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Engaging Black and Latinx students through communal learning opportunities: A relevance intervention for middle schoolers in STEM elective classrooms☆

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ABSTRACT

With the aim of bridging research in educational psychology and teacher education, we designed a research-practice partnership to unpack the concept of relevance from a race-reimaged perspective. Specifically, we employed a mixed-methods sequential explanatory research design to examine associations between the communal learning opportunities afforded to Black and Latinx students, and their engagement patterns during STEM activities. Within a nine-week instructional unit we provided students six opportunities to rate their scholastic activities. High levels of behavioral engagement were sustained over the course of the instructional unit. On weeks when students rated the activities as higher in communal affordances, they also reported more behavioral engagement. Classroom observations facilitated our efforts to create state space grids that show when and how teachers used emancipatory pedagogies to support students' learning. We used these state space grids, along with teacher interviews and student focus groups, to develop contextualized illustrations of two teachers of color as they successfully provided communal forms of motivational support over the span of six observations per teacher. These strategies differed based on three key factors: where the lesson was placed within the larger instructional unit, the way teachers interpreted and responded to their students' engagement patterns, and how the demands of the larger school environment impacted classroom dynamics.

1. Introduction

Efforts to make scholastic activities meaningful to students are at the very heart of education—for if students do not see the relevance of what they are learning, they are less likely to make choices that are compatible with scholastic achievement in those domains (Eccles et al., 1983). Yet, many educational psychology studies are not designed to sufficiently address structural issues that inform students' appreciation of the academic content they are learning. For example, some scholars argue that the roles of curriculum and instruction are largely ignored by educational psychologists who study concepts such as meaning and relevance (Brophy, 2008).

Within the metanarrative of scholarship on relevance interventions in educational psychology, few studies have empirically assessed the role teachers play in scaffolding students' appreciation of STEM content, or have questioned the meaningfulness of the academic content that teachers present to their students. Recently, however, scholars have attempted to highlight the motivational significance of relevance research for empowering students who are members of historically marginalized groups, by building conceptual bridges between motivation research and culturally relevant and responsive education (Kumar, Zusho, & Bondie, 2018).

Relevance interventions in educational psychology have helped students make connections between STEM content and their own lives. For example, psychologists have asked students to write a short explanation about why the subject matter they are learning is relevant to furthering

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their current and/or future goals (e.g., Hulleman & Harackiewicz, 2009) and have also supported students by assigning them to read descriptions about the broader impacts of scientific research (e.g., Brown, Smith, Thoman, Allen, & Muragishi, 2015). In addition, psychologists have further supported families by providing parents with reading materials that convey the importance of STEM literacy in daily life (e.g., Harackiewicz, Rozek, Hulleman, & Hyde, 2012).

Still, despite psychological research showing that teacher messages about relevance positively impacts Black and Latinx adolescents (Matthews, 2018), few educational psychology studies have directly intervened on structural aspects of schooling (e.g., curriculum and instruction) that can make learning opportunities more relevant for culturally and ethnically diverse learners. With a goal of investigating the construct of relevance from a race-reimaged perspective (DeCuir-Gunby & Schutz, 2014), we designed a research-practice partnership[1] for Black and Latinx students—emphasizing the relevance of STEM activities in terms of their communal benefits for serving the community, serving humanity, and serving one another. In sixth-grade Design and Modeling classes, we examined associations between communal learning opportunities and students' engagement in STEM activities.

2. Relevance research: a call to unify perspectives from educational psychology and teacher education

In contemporary psychological research in education, studies examining the impact of relevance interventions can, for the most part, be categorized into a family of studies referred to as social-psychological interventions. Within this genre of interventions, researchers typically use such terms to describe their methodological approaches as *brief* (e.g., *brief essays*: Hulleman, Hulleman, Godes, Hendricks, & Harackiewicz, 2010; e.g., *brief events*: Cohen, Garcia, Apfel, & Master, 2006); *simple* (Gehlbach, 2010); and *short* (Yeager & Walton, 2011). Using the premise that achievement behavior can be altered by changing how people make sense of themselves and their social (or learning) context (Ross & Nisbett, 1991; Wilson & Buttrick, 2016), interventions examining the construct of relevance have been well established as an approach for identifying individually based values that relate activities and behaviors to future goals and/or daily life (Hulleman, Kosovich, Barron, & Daniel, 2017). As contemporary social-psychological intervention research started to increase in popularity, Gehlbach (2010) suggested that educational psychologists could play a pivotal role in contributing to educational components of social psychology by also serving as teacher educators—explaining that "they have the background and training in social science research to understand and evaluate social psychological research, and they have a rich understanding of the context in which teachers work" (p. 358). But even now, the majority of psychological intervention research on relevance has not been designed to examine what Nolen, Horn, and Ward (2015) refer to as *motivation in context*.

