Broadening Participation of Culturally and Linguistically Diverse Students in STEM+CS

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Background

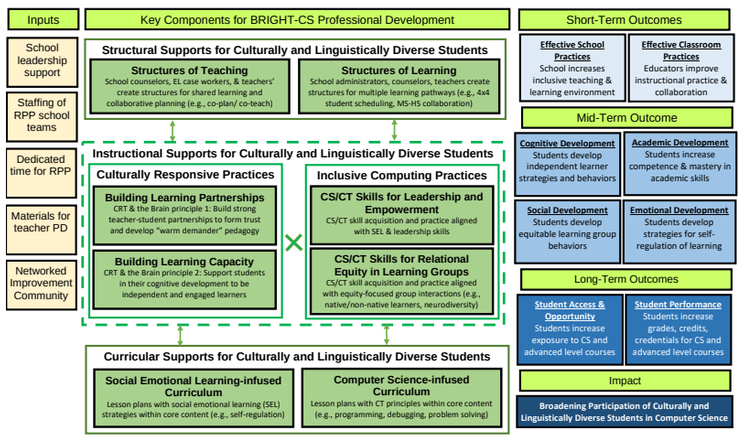
Culturally and linguistically diverse students—particularly Black, Latino and English Learner students—are underrepresented in advanced coursework in STEM, such as computer science (CS). For example, a recent survey conducted by Google and Gallup indicates that in K-12, black students and their parents show high interest and support for CS (Google Inc. & Gallup Inc., 2015, 2016). Yet intent to major in CS, mathematics, or statistics among Black college freshmen declined to an all-time low of 9% in 2014 (National Science Board, 2016). There is clearly a need to address this problem in K-12, when students and parents are most interested in learning about CS. However, there is little research evidence of sustained long-term impacts of STEM+CS programming aimed to increase CS interest and outcomes of culturally and linguistically diverse students. Rather than a stand-alone student program, there is a critical need to address instructional, curricular and structural barriers to accessing and succeeding in advanced STEM+CS coursework in K-12 schools. These may include instructional practices and curricula that are not culturally responsive or rigorous for all students, and school policies around placement in gifted and special education services or course pathways that result in a chilly environment. BRIGHT-CS RPP (Building Student Retention through Individuated Guided coHort Training in Computer Science Researcher-Practitioner Partnership) is a two-year project that engages teachers, school leaders, school counselors, and researchers at two schools in Virginia to identify barriers and future work in the areas of instructional, curricular and structural improvements to promote more culturally and linguistically diverse students gaining interest and experience in STEM+CS.

Aim

The RPP is a small size grant under NSF's Computer Science for All program (NSF 18-537), designed to support the initial steps in establishing a strong well-integrated RPP team. The RPP team will study the instructional, curricular and structural barriers to access and succeed in STEM+CS for culturally and linguistically diverse students by using data to plan, implement and assess a series of short-cycle interventions in each area. The results of these interventions will inform the RPP team's culminating task of proposing a plan for improving access to advanced STEM+CS coursework among culturally and linguistically diverse students. RPP members can also apply this systematic approach to addressing other problems of practice, serving as a model for the development of sound RPP practices outlined by Schneider (2015) and Henricks et al (2017).

Theory of improvement

To promote inclusive practices and policies in STEM+CS, we must address three components for improvement: 1) Structural, 2) Instructional, and 3) Curricular Supports.



Example

Adaptive Implementation cycle

In January and February 2020, RPP members studied instructional barriers to access by completing an Adaptive Implementation (Plan-Do-Study-Act) cycle (Yamaguchi, 2017) to implement ideas for building Learning Partnerships, a culturally response teaching practice (Hammond, 2015). Specifically, RPP members:

1. **Discussed data from student empathy interviews**, on questions about the school learning environment
2. **Read an article** on "Promoting equity, access, and success through productive student partnerships"
3. **Planned a small intervention** to try to build productive student partnerships in their own classrooms
4. **Tried out the intervention** and collected data through observation
5. **Reported back to the team on the intervention and its results**

Data

I allowed students to teacher each other and me about the games they play, [then] channeled the information into an essay assignment. Students were more engaged and willing to listen to each other and disagree without being disagreeable.

I had to stay longer as a modeling partner in a group with a student who was being overlooked for conversation.

Students were apprehensive to participate at first. Over time, they became more comfortable and began to participate more in the conversations.

Students are more conscious to self-monitor and eagerly reciprocate and alternate in their interpersonal relationships. They have more accurate self-perceptions, greater self-efficacy, and greater respect towards others.

They became very productive and got more work done than they usually do. All 5 of my students completed their 75% of their projects, when the goal was to finish 25%.

Learnings

Thus far, teachers, school counselors, and administrators have reported:

- "Constructive criticism is more challenging [for students to give] when spoken; students need nuanced phrases: 'Explain your thesis to me' vs. 'This doesn't make sense.'"
- "My students became "available for learning" when their gaming interest was incorporated into my lesson. They earnestly worked toward acquiring writing skill objectives, and they enhanced their dialogic communication skills with each other.
- "We don't directly teach the how's in productive partnerships- they are assumed."
- "I need to have 3-4 questions / sentence starters ready to go to help build communication."
- "While many of my students do not have much verbal language, my students are reinforced by interactions with their [general education] peers. It was as if they wanted to impress them and show them what they could do."