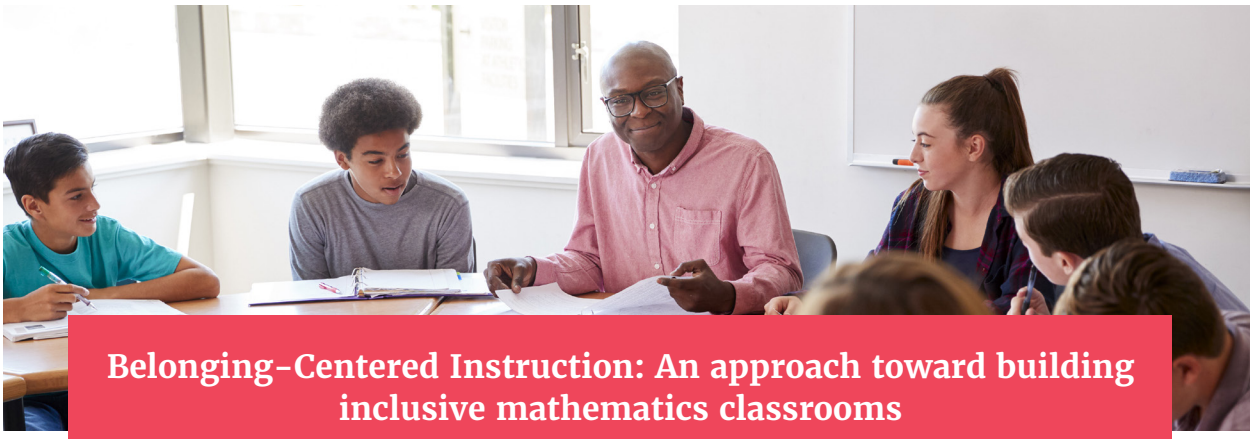

Belonging-Centered Instruction: An approach toward building inclusive mathematics classrooms

RESEARCH SNAPSHOT | OCTOBER 2021

Black and Latinx students in middle school mathematics classrooms have historically faced assaults on their sense of belonging. Beyond encountering increasing complexity in mathematics,[1] they also confront stigma, discrimination, and cultural erasure within segregated, punitive, and colorblind school environments.[2-8]

Consequently, Black and Latinx students' sense of belonging persistently declines throughout middle school, and they often experience alienation in mathematics specifically.[9-12] In response, we have conceptualized the Belonging-Centered Instruction (BCI) Observation Protocol, which evaluates the ways teachers combat inequity by foregrounding marginalized students' inclusion, access, and sociocultural identities through empowering interpersonal and instructional interactions in mathematics classrooms.

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Areas of expertise: Adolescent development and psychology, motivation, school belonging, equity in mathematics education, classroom observation, quantitative and qualitative methods

Key Findings

- Using video recordings of mathematics classrooms, three dozen qualitative interviews with urban adolescents of color, and prior theory on school belonging, we developed and validated the Belonging-Centered Instruction (BCI) Observation Protocol. The protocol is comprised of two domains and seven subdimensions that evaluate the multiple ways teachers can provide opportunities for active inclusion, learning equity, and empowerment through their instruction and in the social climate they create in their classrooms. These seven subdimensions demonstrated good reliability across 10 coders and nearly 400 middle school mathematics classroom sessions.
- Multiple subdimensions within the Interpersonal and Instructional domains of BCI predicted student engagement (measured through both student self-report and observation metrics).
- Multiple subdimensions within the Interpersonal and Instructional domains also predicted students' self-reported sense of mathematical agency.
- *Decentering Teacher Authority* (see Table 1)—a subdimension within the Instructional domain—predicted year-end standardized mathematics achievement.
- Teachers' self-reported perceptions of quality support and feedback from school administrators did not significantly predict their enactment of any of the seven subdimensions.
- State-space grid (SSG) analyses allowed us to graphically display the dynamic interplay between Interpersonal and Instructional belonging supports within mathematics lessons. SSG illustrated unique patterns of how belonging-centered practice materialized within mathematics classrooms.

student experience RESEARCH NETWORK

Student Experience Research Network (SERN), formerly known as Mindset Scholars Network, envisions an education system in which every student experiences respect as a valued person and thinker, so that they can learn and thrive. To this end, SERN connects people and ideas across research, practice, and policy to advance scientific knowledge and inform decision-making by education system and institution leaders.