The descriptive classroom-based research in the field of multicultural education (Banks, 1995; Gay, 2002; Marshall, 2002) offers insights for educational psychologists seeking to understand how teachers can support historically marginalized students in finding meaning in academic material. Acknowledging and building upon this work is crucial for educational psychologists, given that (1) several prominent frameworks of achievement motivation highlight how meaning and/or relevance energize and direct achievement behavior, and that (2) scholars have drawn conceptual parallels between the construct of meaningfulness and notions of cultural relevance (for a review, see Kumar et al., 2018). In addition, educational psychologists have begun to categorize culturally relevant and sustaining pedagogies as relevance interventions (Priniski, Hecht, & Harackiewicz, 2018), given that "identification is the most personally meaningful type of relevance" (p. 23) and that these asset-based approaches to classroom instruction affirm students' cultural identities while supporting them in succeeding academically through scholastic engagement and leadership opportunities (Alim & Paris, 2017; Aronson & Laughter, 2016; Ladson-Billings, 1995). To echo the sentiments of Priniski et al. (2018): Now is the time to unify scholars of both educational psychology and teacher education in order to maximize the positive impact that this already expansive (yet disjointed) literature base on relevance might have on students from historically marginalized backgrounds.

3. Cultural continuity and communalism: a race-reimaged view of relevance for educational psychologists

3.1. Cultural continuity

A *cultural continuity* represents a pattern of norms and standards that manifest in the lives of ethnic groups across geographic locales and over time. From a culturally relevant teaching perspective (Ladson-Billings, 2009), cultural continuities are important because they can serve as assets that teachers can use to help students of color succeed academically while upholding and reinforcing the cultural meaning systems of their ethnic groups. In the educational psychology literature on relevance, parallel arguments have been made about how students can derive a sense of personal usefulness by participating in scholastic activities that enable them to live up to culturally based standards through the social roles they occupy (Priniski et al., 2018). One recognition common within these disparate literature bases is that students of color are not drawn to scholastic activities solely for self-oriented reasons: their decision may also be based on an awareness of the communal benefits (Boykin, 1986). The communal benefit these activities hold is referred to as *communal utility value* in educational psychology, as *communal goal affordances* in social psychology, and as *communal responsibility* in teacher education. Due to our overarching goal of contributing to scholarly conversations on motivationally supportive classroom environments, we refer to *communal learning opportunities* as curricular activities and instructional practices that are structured for the student to derive communal benefits from engaging in the activity.

3.2. Communalism

Communalism is a cultural continuity in the lives of individuals from Black and Latinx backgrounds. Boykin (1986) refers to communalism as "a commitment to social connectedness which includes an awareness that social bonds and responsibilities transcend individual privileges" (p. 61). Examples of this other-focused orientation include when individuals value relationships and meaningful social interactions more than they do material objects, and when the needs and concerns of the cultural group are promoted over the self (Hurley, Boykin, & Allen, 2005). King and Swartz (2016) explain that in the Black community, such cultural values are evident in many forms of community building including social movements, family structures, churches, economic cooperatives, and Kwanzaa; and are underpinned by the African ontology of (1) *collectivity* (the belief that the well-being of the group supersedes the needs of individuals in the group), and (2) *cooperation* (the belief that individuals benefit as the group benefits). A similar cultural continuity, *familismo*, is found in Latinx cultures, which represents a strong identification and attachment to persons within nuclear and extended families, and which may involve prioritizing the group's needs over the individual's needs (Smith-Morris, Morales-Campos, Castañeda Alvarez, & Turner, 2012; Suizzo et al., 2012).

[1] This study is situated within iScholar, a school-university partnership with a vision to empower students to substantively contribute to the improvement of their social and physical condition in which they live. We partner with teachers in predominantly Black and Latinx public schools to (1) develop lessons that honor and affirm students' cultures, and (2) observe emancipatory pedagogies rooted in, and informed by, motivation research and culturally relevant teaching.

3.2.1. STEM and communalism

A growing body of literature suggests that when communal messages are integrated into STEM subject areas, students who otherwise are underrepresented in STEM disciplines find them appealing (e.g., Brown, Smith, et al., 2015; Brown, Thoman, Smith, & Diekman, 2015; Clark, Fuesting, & Diekman, 2016; Diekman, Clark, Johnston, Brown, & Steinberg, 2011; Fuesting, Diekman, & Hudiburgh, 2017). The conceptual basis for this research is that communally oriented people are said to perceive a lack of fit in STEM-focused fields when these fields do not afford them the opportunities to fulfill communal goals (Diekman, Steinberg, Brown, Belanger, & Clark, 2017). Moreover, communal learning opportunities are important because they can contribute to the fulfillment of the psychological need for belonging in academic domains in which one's social identities are stigmatized (Walton & Brady, 2017).

