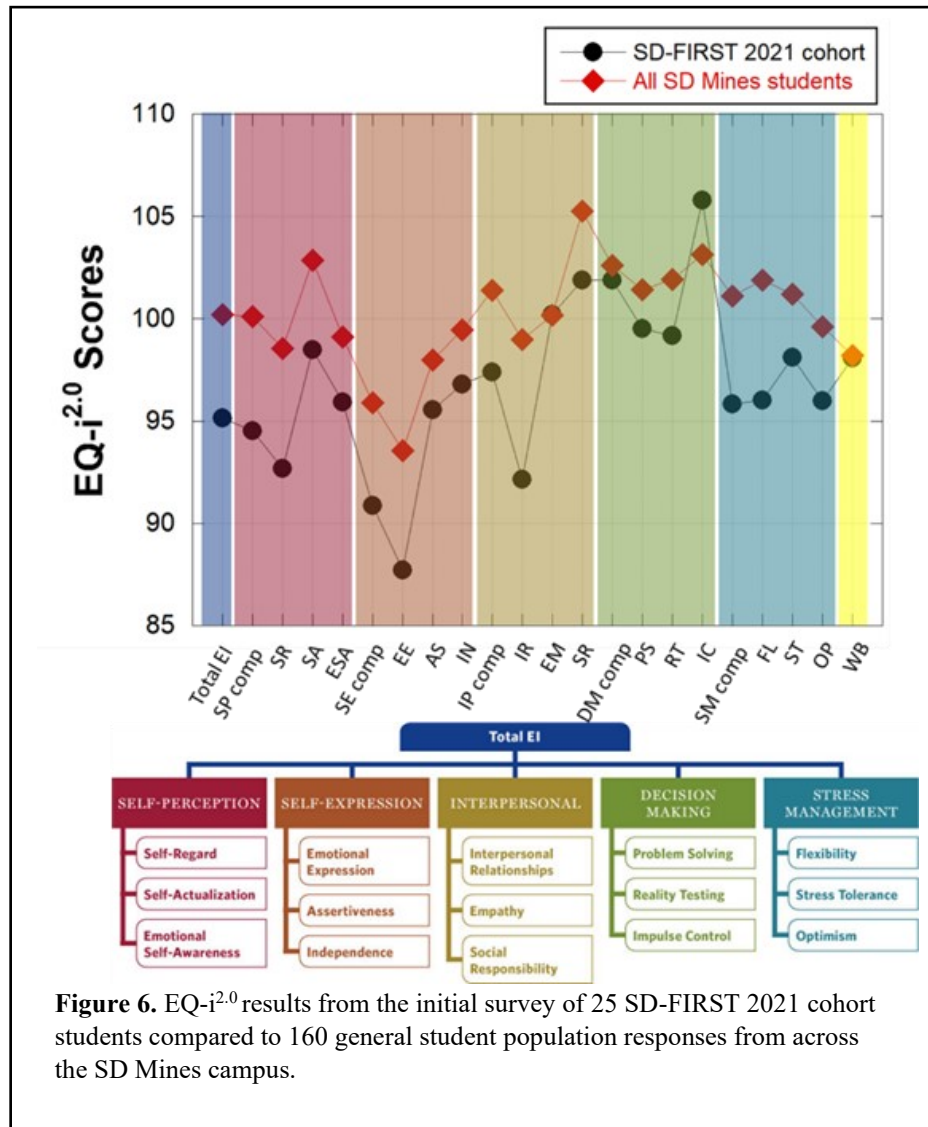


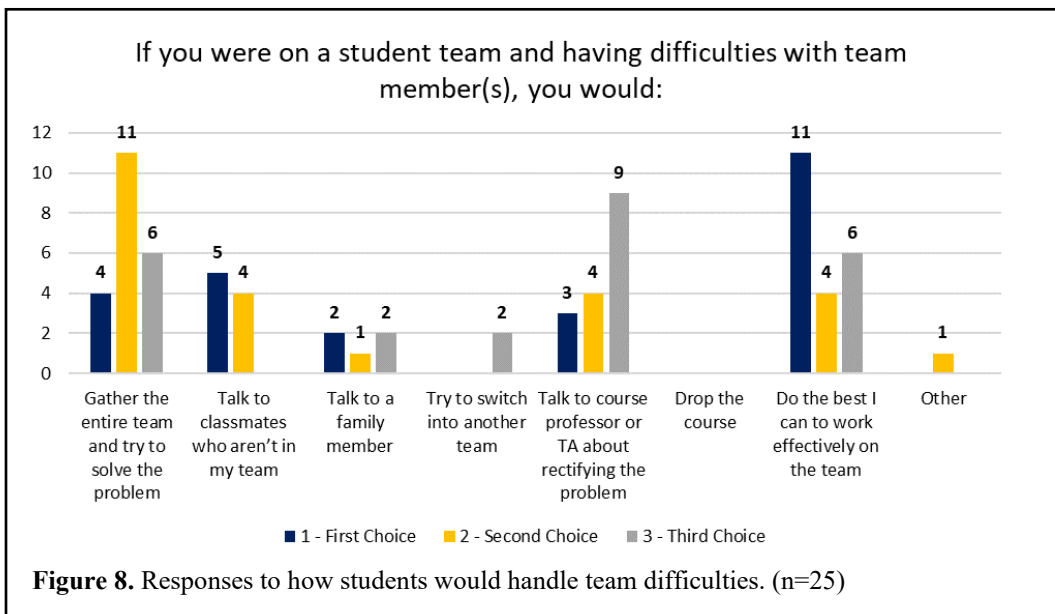
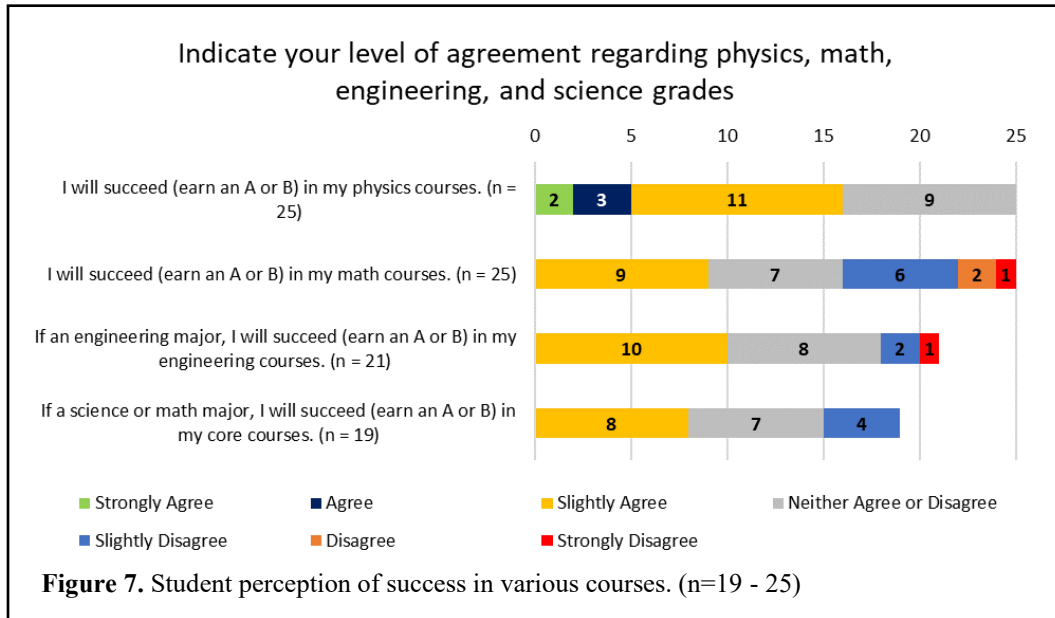
Figure 6. EQ-i^{2.0} results from the initial survey of 25 SD-FIRST 2021 cohort students compared to 160 general student population responses from across the SD Mines campus.

