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Reel Them In: A Framework for Bridging Underrepresented Students to STEM Majors

Martha Vang
The University of Akron, mv37@uakron.edu

Nasser A. Razek
The University Of Akron, aaa44@zips.uakron.edu

Christine Rose
The University of Akron, crose@uakron.edu

Emily McClaine
Kent State University, elamiell@kent.edu

Katie Schrader
Northeastern University, kaitlynschrader@gmail.com

See next page for additional authors

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Authors
Martha Vang, Nasser A. Razek, Christine Rose, Emily McClaine, Katie Schrader, and Laura Weissbaum

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Martha Vang, The University of Akron
Nasser Razek, The University of Akron
Christine Rose, The University of Akron
Emily McClaine, Kent State University
Katie Schrader, Northeastern University
Laura Weissbaum, Georgia State University

ABSTRACT

The eight-week math intensive Running Start Summer Bridge Program (RSSB) supports and challenges incoming STEM students in their coursework while immersing them on campus life. The current study explores the effectiveness of RSSB in easing students' transition to college life and the rigorous nature of STEM disciplines. Throughout the program holistic mentoring and participatory tutoring techniques provided students with academic enrichment opportunities. Central to this initiative is encouraging equity-mindedness and foster community-building practices. Data presented demonstrate how this innovative initiative increased retention and persistence among underrepresented students in STEM disciplines while fostering a sense of community. Best practices and assessment for holistic STEM summer bridge programs are included as a model to better retention and student success on different institutions taking in consideration the various factors and circumstances influencing program admission and demographics.

CONCEPTUAL FOUNDATION

Castleman and Page (2014) argue the importance of engaging low-income students during the summer transition from college to high school. When considering the rigorous nature of STEM careers paired with an evident lack of diversity in these fields, summer bridge programs allow for underrepresented students in STEM to prepare for the college transition and have the best chance for college and STEM success (Cairncross, Jones, Naegele, & VanDeGrift, 2015).

The Running Start Summer Bridge Program at The University of Akron seeks to challenge and support students while immersing and engaging them on the college campus and in their coursework. This program thus eases their transition to college life and the STEM disciplines while fostering a sense of community throughout the program and campus at large. The theoretical framework is highly supported by several college student development theories such as Astin's Theory of Student Involvement (1999), Perry's Intellectual Development Stages (1968), King and Kitchener's Reflective Judgement Model (2004), Sanford's Theory of

Dissonance between challenge and support (1962) and Schlossberg's Transition Theory (1981) and theory of Marginality and Mattering (1989).

STEM Initiatives for Underrepresented Students

Programs and initiatives across the country evidence the growing demand to prepare and support students seeking science, technology, engineering, mathematics, or medicine (STEM) degrees. A particular need has developed to bridge the gap from K-12 education to collegiate STEM programs. Studying within-field persistence rates of physical science and engineering students, King (2015) found that STEM students may earn lower within-field college grades compared to other programs. Additionally, they routinely leave the field; because students may earn lower grades in STEM classes, they may "receive messages that they do not belong in the field" (p. 50). In response to these trends, programs and initiatives are continuously being developed and improved in order to support students, specifically underrepresented students (such as first-generation, low-income, minority, women, displaced workers, Veterans, non-traditional), seeking STEM degrees.

Across all programs, the interdisciplinary nature of STEM education must be highlighted when students are supported in pursing these careers. Reeve (2015) discusses the need for educators and students to perform "STEM Thinking" defining it as "how STEM is involved in most of the products and systems they use in their daily lives" (p. 8). Educators in United States primary and secondary schools often stay confined to a specific area of expertise (specializing as a Science teacher or a Math teacher), rather than taking on the challenge of learning about all aspects of the STEM fields and familiarizing themselves with the standards of each area (Reeve, 2015). Because teachers do not focus on the interdisciplinary nature of their subjects and their students' learning, they often do not teach their students how Science, Technology, Engineering, and Mathematics are interrelated and dependent on one another. If students are to be successful in the STEM areas, they must be able to develop STEM Literacy, enabling them "to 'know, understand, use, and evaluate the STEM concepts, principles, practices, artifacts, and phenomena being studied" (Reeve, 2015, p. 10). STEM Thinking in classrooms and all programs and initiatives will aid in creating a STEM workforce and competing on the global scale when it comes to solving world issues. Using the model of STEM Thinking to assess program success as well as find solutions to better prepare educators and/or modify the education system will allow this framework to retain more students in the STEM discipline while ensuring their success.