Recent educational psychology studies of communalism have focused on issues of gender; but some scholars acknowledge that the notion of communal goal congruence is also applicable to addressing STEM beliefs and behaviors among a broad array of social identity groups (Boucher, Fuesting, Diekman, & Murphy, 2017). In the present study we responded to the call by Boucher and colleagues to expand the study of communalism to include other underrepresented populations in STEM—by recognizing the importance of communalism as a cultural continuity (Boykin, Jagers, Ellison, & Albury, 1997; Coleman, Bruce, White, Boykin, & Tyler, 2017; Hurley et al., 2005). This theoretical connection is especially valuable, given that the cultural traditions and assets of historically marginalized groups can sometimes be silenced, distorted, and/or forgotten over time (King & Swartz, 2016). As a case in point, historical accounts of southern Black schools during the Segregation Era reveal that schools nurtured their students' motivational resources by embracing "a deeply communal and political agenda that sought to elevate the needs of the race through education" (Walker, 2009, p. 8).

3.2.2. Middle school students and communalism

Recent scholarship speaks directly to the notion of communalism as a cultural continuity for middle school students from historically marginalized backgrounds. For example, Calabrese Barton and Tan (2018) examined the benefits Black and Latinx students derived from engaging in equity-oriented STEM projects. In their study they made observations, conducted interviews with instructors and students, and utilized student artifacts. The researchers found that these students chose to immerse themselves in creating artifacts that honored their community's cultural assets, which also contributed to the students' sense of *relationality*—a connection to community issues, project collaborators, community stakeholders, instructors/mentors, and structural injustices in their environments. These findings provide an additional perspective as to why communally oriented STEM experiences support student engagement: namely, that community issues being addressed by students can reflect a fit between their own concerns and those of community stakeholders. But addressing community issues is not always straightforward and can be multilayered. Thus, if students are to generate practical solutions to the challenges faced by residents in their neighborhoods, they may need to more deeply engage. Moreover, collaboratively working on these projects builds a sense of community and has developmental significance for adolescents—helping to assuage adolescents' preoccupations with belonging and identity (Diekman et al., 2017) and addressing some additional questions that historically marginalized youth may raise about the degree to which they are afforded opportunities to belong at school (Gray, Hope, & Matthews, 2018) or in STEM fields (Collins, 2018).

3.3. A cultural interpretation of student engagement in middle school

Considering our aim to investigate the concept of relevance from a culturally based communal perspective, we deemed it necessary to draw on arguments from established theoretical perspectives underscoring the importance of tailoring school environments to meet the needs of the students they serve. Our framework for conceptualizing relations between communal learning opportunities and behavioral engagement emanated from multiple perspectives including stage-environment fit (Eccles et al., 1993), expectancy-value theory (Eccles et al., 1983), the triple quandary (Boykin, 1986), and teaching for freedom (King & Swartz, 2016).

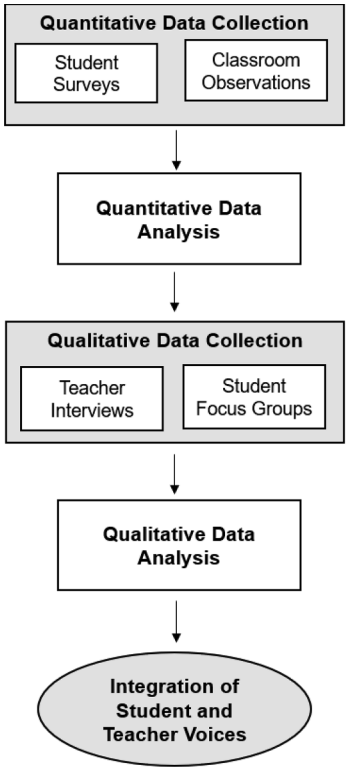
Empirical studies on teacher attunement to student needs suggest that developmental considerations (Hamm, Farmer, Dadisman, Gravelle, & Murray, 2011) and cultural considerations (Boykin, Tyler, & Miller, 2005) underlie the extent to which teacher-student classroom exchanges are likely to foster student engagement. Studies find that from a developmental standpoint, early adolescents place less importance on scholastic activities in STEM as they transition into middle school—often resulting in negative trajectories that persist throughout middle school and beyond (e.g., Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). Such student-motivation patterns can be expected when schools are not responsive to the developmental needs of students (Eccles & Midgley, 1989; Eccles et al., 1993). Cultural perspectives of engagement patterns among students of color corroborate with this assertion. For example, achievement behaviors of students of color may be related to how attuned a school environment is to the cultural values and beliefs espoused in students' homes and communities (Boykin, 1986). Adolescents' needs, values, and sense of identity all influence their engagement in scholastic activities (Eccles, 2009). In research on psychological need satisfaction, such terms as *maladaptive* and *non-optimal classroom functioning* are used to characterize disengagement (e.g., Jang, Kim, & Reeve, 2016). However, there may be other reasons why students—particularly students of color—disengage in academic spaces.

"What a child does may represent an internally consistent resolution of what can, will, and should be done" to protect their cultural integrity—even if such behaviors are at times incompatible with scholastic achievement (Boykin, 1986, p. 79). In this way, student behaviors that some scholars call *adaptive* could be antithetical to the cultural values promoted in the families and communities in which students of color live. Such cultural interpretations of fit are important for understanding the behavioral engagement of middle school students, considering that they are in a developmental phase in which belongingness needs are particularly salient (Juvonen, 2006). From this perspective, the consistently positive research findings on culturally relevant and sustaining pedagogies (for a review, see Aronson & Laughter, 2016) warrants serious theoretical and empirical attention by relevance researchers in educational psychology.