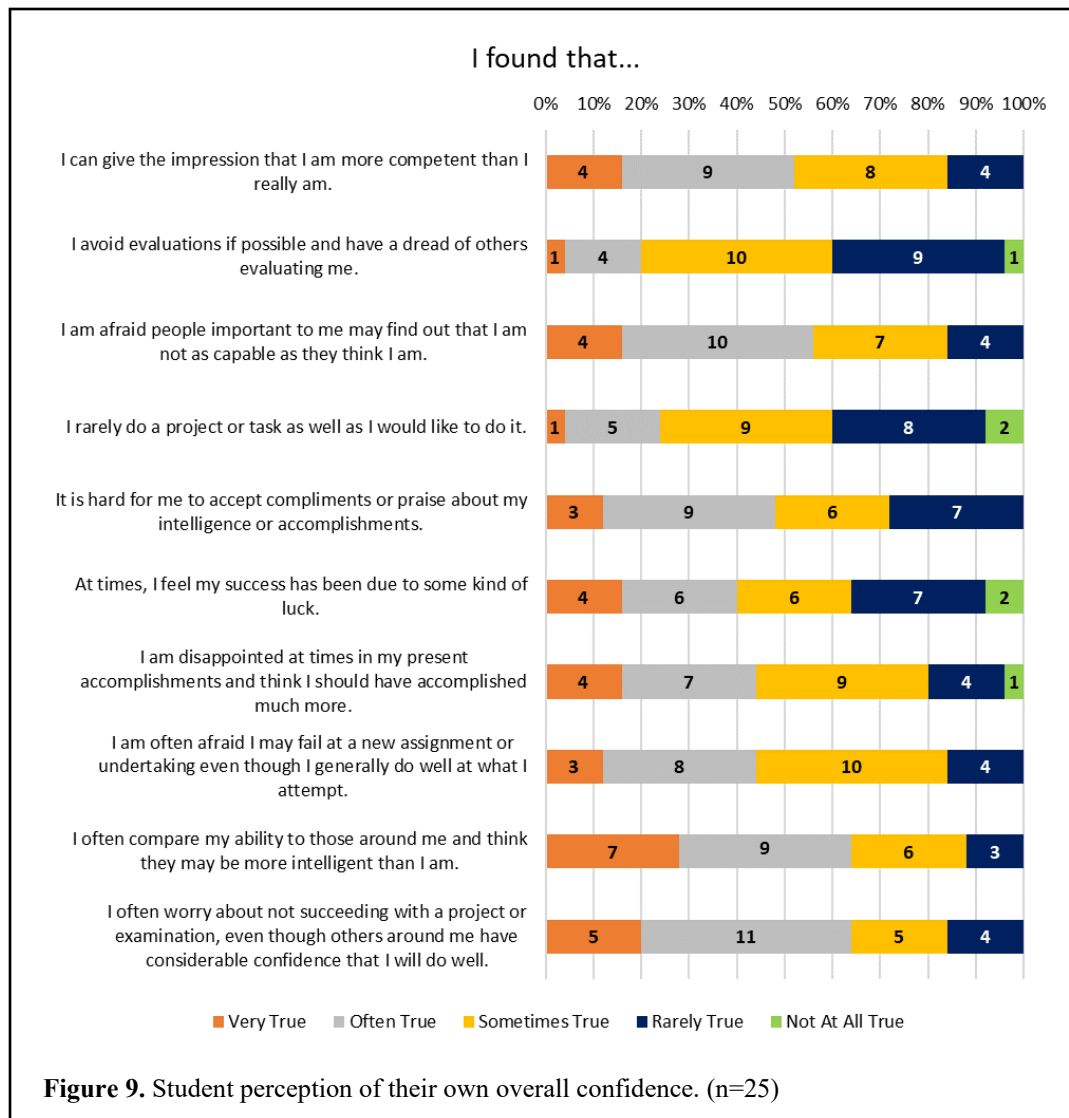
Student Satisfaction Survey

The Student Satisfaction Survey provided both demographic information as well as insights on self-efficacy, feelings of personal competence, and program satisfaction. The following list contains several notable results from the survey:

- Most students believed they would succeed in their physics, engineering, and core courses, while most did not believe they would succeed in their math courses (Figure 7).
- Most students would not speak up to resolve a team conflict and would simply “Do the best I can to work effectively on the team” instead (Figure 8). Responses here also suggest that the SD-FIRST students in the 2021 cohort may not speak up for their success in certain situations.

- Regarding overall confidence in academics, many students responded that they appear more confident, competent, and capable than they believe they are, as shown in Figure 9.





Program Coordinator Interviews

The program coordinator interviews provided feedback on many aspects of the programming that SD-FIRST provided over the Fall 2021 semester. This information is shown below and is divided into specific areas of the program.