In K-12 education, initiatives such as Project Lead the Way (PLTW) (McMullin & Reeve, 2014), EnvironMentors (Monk et al, 2014), and Dual-Enrollment programs for college level sciences (Lukes, 2014) introduce students to STEM fields in ways that encourage them to consider STEM careers. The EnvironMentors program at Louisiana State University (LSU-EM) specifically serves underrepresented students with a goal to "engage students in STEM fields to create a competent and diverse workforce" (Monk et al, 2014, 386). The EnvironMentors program partners with GEAR-UP. GEAR-UP provides the overall programming structure, and caseload management for the students. Through this partnership, this program provides high school student participants with an opportunity to meet weekly with a science mentor from LSU to execute a science project. Program assessment indicates that of the 23 students who completed the LSU-EM program and graduated high school, 21 are currently enrolled in post-secondary education, which highlights a correlation to the preparation this program may have provided (Monk et al, 2014, p. 390). Student participants also voiced feelings of enjoyment in the

program. While this assessment weighed heavily on satisfaction, the evaluations do demonstrate that the LSU-EM program offered a positive impact for students, engaged them in STEM subjects, and offered them college preparation experiences during high school.

While these initiatives create a foundation for students to consider STEM careers, many students are still unprepared for college-level programs. In order to bridge the gap between K-12 and STEM college coursework, summer bridge programs allow students to transition to such a workload while providing support in STEM subjects and teaching college preparation and readiness. For example, Middle Tennessee State University (MTSU), a public, open admissions university of approximately 26,000 students, began a two-week summer bridge program in 2010 called FirstSTEP, which aimed to help 35 at-risk STEM majors address math deficiencies and persist through college (Raines, 2012). These students earned ACT scores of 19-23, 50% were of an underrepresented race, and all were preparing to take their first college course of pre-calculus in the fall 2010 semester. All students received ten days' worth of instruction on basic mathematical principals such as factoring, exponents, and radicals, etc. and at the end of the program "88.6% said that… they felt better prepared for pre-calculus in the fall and felt much more positive about their ability to learn math" (Raines, 2012, p. 26). Showing the benefits of the program, Raines (2012) concluded that FirstSTEP had 77.1% of students persisting to their second year of college (higher than the university's general retention rate), and earning a cumulative GPA of 2.54 (a C+ average) (26). While support through K-12 and the summer before college is important, STEM students need continued academic support through their first-year of college.

Programs for current undergraduate students also exist in particular effort to retain students in STEM programs once they are pursuing a STEM degree. Science Technology Reaching Out to New Generations in Connecticut (STRONG-CT) is program initiative to foster retention in underrepresented student populations in STEM programs at community colleges and the University of Connecticut (McGonagle et al., 2014). Through this program, students receive academic and advising assistance for STEM classes, mentoring and networking with STEM professionals and program alumni, and career development and preparation workshops. Program evaluation data showed that "while most STRONG-CT students come from disadvantaged backgrounds in terms of parents' education and SAT scores, those in the program perform in science majors similar to, and in some cases better than control students" (McGonagle et al., 2014, p. 59).

When considering the demographic of students who participate in preparation initiatives and bridge programs for STEM degrees, underrepresented students surface as a target population. Examining the factors motivating first-generation minority college students to become the first in their family to pursue a college degree, Blackwell and Pinder (2014) found that generally, first-generation college students have leveled off to make up about 25% of the college student population. Their data showed that first-generation college students were not encouraged by family to attend college but intrinsically wanted to go to college (Blackwell & Pinder, 2014). The findings also included three causal conditions that influenced the participants: 1) the participants had a love for reading at an early age, 2) they each felt they were different from their family, and 3) they all wanted a better life for themselves than what their parents had. Even though all three participants went to college, they still faced financial obstacles and personal stress. First-generation college student participants' experiences of deciding to go to college and actually going through college were starkly different from the third-generation college students' experience. Third-generation college students' experiences

included knowing that they were expected to go to college and had the access and information that they needed to navigate college. First-generation college students were also successful due to the nurturing support (not financial) of their parents and influence of teachers. The continued support of peers and family through college provided motivation to complete college.