4. Which methodological approaches lend themselves to a race-reimaged investigation of relevance?

Classroom-based studies from the broader educational psychology literature provided a roadmap in the present study for cataloguing pedagogical techniques as well as for assessing student engagement. We found that the methodological approaches of Straiti, Schmidt, and Maier (2017) in relation to motivational support[2] were particularly helpful for this purpose. Specifically, by coding classroom instructional practices for the presence of instrumental and emotional support—along with using experience sampling methodologies to assess student

[2] For this article, the term teacher motivational support refers to aspects of teachers' instructional practices that are used to foster students' engagement in learning. Building on research examining linkages between teacher instructional practices and student engagement (Turner et al., 2014) as well as scholarship examining teachers' cultural expression in the classroom (Boykin et al., 2005) and meaning (Brophy, 2008), we introduce the term teacher support for communal learning opportunities to describe how teachers' use of pedagogical techniques support students' understanding of when, where, and why academic learning material has relevance to serving their community, serving humanity, and serving one-another.



Phase	Procedure	Product
Quantitative Data Collection	Survey administration. Students (n = 99) completed brief surveys six times.	Within-person multilevel modeling
	Classroom observations. Observers visited four teachers' classrooms (six observations per teacher).	State-space grids
Quantitative Data Analysis	Multilevel modeling	Use quantitative data to develop probing areas for teacher interviews and student focus groups
	State-space grids	Use quantitative data to develop the framework for case reports including case selection based on inclusion criteria
Qualitative Data Collection	Follow-up interviews with two teachers using state-space grids. Follow-up focus groups with four students from each of their classrooms.	Text data (transcripts from interviews and focus groups)
Qualitative Data Analysis	Triangulation of teacher interviews, student focus groups, and observations	Descriptive statements made by teachers and students that contextualize quantitative findings
Integration of Student and Teacher Voices into Observation Reporting	Interpretation and explanation of quantitative and qualitative results	Qualitative illustrations of defining moments that characterize trajectories of student-teacher interactions

Fig. 1. Sequence of mixed-methods design and integration.

engagement—we better understood (1) how engagement levels can vary frequently based on the provision of motivational support, and (2) how different aspects of motivational support are uniquely associated with patterns of student engagement. We also benefitted from the methodological approaches on motivational support by Jang et al. (2016). After training two observers on how to rate motivational support for autonomy and structure in relation to students' observed and self-reported behavioral engagement, the authors sent them to visit teachers' classrooms to conduct observations and administer student engagement surveys. The observers' input enabled the authors to assess engagement from multiple perspectives (student and observer), which helped them capture distinct ways motivational support is related to individual and classroom-wide engagement.

In relevance research, if the aforementioned quantitative observation and survey-based approaches were integrated with qualitative approaches that are more common in the multicultural education literature, the methodological repertoire could be greatly expanded—and could capture the complexities at play within classroom-based relevance studies focusing on students of color. Such interview and focus group studies—which typically involve a high number of contact hours with student and teacher participants—stress the importance of participants' voices for contextualizing the dynamic interplay between teachers' pedagogical decisions and students' behavioral engagement. To further gain insight into contextual dimensions of classrooms from a race-reimaged relevance perspective, a classroom-based study could also employ inductive approaches to investigate some of the ways in which (1) instructional activities inform teachers' emergent instructional practices that legitimize the life experiences of students of color and ultimately foster student engagement over time (Tsurusaki, Calabrese Barton, Tan, Koch, & Contento, 2013), (2) teachers critically reflect and adjust when students of color overtly disengage (Houchen, 2013) in order to give them additional chances (Milner, 2011) to recognize the meaning and relevance of academic material they are learning, and (3) teachers scaffold students' understanding of academic material and societal injustices in order to help them make sense of their own relevance for making the world a better place (Ladson-Billings, 1995).

As noted by Hilpert and Marchand (2018), observation studies in educational psychology are rarely conducted using methods designed to capture complex phenomena that emerge over time. In order to do so, *The Afrocentric Praxis of Teaching for Freedom* (King & Swartz, 2016) served as a lens in the present study for understanding how teachers may support students' communal learning opportunities in a culturally relevant and responsive manner. This model encourages educators to make use of culturally anchored pedagogical principles (referred to as *emancipatory pedagogies*) that provide students with a sense of connection to their ancestral heritage. When observing the pedagogical techniques teachers use to support students' communal interpretations of STEM activities, researchers could employ a Teaching for Freedom lens by documenting the ways in which teachers (1) highlight community and/or historical figures of color who have created innovations to elevate the needs of the groups they belong to above their own individual wants and desires, (2) take time to acknowledge students' life experiences and emotions to help them develop a sense of compassion and perspective for the group members they are working alongside, and/or (3) ask questions that prompt students to make connections between what they are learning and why it matters for making the world a better place.