Sample

To develop the BCI Observation Protocol, data were drawn from two distinct samples. First, qualitative interviews were conducted with 37 Black and Latinx students (grades 6-12), which originated from a previous longitudinal study conducted by the PI.[13] Second, the video recordings of classrooms originated from data of the Measures of Effective Teaching Longitudinal Database (MET-LDB; criteria outlined below).

Once the protocol was developed, we established reliability and predictive validity by assessing teacher practices in 399 additional video recordings across 133 teachers from the MET-LDB. These videos were selected according to the following criteria:
1) students were randomized into their classrooms;
2) students were between grades six and eight;
3) students of color comprised at least 50% of the classroom; 4) students were learning mathematics.
The MET-LDB also included survey data from students and teachers in the recordings, which were used in predictive analyses.

Few studies have explored teachers' support for student belonging while considering the lived experiences of adolescents of color and psychological literature on belonging. This protocol is unique in that it integrates theoretical and empirical research with the voices of Black and Latinx students in secondary mathematics classrooms, who self-articulate their preferences, values, and needs. Researchers and practitioners may find this protocol valuable for evaluating and supporting equity in learning for students of color. It can guide teachers, whose support for students is one of the strongest predictors of belonging,[14] toward practices that are more inclusive, affirming, and empowering for populations that have been historically marginalized.

Study Design

We worked to avoid common limitations of existing survey measures of belonging, which are primarily top-down and grounded in the logic of the researchers rather than the participants. Thus, the BCI Observation Protocol was developed through the convergence of three data sources using a bottom-up approach. First, qualitative interviews with Black and Latinx secondary students allowed us to derive eight broad themes that captured students' perceptions of how teachers cultivated interpersonal and instructional opportunities for belonging in mathematics.

Second, we modified, refined, and synthesized these themes after reviewing video-recorded mathematics classrooms from the MET-LDB. While analyzing these videos, we generated a codebook of teacher actions related to belonging, which underwent a rigorous revision and refinement process over six months to ensure the consistency and accuracy of the codes. Codes were then sorted according to the themes developed from the qualitative interviews. Themes were revised, removed, or generated to include the available codes. The final themes appear as the seven BCI "subdimensions" in the Observation Protocol (see Table 1).

Third, all phases of BCI protocol development were guided by theory and empirical research on school belonging. This literature 1) indicated the need for a multidimensional and integrative model of belonging,[14,15,16] 2) confirmed the potential of each of the seven subdimensions to support belonging, and 3) demonstrated that belonging can be leveraged to promote motivation, academic achievement, and learning equity.[17,18,19]

Key Findings

Using video recordings of mathematics classrooms, three dozen qualitative interviews with urban adolescents of color, and prior theory on school belonging, we developed and validated the Belonging-Centered Instruction (BCI) Observation Protocol. The protocol is comprised of two domains and seven subdimensions that evaluate the multiple ways teachers can provide opportunities for active inclusion, learning equity, and empowerment through their instruction and in the social classroom environment. These seven subdimensions demonstrated good reliability across 10 coders and nearly 400 middle school mathematics classroom sessions.

The protocol enables researchers and practitioners to evaluate the degree to which teachers' interpersonal and instructional practices can support or undermine students' sense of mathematical belongingness. The seven subdimensions that comprise the BCI protocol are: *Social & Emotional Bridging, Communal Orientation, Empathetic Awareness & Support, Safety to Be Wrong, Decentering Teacher Authority, Mathematics to Know Myself & My World, and High Standards & Rigorous Support* (see Table 1). The BCI protocol was found to be reliable across 10 coders and 399 classroom sessions (intra-class correlation coefficients: .79 for Interpersonal Belonging, and .75 for Instructional Belonging).[20]

Multiple subdimensions within the Interpersonal and Instructional domains of BCI predicted student engagement (measured through both student self-report and observation metrics).

