STEM Bridge Program: Underrepresented Minority Students' Perceptions of Louis Stokes Alliance for Minority Participation Program Impact

By Anna Brady and Dorinda Gallant

We explored underrepresented minority (URM) students' perceptions of the merit and worth of a summer STEM bridge program. The Ohio State Louis Stokes Alliance for Minority Participation program facilitated a three-week residential program for three consecutive summers with the goal of social and academic integration of first-year URM students into the Ohio State University. We were interested in understanding students' perception of the impact of the bridge program. Through qualitative data analysis, our findings revealed five impacts of the program: acclimation to college, confidence, self-awareness, connections with others, and college preparation. In addition to exploring students' perception of the program impacts, we asked students to identify elements of the program that were most beneficial and elements of the program to change. Our findings revealed that students found the introduction to college, facilitation of connections, and autonomy to be the most beneficial aspects of the program. Interestingly, students disagreed on elements of the bridge program to change. In light of our findings, we highlight the importance of ongoing evaluations of bridge programs, particularly evaluations that emphasize students' perceptions of the impact of programs.

For decades, researchers, practitioners, and policy makers have called for greater emphasis on investigating the factors that influence the persistence, retention, and graduation of historically underrepresented minority students (i.e., Black or African American; Hispanic or Latino; American Indian or Alaska Native; Native Hawaiian or Other Pacific Islander) in STEM (e.g., Tsui, 2007). Despite this call, underrepresented minority (URM) students continue to graduate with STEM bachelor's degrees at a lower rate compared to other students (Flynn, 2016). The National Science Foundation reported that the percentage of traditionally URM students in STEM who graduated with science or engineering degrees in 2017 was less than 25%, which excludes individuals who reported more than one race (4%) (NSB & NSF, 2019). This report confirms a continued need for researchers and practitioners alike to investigate factors that influence URM students' retention in STEM and build effective interventions to support retention in STEM.

The purpose of the present study is to investigate one specific intervention that intends to support URM students' persistence in STEM: summer bridge programs. Practitioners and researchers have implemented summer bridge programs to support students during academic transitions (Ashley et al., 2017). Bridge programs could occur between high school and entry into a postsecondary institution or between completion of an undergraduate degree and a graduate degree. Although summer bridge programs have focused on a range of topics and populations, they have become particularly common in supporting the transition from high school to college for URM students pursuing degrees in STEM. In the present study, we explored URM students' perceptions of the Louis Stokes Alliance for Minority Participation (LSAMP) bridge program at The Ohio State University. Specifically, we were interested in students' perceptions of the benefits of program participation, elements of the program that they found impactful, and elements of the program to change.

Factors that influence retention of underrepresented minorities in STEM

Researchers have suggested an array of confounding factors that interact to produce gaps in reten-

tion. For example, May and Chubin (2003) noted precollege preparation, undergraduate recruitment and admissions, financial support, and intervention programs as factors that contribute to the persistence of URM students in engineering. Empirical investigations have highlighted the role of URM students' high school preparation and students' beliefs in their persistence in STEM. Chang et al. (2014) found Black and Latinx students were less likely to persist in STEM when compared to their white and Asian counterparts. Moreover, their findings suggested that both high school preparation and college experience moderated this relationship. The authors pointed out the important way that college programs can buffer against factors that might discourage URM students to continue in STEM.

URM students' self-efficacy beliefs are also important predictors of persistence and academic performance. Self-efficacy beliefs are students' beliefs in their ability to complete particular tasks. Students develop different self-efficacy beliefs for different tasks and domains (Bandura, 2000). For instance, Wang (2013) found that students' 12th-grade math self-efficacy predicted intent to pursue STEM. Similarly, Byars-Winston and Rogers (2019) found that students' self-efficacy in research and attainment of their bachelor's degree predicted career intentions. Garriott and Flores (2013) found that college self-efficacy predicted educational goals and college grade point average (GPA). In a meta-analysis, researchers found that students' self-efficacy in a variety of domains predicted outcome expectations and interest, particularly for minority students (Lent et al., 2018).

Impact of STEM bridge programs

Early arrival and bridge programs have emerged as an intervention with the potential to prepare URM students for college. Broadly, summer bridge programs focus on preparing students to transition into college. In a review of STEM bridge programs, Ashley et al. (2017) noted that the goals of bridge programs tend to fall into three categories: academic success goals, psychosocial goals, and department-level goals. The goals adopted by bridge program facilitators directly translate into the anticipated outcomes of the program. For example, researchers might examine students' content knowledge or retention as an outcome of a program that focuses on academic success goals (Ashley et al., 2017).