5. Purpose of the present study

Within the context of a research-practice partnership, we examined the following:

(1) To what extent is variation in students' behavioral engagement during STEM activities explained by their perception of these activities as communal learning opportunities?
(2) When do teachers engage students in ways that support them in

Table 1
STEM Curriculum Unit: "Making the World a Better Place: Investing in Thyself, Others, and the Global Community".

Lesson	*Lesson Name*	*Communal Emphasis*	*Lesson Activity Descriptions*
1	Investing in Thyself: Agents of Change Consider Who They Are and What Matters to Them	A Malawian teenager was able to provide electricity to his entire village by understanding the community needs and utilizing the resources available to him. How do engineers utilize available resources to create solutions to community issues?	1.1 Students designed and tested windmill prototypes. 1.2 Students built a simple electric motor using AA batteries and conductive wire.
2	Investing in Others: Identifying the Needs and Priorities of the Communities We Serve	Students have first-hand knowledge about their community and the issues facing their neighborhood's citizens. How would students describe these issues and potential solutions?	2.1 Students conducted peer interviews to understand the needs of citizens in their community and to identify opportunities to act as change agents.
3	Investing in the Global Community: Taking Intellectual Risks to Develop Skills That Will Benefit Society	The local community has an issue providing citizens with adequate housing options. In the growing community, there are more housing vouchers than available space. How can tiny houses serve as a solution to local housing issues?	3.1 As a group, students sketched tiny houses using architectural tools. 3.2 Students created 3D models of tiny house sketches using AutoCAD software.
4	Protecting Our Investments	One of the communal issues students identified during their interviews was safety. How can students address this issue?	4.1 Students created presentations of their tiny house solutions. 4.2 Students built a simple alarm to be used as a personal possession or as an investment.
5	It's Gotta Be the Shoes! Part 1	NASA predicts that by 2050, humans will be able to live on Mars. How could we protect our bodies from the Mars environment (e.g., with clothing, shoes)? How do engineers incorporate culture and style into their innovations?	5.1 Students conducted research on the planet Mars. 5.2 Students sketched the design of a shoe suitable for life on Mars. 5.3 As a group, students collaborated on building a shoe prototype with provided materials.
6	It's Gotta Be the Shoes! Part 2	Engineers often create and adapt solutions to serve individual needs and the needs of larger communities. How do engineers and consumers decide which solutions are most beneficial for the global community?	6.1 Students finished their Mars shoe prototype. 6.2 As a group, students created a sales pitch for their Mars shoe. 6.3 Students presented and judged each Mars shoe using teacher-designed rubrics.

recognizing STEM activities as communal learning opportunities?
(3) How do curricular and instructional opportunities for communal learning contribute to students' engagement in STEM activities?

6. Method

6.1. Design

Fig. 1 outlines the mixed-methods sequential explanatory design we employed in the present study. We structured data collection and analysis in two consecutive phases: quantitative and then qualitative (Creswell & Plano Clark, 2018). In the quantitative phase, a repeated ratings approach to student survey administration and to classroom observations facilitated our efforts to assess the extent to which (1) students' perceptions of communal learning opportunities explained fluctuations in their individual reports of behavioral engagement during the course of an instructional unit (RQ1), and (2) observations of teacher support for communal learning opportunities were related with observed whole-group behavioral engagement over the course of that same instructional unit (RQ2). Considering that cultural content integration is vital to the achievement of students of color (Matthews & López, 2019) and integral to their understanding of the relevance of STEM-based material for their own lives (Tsurusaki et al., 2013), we wished to build on prior research on teacher support and behavioral engagement that had not explicitly acknowledged the types of curricular activities in which students were engaged (e.g., Jang et al. (2016); Straiti et al., 2017). We therefore collaborated with teachers to develop curricular activities that employed an engineering and design process. In autumn of 2017, teachers co-developed an instructional unit—called "Making the World a Better Place: Investing in Thyself, Others, and the Global Community"—which reflected how they interpreted communalism and cultural relevance from a practical standpoint. Table 1 displays a brief outline of each lesson, each of which spanned two or three class meetings.

As is common in sequential explanatory designs (Ivankova, Creswell, & Stick, 2006), we prioritized the quantitative phase of the study because these data (i.e., both surveys and observation data over multiple time points) allowed us to assess trends in individual and classroom-level trajectories of behavioral engagement as a function of communal learning opportunities. The qualitative phase of the study was necessary for providing a descriptive account of these motivational processes in context—a process that includes descriptive accounts of activity settings through the triangulation of data sources (Nolen et al., 2015) such as interviews and focus groups. The qualitative phase culminated in the presentation of two distinct illustrative cases of classrooms that help explain the relations between communal learning opportunities and behavioral engagement in greater depth (RQ 3).