Workshops:

- Students found the blacksmithing and national first-generation celebration day presentation to be the most useful and enjoyable workshops.
- For future workshops or events students have suggested off campus activities, community service, and group activities like a competitive event (engineering building project) or social gathering.
- There were not any workshops identified as being unhelpful.
- Several students did mention scheduling difficulties regarding workshop attendance.

Peer Mentoring:

- Most students met with their peer mentor four times (all but five students).
- Meetings were both in person and via text/email/social media.
- Feedback from students indicated that they found scheduling meetings with their mentors difficult. Most were reaching out to their mentors (as opposed to mentors reaching out to them).
- Many students suggested fewer peer mentor meetings as they experienced difficulties with scheduling conflicts (both student and peer mentor).
- Mentor feedback did indicate that there was some confusion about meeting requirements.

Academics:

- A majority of the concern expressed by students was related to classes that they were struggling in. Specifically, they identified calculus, chemistry, and trigonometry to be the most difficult classes.
 - These were also the classes that students were most likely to withdraw from or receive a D or F (calculus: 1 F, 1 D; trigonometry: 3 F, 3 W; chemistry: 3 F, 3 D)
 - Students stated that tests and difficult faculty were the reasons for their low scores.
- Several students did attend Slide Rule and Sunday Crunch (other existing tutoring programs on SD Mines campus) for chemistry (approx. 6 students). While they felt the tutoring was helpful, several did state that it didn't seem to help them when it came to testing.
- Nearly every student (only one dissent) liked the idea of a regularly scheduled tutoring session specific to SD-FIRST students.
- Students also received tutoring help from roommates, classmates, and residence hall tutors.

Social:

- Students are joining different groups on campus, but several did state that they felt that their academic course load made it difficult for them to participate.
- Several students did mention that they would like to see more interaction with other SD-FIRST Scholars to feel more like a "group". Also, they would like more people on campus to know about the SD-FIRST program (One student stated that they were surprised when no one seemed to know what he was talking about when he mentioned being in the SD-FIRST program.)
- Nine students have indicated that they were working, with the average number of hours per week being 10. Most of these students are working on campus (two are off campus).

The PIs on this project view the above information as lessons learned and will use the results to guide programmatic changes and tailor the SD-FIRST program for first-generation student success.

Conclusions

Based on the results from the first semester of the program, the team has made a few changes to the SD-FIRST program to benefit students. Monthly workshops and events will continue as in

the Fall 2021 semester, with a heavier focus on hands-on, confidence in STEM building events and social events to build relationships within the 2021-2022 cohort. Planned activities include professional development and career fair preparation, a panel of faculty to discuss summer research opportunities, a hands-on design challenge and competition, and a tour of a local engineering facility. Weekly tutoring at any existing campus tutoring session is now required for all SD-FIRST students (two hours per week) and to-date has been met with enthusiasm from the scholars. To avoid overloading scholars with requirements, the number of required peer mentor meetings has been reduced from 4 to 2 per semester with the hope that scholars have already built a relationship with their mentor that they may want to continue with more than the required meeting times. Finally, scholars will be required to fill out and submit 2-week calendar showing their dedicated class times, study times, extracurricular activity times, work times, and social times to help with time management throughout the semester.

Future Program Development

The SD-FIRST program is continually evolving and growing. Using results from assessments like the EQ-i^{2.0}, external program evaluation, and observations by the project team, changes are expected to occur to direct program elements to guide student success.

Looking to the future of the SD-FIRST program, the team is now collecting applications for the 2022-2023 cohort and will review during the spring 2022 semester. A cohort size of 20-25 students is expected for the 2022-2023 academic year, and current program scholars will continue as long as requirements are met and GPA is maintained. New scholars will be onboarded to the program in the Fall of 2022 and will participate in the program as the first cohort did, with evolution of the program occurring as assessment results dictate.

The team is working to make a few slight changes in addition to those being newly implemented during the Spring of 2022, including aligning GPA requirements for students receiving scholarship through the NSF award and through the CARA donor, which currently have GPA requirements of 2.5/4.0 and 3.0/4.0, respectively. A main goal of the Spring 2022 semester will also be to create more group cohesion between the 22 scholars and to engage scholars to be more active participants in the workshops, events, and on campus.

Acknowledgements

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