Both the Interpersonal and Instructional domains and three specific subdimensions predicted student engagement. The Interpersonal and Instructional domains predicted student engagement as measured by classroom observations, explaining 28% of the variance. The Interpersonal domain also predicted student engagement as measured by student self-report surveys, explaining 6% of the variance. One Instructional subdimension (*Decentering Teacher Authority*)

predicted student engagement as measured by external classroom observations, explaining 34% of the variance. Two Interpersonal subdimensions (*Social & Emotional Bridging, Communal Orientation*) predicted both measures of student engagement, explaining 24% of the variance in external classroom observations and 15% of the variance in self-reported data. Several domains/subdimensions predicting two different measures of student engagement reinforces the robustness of these relationships. These findings indicate that belonging-centered practices are important for student attentiveness, participation, and interest in mathematics.

Multiple subdimensions within the Interpersonal and Instructional domains also predicted students' self-reported sense of mathematical agency.

Two Interpersonal subdimensions (*Social & Emotional Bridging, Communal Orientation*) and two Instructional subdimensions (*Decentering Teacher Authority, Mathematics to Know Myself & My World*) predicted self-report measures of student mathematical agency. These measures assessed students' perceived ability to direct classroom activities and share ideas, as well as feelings of being valued and respected. The Interpersonal subdimensions explained 12% of the variance, and the two Instructional subdimensions together explained 13% of the variance. These findings add substantially to the body of belonging literature by highlighting how BCI can foster equitable teaching practices by honoring and empowering students' voices and identities.[19]

Decentering Teacher Authority **(see Table 1)—a subdimension within the Instructional domain—predicted year-end standardized mathematics achievement.**

The majority of Interpersonal and Instructional subdimensions did not predict students' standardized mathematics achievement. However, one Instructional subdimension (*Decentering Teacher Authority*) predicted year-end achievement as measured through the Balanced Assessment of Mathematics (BAM), accounting for 29% of the variance. This underscores how BCI may not only empower students socially and emotionally, but also support their mathematical achievement.

Teachers' self-reported perceptions of quality support and feedback from school administrators did not significantly predict their enactment of any of the seven subdimensions.

No associations were found between teacher self-report survey items, which measured perceived support from and competence of school administrators, and the quality of teachers' enactment of BCI. One possible explanation for this is that only a small sub-sample of teachers (63) from the broader study sample (133) completed teacher surveys.

State-space grid (SSG) analyses allowed us to graphically display the dynamic interplay between Interpersonal and Instructional belonging supports within mathematics lessons. SSG illustrated unique patterns of how belonging-centered practice materialized within mathematics classrooms.

The complexities and significance of BCI are difficult to capture entirely through linear predictions of student outcomes. To better understand how the various BCI subdimensions dynamically materialize within the classroom, we used state-space grid (SSG) analyses, which visually represented the interplay of the Instructional and Interpersonal domains over the course of classroom episodes. Each SSG served as a compass that allowed us to identify and analyze high-quality interactions between domains. From these analyses, we identified several patterns of domain interactions that holistically addressed students' multidimensional belonging needs across unique classroom contexts.

For example, during individual practice work, one teacher maintained awareness of students' emotional and academic difficulties (i.e., the Interpersonal domain) while also providing rigorous individualized support (i.e., the Instructional domain). During whole class instruction, however, this teacher connected mathematical concepts to students' lives (i.e., the Instructional domain) and facilitated conversations about students' personal experiences (i.e., the Interpersonal domain) that connected this mathematics to the real world. These examples highlight how pairing the BCI protocol with SSG can aid in capturing the dynamic and contextual interplay between various aspects of belonging-centered instruction.

Further, we identified several patterns of how the sequencing of interpersonal and instructional practices might shape students' sense of belonging. For example, one teacher consistently provided personalized affirmations (i.e., the Interpersonal domain) before pushing students to adhere more rigorously to certain mathematical procedures (i.e., the Instructional domain), which mitigated the threat students often experience when corrected. Similarly, this teacher verbally expressed a willingness to partner with frustrated students (i.e., the Interpersonal domain) while providing them with individualized scaffolding (i.e., the Instructional domain), which addressed students' emotional and academic needs simultaneously. These examples demonstrate how pairing the BCI protocol with SSG can illuminate the ways BCI practices can be sequenced and paired to enhance students' belongingness.