The integration of these methodological approaches served to more effectively explore the relationship between classroom experiences and the participants' perceptions that shaped them. Results from the quantitative phase were collected, analyzed, and integrated into the qualitative phase—thus informing the teacher and student interviews, and enabling us to develop a more comprehensive picture of trajectories of teacher support for communal learning opportunities and student engagement across an instructional unit. Specifically, we connected the quantitative and qualitative phases of our investigation by (1) using survey items to develop questions for teacher interviews and student focus groups, and (2) visualizing teachers' observation ratings on state-space grids (Lewis, Lamey, & Douglas, 2001). The state-space grids, along with field notes from the observers recorded during and directly after the classes they attended, were used to inform interview conversations and guided our decisions about which cases would be presented. Our integrated discussion of the overall study, with an emphasis on implications and future directions, emerged at the intersection of our quantitative and qualitative findings.

6.2. Participants and setting

A recent call-to-action by urban educators calls for shifting Career and Technical Education (CTE) courses away from a sole focus on skill development for the labor market, and toward the development of students of color as societal change agents (Jocson, 2018). Over a period of nine weeks during Fall 2017, we observed four CTE educators in their classrooms (three Black males and one Black/Latina female) as they taught sixth graders (54% male and 46% African American, 34% Latinx, 5% White, 3% Native American, and 12% Multiracial/Other Ethnicity). The educators' instructional experience in the classroom ranged from one to six years. Although these educators teach a variety

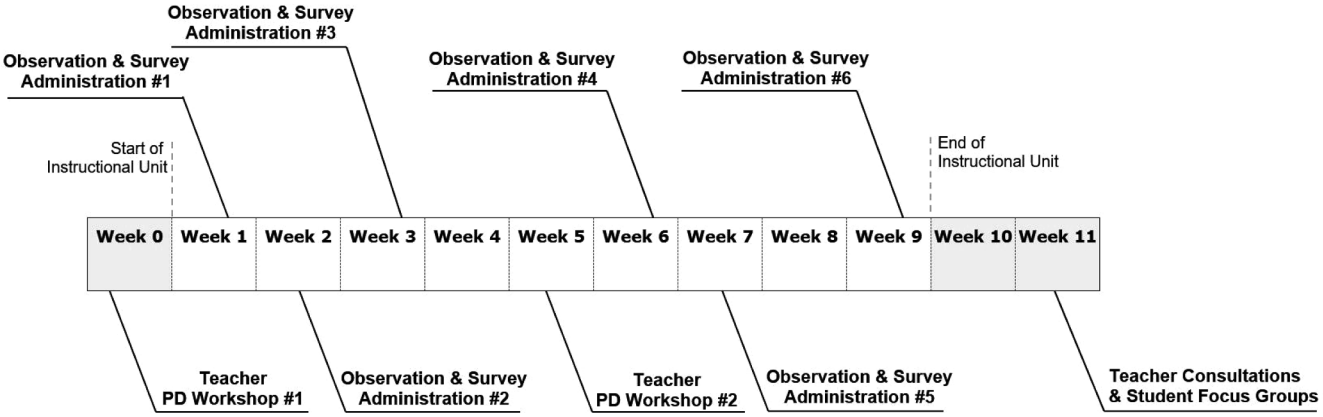


Fig. 2. Timeline of Research-Practice Partnership.

of CTE courses, they all taught a STEM elective (called Design and Modeling) during our observations. These courses met each day of the week. The project site was an urban public middle school (sixth – eighth grade) in the Southeastern United States. The school serves approximately 850 students each year, the majority of whom are enrolled in the National School Lunch Program (83.1% of students received a free or reduced-price lunch in 2015).

The lead researcher for the present study visited each participating classroom and explained to students that they were candidates for a study on STEM engagement. Students were given a description of the study and parental consent forms to take home. They were told that no incentives would be provided for participating in this study, but that those who returned the consent forms would be invited on a field trip to a university—regardless of whether their parents/caregivers agreed to have them participate in the study. Of the 105 students enrolled in the Design and Modeling course with the four participating teachers, 99 students submitted the consent forms. One parent declined to allow their child to participate in the study.

6.3. Procedure

As shown in Fig. 2, our semester activities included two teacher professional development (PD) workshops, six observations per teacher and six survey administrations to students ("Observation & Survey Administration"), and follow-up reflections with teachers and students ("Teacher Consultations & Student Focus Groups"). For the quantitative phase of data collection, we collected student and observer ratings of communal learning opportunities and behavioral engagement over the course of a nine-week instructional unit. The quantitative phase of data collection informed the qualitative phase of data collection in which teacher interviews and student focus groups were conducted and analyzed to further illustrate participants' communal learning opportunities.