Generally, research has supported the effectiveness of bridge programs (Ashley et al., 2017; Gilmer, 2007; Strayhorn, 2011; Tomasko et al., 2013), especially in populations with a high college dropout rate, such as URMs in STEM (Tsui, 2007). For example, evaluations of an engineering bridge program that was comprised of 61% URMs suggested that students who engaged in the bridge program felt more prepared for college, demonstrated an improvement in study skills, and reported clearer expectations of college. In addition, students demonstrated an increase in sense of belonging, particularly with peers (Tomasko et al., 2013). Gilmer (2007) reported that URM students who completed a five-week bridge program demonstrated higher GPAs and greater retention rates compared to a control group. Similarly, Strayhorn (2011) found that URM students who completed a bridge program demonstrated increases in academic self-efficacy and academic

skills. Interestingly, students did not report increases in sense of belonging or social skills. Strayhorn (2011) also found that students' postbridge program self-efficacy, which was measured prior to the start of students' first semester of college, predicted their first semester GPA.

Present study

The focus of the present study is one specific bridge program aimed at preparing URM students for college. The bridge program is a part of a larger intervention focused on increasing students' retention in STEM programs. LSAMP programming assumes a relationship between academic integration, social integration, and student retention (Tinto, 1975) and includes professionalism. The bridge program is a three-week residential program that takes place directly before the autumn semester. Programming includes a math-focused course, a science-focused course, a writing course, a study skills course, STEM-focused excursions, lunch-and-learns focused on resources around campus, and peer mentor–led study tables and activities.

While researchers have provided evidence to support the effectiveness of summer bridge programs for URM students, it remains unclear what aspects of the program students consider to meet their academic and social needs. We pursued this gap in the literature by emphasizing students' perceptions of the impact of a bridge program. In the present study, we explored, qualitatively, aspects of a summer bridge program that students found to be most beneficial to meet their academic and social needs and the aspects of the program that students suggested to change.

The overarching research ques-

tions guiding the study were: (1) What are URM STEM students' perceptions of the merit and worth of the summer bridge program? and (2) What aspects of the program did students find to be the most and least beneficial to their academic and social integration?

Method
Participants

Fifty-two incoming college freshmen (58% female) participated in one of three summer programs: 2016 ($n = 20$), 2017 ($n = 13$), or 2018 ($n = 19$) at The Ohio State University. All students identified as URMs in STEM (56% Black or African American, 31% Hispanic or Latinx, and 13% two or more races). All students were U.S. citizens, U.S. nationals, or permanent residents of the United States; and planned to pursue an undergraduate major in a STEM discipline. In addition, 44% of students were first-generation college students, that is, neither parent completed a four-year degree.

Procedure

Program participants completed a survey following the completion of the bridge program. The survey consisted of Likert-type scale self-report questions and short-answer questions. For the present study, we focused on analyzing students' responses to three short-answer questions: (1) What impacts do you think this program had on you? (2) What aspects of this program do you think were most successful or helped you the most? and (3) What changes, if any, would you recommend be made to this program? The quantitative data were not related to the goals of the present study, but will be included in future presentations and publications focused on the LSAMP bridge program.

Data analysis

We conducted a thematic qualitative analysis (Braun & Clarke, 2006, 2012). The first and second authors independently reviewed and coded all student responses to the three questions. The coding process was inductive, meaning the authors created codes based on themes that emerged from students' responses rather than rooted in prior literature (Saldaña, 2016). Both authors then convened to discuss themes that emerged from the coding and to arrive at consensus on themes.

Results
The impact of the program on students

Five major themes emerged from students' responses to "What impacts do you think this program had on you?" Students reported that the bridge program facilitated their acclimation to college, confidence, self-awareness, connections with others, and college preparation. We describe each theme and illustrate using example quotes.

Acclimation to college. Students felt they left the program with a better understanding of college life. One student noted, "Being that I am an out-of-state student, this program allowed me to become acclimated to my new environment before the rush of school starting." Some students noted that this understanding facilitated a greater sense of comfort as they transitioned to campus. One student stated, "This program made me comfortable with being in Columbus at [The Ohio State University] without feeling overwhelmed by the herd of people expected when the semester starts."