Specifically, we used SSG analyses and the BCI protocol to examine how different teachers enacted "warm demander pedagogy," which has been theorized to be particularly empowering for students of color due to the low expectations and insufficient resources they often encounter in mathematics classrooms.[4,21-26] Warm demander pedagogy reflects the interaction of two BCI subdimensions, *High Standards & Rigorous Support* (Instructional domain) and *Empathetic Awareness & Support* (Interpersonal domain). Using SSG to analyze recordings of three teachers who were highly rated on these two subdimensions, we observed how two teachers alternated between the two subdimensions, while the third

teacher leveraged them simultaneously. These findings illustrate the dynamism of warm demander pedagogy and suggest that teachers may use distinct approaches to enact a specific high-quality pedagogy all the while using some shared characteristics that supported their pedagogy.

Thus, SSG provides educational stakeholders with a novel tool to visually identify the specific teaching practices and processes—as well as the relationships between them—that nurture student belonging. SSG breaks down an entire instructional lesson into a series of events that can be examined in isolation and/or in relation to one another in order to curate more belonging-centered practices.

Insights & Future Directions

The BCI protocol adds to the belonging literature by addressing limitations of existing belonging measures. Many of these measures conceptualize belonging in disparate ways, focus only on teachers' interpersonal actions, rely exclusively on self-report survey measures, and lack an equity and humanization focus.[14,15,16] Our protocol instead provides an integrative and multidimensional evaluation of belonging that focuses on how teachers' interpersonal *and* instructional actions facilitate belonging for students of color.

The results outlined above highlight the importance of BCI for promoting learning equity. Since students of color typically contend with stigma, stereotypes, and deficit perspectives related to their mathematics ability and racial identities,[3-9] cultivating their sense of belonging within mathematics classrooms is essential for thriving socially and academically. The results above provide empirical evidence to support this hypothesis, given how teachers' enactment of BCI could empower students of color to actively participate, feel agency, and achieve within an academic discipline from which they have been historically excluded.

BCI has practical implications for teachers that are interested in supporting student belonging, especially for students of color. By guiding teachers towards the practices embedded within the protocol, educational stakeholders can help teachers address the alienation and dehumanization that students of color often experience in middle school mathematics classrooms. They can also support teachers in developing high-quality teaching practices that facilitate access and achievement for students of color. Further, SSG can be a valuable tool for teacher development, providing visual representations the dynamic interplay between various belonging supports, which can illustrate how teachers might leverage BCI practices in their own classrooms.

Table 1: ***BCI Subdimensions & Descriptions***

Interpersonal Belonging Supports	Instructional Belonging Supports
Social & Emotional Bridging Teacher creates a positive classroom environment that deconstructs social boundaries between teacher and students. Teacher shares their humanity (e.g., opinions, likes, stories, personal details) and seeks to relate to students in ways that recognize students' humanity (i.e., seeing them as whole people, not just as students). Teacher and students share emotions and experiences that help each other become "seen" and "known." **Communal Orientation** Teacher promotes a "we're in this together" orientation with their students. Teacher supports a climate of communalism over individualism across the social dynamics within the classroom. Teacher maintains a vested interest in the academic and social growth of the group, and in relying on one another to achieve that growth. **Empathetic Awareness & Support** Teacher is conscious of individual students' strengths, emotions, physical wellbeing, and resource needs. Teacher supports individual students' emotional and psychological health, and demonstrates that individual students matter in the life of the classroom. Teacher emphasizes students' value regardless of mathematical ability.	**Safety to Be Wrong** Teacher creates a space where students do not feel stigmatized for wrongness or needing support. Teacher disarms and normalizes wrongness. Students have the opportunity to break the pattern of judging their mathematical belongingness simply based on correctness. Mastery and effort are celebrated over performance and talent. **Decentering Teacher Authority** Teacher indicates that students' mathematical methods/ideas have real value (worth). Teacher positions students as knowledgeable authorities in mathematics. Students have a sense that their intellectual contributions matter in the life of this classroom. **Mathematics to Know Myself & My World** Teacher provides opportunities to use mathematics to support student agency, empower cultural identity, understand the world, and critique their social world. **High Standards & Rigorous Support** Teacher communicates high standards for students while also providing support to help students achieve these standards. Teacher implicitly or explicitly communicates that they expect consistent mathematical effort and high-level performance. However, beyond high standards and support, the teacher cultivates the belief within students that they can fulfill the high expectations by instilling confidence and/or sharing strategy.

Note: This table synopsizes the BCI subdimensions and does not represent the protocol in its entirety. The protocol requires extensive training in its use before it can be integrated into research or teacher feedback. Please refer to our working paper[27] for more information.

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