6.4. Quantitative phase

6.4.1. Student reports of behavioral engagement and communal experiences

Based on a design used by Schmidt, Shumow, and Kacker-Cam (2017), we designed a post-activity questionnaire to be distributed to students at the end of each of the class meetings during which observations were conducted—thereby providing each student with six reporting opportunities. Students took approximately 10 min to complete the questionnaire. As all participating students were working on the same curricular activities, questionnaires collected across various classrooms on the same week can be thought of as representing similar academic events—thus "controlling for the effects of particular content units" (Straiti et al., 2017, p. 134). On average, students completed at least four (M = 4.30) questionnaires. Examinations of missed reporting opportunities revealed that students' responses to questions of behavioral engagement and communal learning opportunities were missing completely at random (MCAR): Little's MCAR Test $\chi^2 = 12.18, p = .79$.

6.4.1.1. Behavioral engagement. We assessed students' behavioral engagement using five items adapted from the Engagement Versus Disaffection with Learning Survey (Skinner, Kindermann, & Furrer, 2009). In light of the present study's emphasis on assessing students' reported behavioral engagement over the course of an instructional unit, and based on a previous adaptation of this measure by Reeve (2013), we made slight modifications to these items for ease of interpretation. All items began with the item stem "During today's lesson" and provided six response options, ranging from 1 = *Strongly Disagree* to 6 = *Strongly Agree*. The five items representing students' reported behavioral engagement were: (1) "I paid attention"; (2) "I listened carefully"; (3) "I worked hard to do well"; (4) "I worked as hard as I could"; and (5) "I participated in the class discussions." Ratings of behavioral engagement at each time point demonstrated acceptable single-factor structure in a multilevel confirmatory factor analysis.[3] The measure of behavioral engagement also demonstrated acceptable internal consistency, with reliability coefficients ranging from $\alpha = 0.73$ to $\alpha = 0.82$. Table 2 displays descriptive statistics for response-level variables at each data collection period.

6.4.1.2. Communal learning opportunities. Three single items were used to assess the relevance of class lessons for either (1) serving the community ("Today's lesson connected to problems in my community"), (2) serving humanity ("Today's lesson showed me how my actions can protect the lives of humans, animals, or plants"), or (3) serving one another ("Today's lesson was important for learning how to help other people"). The items were rated on a six-point Likert-type scale, ranging from 1 = *Strongly Disagree* to 6 = *Strongly Agree*.

Based on prior research, we chose to employ these single-item measures for three reasons: First, experimental research shows that motivational outcomes are not identical when intervening on various aspects of communal STEM experiences, e.g., helping others, working with others, forming connections with others (Brown, Smith, et al., 2015). Second, in an effort to reduce the cognitive burden commonly

[3] Using Mplus Version 8.1, we conducted a multilevel confirmatory factor analysis with maximum likelihood estimation to assess the single-factor structure of the measure of behavioral engagement. Fit indices revealed that a single factor at Level 1 and at Level 2 was a strong representation of the data: χ^2 (10) = 288.87, p = .001; CFI = 0.966, TLI = 0.932, RMSEA = 0.066, $SRMR_{within}$ = 0.039; $SRMR_{between}$ = 0.043. Both at Level 1 and at Level 2, all observed variables loaded significantly ($p < .05$) onto the behavioral engagement latent variable at values of 0.40 or higher.

Table 2
Descriptive Statistics for Response-Level Variables at Each Data Collection Period.

	Behavioral Engagement		Serving the Community		Serving Humanity		Serving One Another	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Lesson 1	4.76	0.72	4.00	1.42	4.70	0.97	4.64	1.08
Lesson 2	4.94	0.84	4.57	1.27	4.47	1.15	4.91	1.18
Lesson 3	4.84	0.84	4.58	1.32	4.64	1.24	4.86	1.05
Lesson 4	4.99	0.74	4.37	1.38	4.46	1.10	4.72	1.06
Lesson 5	4.85	0.96	4.48	1.47	4.27	1.48	4.71	1.39
Lesson 6	4.79	1.01	4.00	1.68	4.33	1.35	4.40	1.34

Note. A score of "1" represents lowest value on each variable; a score of "6" represents highest value on each variable.

Table 3
Means, Standard Deviations, and Correlations Among Study Variables.

Variable	*M*	*SD*	1	2	3	4
1. Serving Community	4.33	1.45	–			
2. Serving Humanity	4.48	1.23	0.30	–		
3. Serving One Another	4.70	1.20	0.30	0.34	–	
4. Behavioral Engagement	4.85	0.86	0.26	0.42	0.39	–

Note. Means and standard deviations reflect person-level aggregates. Correlations reflect response-level associations among study variables (n = 427–430 responses). All correlation coefficients are significant at $p < .001$.

experienced by participants when responding to the same survey items on several occasions, the construction of abbreviated survey forms is a recommended practice (Hektner, Schmidt, & Csikszentmihalyi, 2007; Zirkel, Garcia, & Murphy, 2015) that—in certain circumstances—informs the practical (but not ideal) approach of using single-item measures (Ohly, Sonnentag, Niessen, & Zaph, 2010; Vignoles, 2004). Third, because taking the surveys reduced instruction time during those class periods, we wished to keep interrupted instruction time to a minimum.