Confidence. As students were introduced to college life, they reported feeling more confident about their skills and abilities. Students frequently connected their feelings of confidence to feeling less anxious or stressed. For example, one student reported, "I feel more at home on a big campus, feel less stressed and feel that I'm capable of completing what is placed in front of me." A second student noted, "This program gave me the confidence to enter college prepared to succeed in my STEM major…I feel empowered to take on college and have success within my area of study."

Self-awareness. Students' feelings of self-awareness seemed to be prompted by self-evaluation they engaged in during the bridge program. As an example, one student reported, "It made me realize what I need to work on as a student before college starts and throughout college. An example [is not putting] off studying until the last minute." A second student described awareness of the way they engage with others noting, "I need to focus more on how I'm perceived to others. One of my personal beliefs is that people should be more unfiltered in what they discuss with others however I have learned that in a professional setting this may not be the best route to take. I will try hard in the future to keep this in mind although I'm sure I will still blunder with this."

Connections with others. Students noted connections with their bridge program peers, peer mentors, faculty, and staff. Many students reported that the relationships they formed with their bridge program peers would act as a support system through college. One student noted, "I feel as though I have made very good friends that can support me throughout my first semester in college." In addition to peer connections, students also felt supported by faculty on campus. As one student stated, "I was able to form meaningful relationships with professors and peers which is the greatest benefit I have received from this program."

College preparation. Students explained that the bridge program provided them with increases in their knowledge of math and science content and knowledge of campus resources. One student noted that the bridge program "taught me a lot about study skills and really prepared me for my courses." Another student described their introduction to resources on campus, "It was easier to take in all the resources offered by the university, especially the libraries, and allowed me to plan how I am going to use these resources to succeed in freshman year."

Most beneficial aspects of the program

Three major themes emerged from students' responses to "What aspects of this program do you think were most successful or helped you the most?" Students described introduction to college, facilitation of connections, and autonomy as beneficial aspects of the program.

Introduction to college. Students noted the introduction to resources, opportunities around campus (e.g., undergraduate research), and local opportunities (e.g., weekend excursion to a laboratory) as especially helpful. In addition, they described the impact of the courses they were enrolled in, with a particular emphasis on integrated sciences, which provided students with hands-on experiences related to chemistry and environmental science, and STEM Study Skills Systems, which focused on the skills students needed to be successful college students (e.g., motivation, time management, study strategies). Finally, students noted that spending time on campus prior to arrival of other students was especially helpful. This provided a greater sense of familiarity with the campus. As an example, one student noted, "One

thing that was helpful was the increase in my familiarity with the campus and how college work is done. For instance, I was told that the speed that [instructor's name] goes is normal for some classes so I know that I need to be more prepared before class and work harder studying." A second student described, "It helped me to grasp the true differences between high school and college. It essentially taught me the basics of college, knowledge I would have had to figured out alone had I not participated in the program."

Facilitation of connections. Students pointed out specific elements of the program that encouraged connections, such as employing experienced LSAMP scholars as peer mentors, prompting networking during group events, and collaborative assignments that students were required to work on in and out of class. As one student noted, "I think the program was most successful at helping me form relationships that allowed me to be comfortable at the university." A second student highlighted the role of their peer mentors, "The mentors really showed me how to study, how to avoid distractions, how to utilize our time at OSU and were stellar examples to follow. They gave us people to look up to."

Autonomy. The bridge program allowed students to transition from the reliance on adults that characterized their precollege lives to independence and "freedom." As one student described, "I thought the part that helped us the most was leaving us alone to find our classes ourselves after a couple days." Similarly, one student noted simply, "The freedom and how we all got to spend time with each other…"

Suggested program changes

Students described both academic and nonacademic aspects of the program that they would change. We

describe suggested changes, with example quotes.

Courses and scheduling. For some, the focus of the courses was unhelpful. For example, one student noted, "When I applied to the program, I thought that the program would be a broader introduction to the STEM field. The hard schedule of classes limited my familiarity with some aspects of campus and didn't give students outside of chemistry or biology much of a chance to interact with faculty in their fields." Some students also expressed concerns with the rigor of the courses. For some, the courses were too challenging or involved an unreasonably large workload; but for others the courses felt remedial. As one student noted, "We as students should be getting instructions to get ahead of the competition, instead of treating us as if we're behind and need to catch [up]. We're all here because we're qualified, and we're also here to get a head start in college."