THE RESEARCH STUDY

After five years of holding the Running Start Summer Bridge program, this study explores the impact it has made on students who successfully completed the eight-week program. Utilizing a descriptive design through the use of a quantitative survey, data on successful elements of the Running Start Summer Bridge program allow for a model of best practice for STEM summer bridge programs. Data also provide insight on how to improve the program.

The Running Start Summer Bridge Program began in summer 2011 at the University of Akron. The program aims to provide highly motivated rising college freshmen, who intend to study in Science, Technology, Engineering, Math, and Medicine (STEM) fields, with an opportunity to improve mathematics skills and begin the college experience. The goal of the Running Start Summer Bridge program is to accelerate the mathematics course progression among incoming STEM students. The program focuses on providing support structures students need to succeed in mathematics, STEM coursework, and college in general. Upon successful completion of the Running Start Summer Bridge, students may be granted membership in the Choose Ohio First Scholarship Program, which includes continued student support as well as a scholarship component.

Research Questions:

1. To what extent has the Running Start Summer Bridge program prepared incoming STEM students for the rigorous nature of STEM college education?
2. To what extent do Running Start Summer Bridge alumni value the preparation, experience, participation and learning that they gained from Running Start Summer Bridge?
3. To what extent do Running Start Summer Bridge alumni experience connectedness and belongingness at the University of Akron as a result of their participation in the summer program?
4. How has the progress and impact of the Running Start Summer Bridge program differed across various student demographics?
5. In addition, how could the Running Start Summer Bridge program improve to better prepare students?

PROGRAM HIGHLIGHTS

The program focused on ensuring success while providing access to underrepresented students through operating a summer intensive program. The program ensured early arrivals on campus and required campus housing and mandatory activities focusing on community building, college success, and positive college life involvement. The program combined the academic aspects and college life skills through the presence of STEM counselors as well as traditional residence assistant while providing full financial aid for cohorts of academic and ethnic diversity.

Such an early and continuous contact with students facilitated the process of tracking, assisting, and mentoring students. Mandatory participation in academic advising, study hall groups, tutoring, and social activities ensured campus-wide knowledge and support while providing an early alert system for immediate and aggressive follow-up for any student having difficulties.

BEST PRACTICES: A REVIEW

Based on the findings of the study and a review of nationwide summer bridge programs, the five best practices were generated: 1) Creating a community and web of support, 2) Tutoring & mentoring that works, 3) Digging deeper: conversations about diversity, 4) Intentional college preparation, and 5) Creating a legacy.

Creating a Community and Web of Support

Create a community and web of support through utilizing campus and community guest speakers, campus tours to different colleges and departments in the STEM field, organizing group events and trips. Essential to creating the web of support is intentionality in utilizing peers and staff through the togetherness of the experience. . The physical space and branding the program provided a pivotal aspect of creating the supportive community aimed for.

Tutoring and Mentoring That Work

Creating tutoring and mentoring that work is accomplished through utilizing junior and senior students who share a common discipline while providing the supportive environment where staff in the program willingly provided flexible schedules working late hours to accommodate student needs. To track the effective=ness of the tutoring and mentoring system, the program should utilize tutors' notes, sign-in reports, and student surveys.

Digging Deeper: Conversations about Diversity

Create conversations about diversity was facilitated with providing "Brave" spaces rather than save spaces where students were encouraged to challenge stereotypes whether common or individual to break down historical contexts and provide insights into current and timely issues. Such spaces were created through tireless efforts of staff and previous students in the program who served as mentors and tutors, as well as the suggestions of current program students.

Intentional College Preparation

To create the intentional college preparation, the program had to have a structure while providing adaptability to the situations of each student. This was accomplished through individual participatory advising where students were involved in goal setting activities and were provided with proactive support through various checkpoints marking their accomplishment and their plans for development towards goal achievements while also monitoring for overall student growth through self-actualization and increasing their executive skills.

Creating a Legacy

Creating a legacy included several aspects like meaningful fun through intentional on campus and off campus events. Another example is expanding the trust both among the cohort students and between the current cohort and the mentors and tutors. Such trust extended to provide a legacy of meaningful bonding among the different cohorts of the program, the staff, and the university community increasing retention and degree attainment patterns.

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