There was also feedback focused on scheduling. For instance, students noted that they wished their days started later, included longer breaks throughout the day, and were shorter. Because of the length of their days, one student noted that they were unable to access faculty members to seek extra help with their coursework: "Maybe more time for the students to meet with the faculty members and perhaps get personal tutoring with the professors if they want it."

Living learning community. For some students, transitioning from living together to living across campus was challenging. As a testament to this challenge, one student wished that the community they created during the summer could carry into the academic year more explicitly, "I would like for there to be an incoming freshmen LSAMP learning community floor.

Rather than splitting up the students on move-in day, it would be better to keep them on the same residency hall in order for them to keep in touch and have that learning community with [them] through the first year." Students also wished there was additional time for fun activities during the program and additional opportunities to get to know the campus.

Transparency. Students noted confusion surrounding the goals and the requirements of the program. They wished staff had been clearer and more transparent. One student captured this issue with a suggestion for the way that the program goals could be communicated to future LSAMP scholars, "Tell people that they are going to be taking classes so that they do not think that it is a summer camp."

Autonomy. Although some students noted that their independence was one of the highlights of the program (see Most Beneficial Aspects section), some students felt they were not treated as independent college students. These students wished they had been given additional free time to more accurately mimic a college schedule: "I would allow the students more free time due to the fact that college is solely how the students schedule it and it is not scheduled for them."

Discussion

Our findings revealed both intended and unintended outcomes of our program. In addition, we uncovered disagreement among students' perceptions of aspects of the program that were beneficial to them and aspects of the program to change. We briefly discuss these two points.

Intended and unintended outcomes

When students described the perceived impact of the program, many of the themes aligned with academic and social integration of students to college. For example, one goal of the program was to provide students with a support system of both students and faculty/staff as they transitioned onto campus. Similarly, the intention of the program was to acclimate students to college campus, increase students' confidence, and prepare students for college-level courses and potential challenges they might encounter. In addition to falling within the bounds of the explicit program goals, these themes also align with prior research focused on bridge programs. Specifically, Ashley et al. (2017) described improvements in content knowledge, sense of belonging, sense of preparedness, and self-efficacy. All four of these improvements align with our findings.

Interestingly, one theme did not seem to fit with our specific program goals or with the goals described by Ashley and colleagues (Ashley et al., 2017). Specifically, students' descriptions of the self-awareness they gained as a result of the bridge program seem less aligned with the specific goals of the program and prior research focused on bridge programs. It seems that engagement in college-level activities and resources encouraged students to reflect on their own prior experiences, skills, and abilities. This led students to a better understanding of areas that they might need to focus on as they transitioned into college.

Beneficial program elements and program elements to change

Broadly, there was some disagreement about the breadth of the program. Some students felt like the programming provided them with a broad foundation, while other students did not perceive the topics covered as representing their STEM interests. Because LSAMP facilitates programming for all URM students in STEM, it can be challenging to choose courses and programming that include all students' interests. The rigor of the courses was a second aspect of programming that caused disagreement among students. For some students, the courses were unexpectedly challenging, while other students found the courses to be remedial. Students' different perceptions might have been due to differences in their prior schooling experiences. Both of these challenges highlight the importance of carefully considering the goals of programs and using those goals to select students. Alternatively, this finding could also highlight the importance of adjusting programming to fit the needs of students. For examples, administrators could assess students' STEM knowledge prior to the start of the program and revise courses accordingly.

The final aspect of programming that students disagreed on was autonomy. This disagreement seemed to reflect the tension between students' expectations of independence and support and facilitators' expectations of independence and support. This is likely closely related to program transparency. If students were made more aware of the specific types of activities they were going to be engaged in during the bridge program, they might have had a different perspective on the program overall.

Limitations

Findings from the present study center on three specific groups of students engaged in the LSAMP summer bridge program. The benefits of the bridge program are likely rooted in the specific content and activities students completed as a part of the program; however, as STEM bridge programs aimed at URM students is commonly used as a retention strategy, it is important for future research to explore the impact of these programs more broadly.

Conclusion

Overall, bridge program participants expressed positive perceptions of the program and highlighted areas that program coordinators could improve. From qualitative responses, we identified intended and unintended outcomes of programming, which lead to positive responses from students. By sharing what we learned from the themes that emerged from students' responses for our summer bridge program, we hope researchers, practitioners, and policy makers gain more insight regarding the benefits to students of STEM summer bridge programs designed specifically for URM students. ∎

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