We examined whether our three indicators of communal learning opportunities were appropriate for testing our hypotheses. If these predictors are distinct, then strong associations should not be observed. We therefore explored whether any unintended associations might lend credence to alternative explanations for any potentially hypothesis-confirming results. As shown in Table 3, correlations among indicators of communal experiences are weak to moderate (*r*s range from 0.26 to 0.42, all *p*s < 0.001). These coefficients suggest that none of the communalism variables serves as a proxy for any of the other communalism variables.

6.4.2. Observer reports of behavioral engagement and communal learning opportunities

To capture student engagement levels during the lessons, we used the Student Engagement component of the *Classroom Assessment Scoring System (CLASS) Manual, Grades 4–6* (Pianta, La Paro, & Hamre, 2008). Whereas a seven-point response scale has been used in prior research, our observers found that they could meaningfully differentiate each response choice using only a four-point scale. Observers in this study therefore rated students' overall level of behavioral engagement on a four-point Likert-type scale, from 0 = *No Evidence* to 3 = *Consistent Evidence*. This measure allowed us to capture the extent to which students were focused and participating (e.g., sharing ideas, asking questions, actively listening, immersed with activity materials) as the teacher facilitated the learning activity. In this study, the lowest score (zero) represented the observers' rating that *the majority of students appear distracted or disengaged consistently* and the highest score (three) indicated that *all or nearly all students are actively engaged in the activity*. In addition to using this rating scale, the observers also took field notes, which included making comments on class engagement as a whole.

Consistent with culturally sensitive approaches to research with historically marginalized groups (Tillman, 2002), we developed our *Teacher Support for Communal Learning Opportunities* observation protocol in a manner that honored the cultural and practical insights of our collaborating teachers and observers. Then, in a working session with our observers (i.e., two African American National Board Certified Teachers with a combined 27 years of STEM teaching experience in the same school district), a researcher summarized how the teachers had worked together to create a list of pedagogical techniques for supporting students' communal learning opportunities in STEM. The researcher and the two observers discussed their interpretations of each aspect of communal experience—making adjustments to the protocol until they reached a collective understanding. Using the observation protocol, shown in Table 4, observers rated each aspect of teacher support for communal learning opportunities on a four-point Likert-type scale, from 0 = *Little or No Evidence* to 3 = *Consistent Evidence*.

In preparation to use the aforementioned observation protocols, observers watched three videos of classroom instruction with a researcher. During each video, observers provided ratings of behavioral engagement and communal learning opportunities within the classroom and discussed their ratings with researchers to establish consensus in ratings. Following training, the two observers and the lead researcher attended each teacher's classroom six times over the course of an instructional unit. As part of our research, development, and implementation efforts on observation days, the lead researcher (a Black male researcher who has led school partnerships in the same district for the past six years) served in the role of participant observer by providing support for lesson implementation (including helping to set up materials, opening computer software links in preparation for classroom activities, and taking videos and photos of student-teacher interactions during classroom instruction). This recurring classroom presence and support made teachers and students more comfortable with our presence—thus contributing to more authentic student-teacher interactions during our classroom visits. Each class meeting was 42 min long—totaling 252 min of observations of each teacher. During each class the two observers completed their own digital observation forms. After observations of the instructional unit had been completed each day, the observers met individually with the lead researcher.

6.4.3. Analytic approach for statistical model estimating student behavioral engagement

We conducted a within-person multilevel model with Full Information Maximum Likelihood (FIML) Estimation to predict variability in students' behavioral engagement following their participation in an instructional unit implemented over nine weeks. This estimation procedure—which uses all available data to generate parameter estimates that are most likely to have produced the sample data—is appropriate when missing values are either missing at random (MAR) or are missing completely at random (MCAR). Using Mplus Version 8.2 (Muthén & Muthén, 1998), we first calculated the intraclass correlation coefficient (ICC) by estimating a random effects analysis of variance (empty model), ICC = 0.39. On average, 39% of the total variability in behavioral engagement is attributed to between-student differences in behavioral engagement.

To assess whether variation in student behavioral engagement over time is explained by their perceptions of whether scholastic activities serve as opportunities to fulfill communal goals, student ratings of behavioral engagement were regressed on student ratings of the relevance of a lesson for serving the community, serving humanity, and serving one another. We person-mean centered each of these Level-1 predictors in order to estimate pure within-person effects that are independent of between-person differences in ratings of STEM-based communal learning opportunities. Given that students completed surveys after

Table 4
Observation Protocol: Teacher Support for Communal Learning Opportunities.

Response	0	1	2	3
Response Description	Where there is little or no evidence that teachers used strategies to support communal learning opportunities.	Where there is some clear evidence that teachers used strategies to support communal learning opportunities.	Where there is clear and adequate evidence that teachers used strategies to support communal learning opportunities.	Where there is consistent, meaningful, and model evidence that teachers used strategies to support communal learning opportunities.

Category	Serving the Community	Serving Humanity	Serving One Another
Category Description	Teacher emphasizes the importance of investing in one's community by devoting one's time and effort to addressing an issue that impacts community members.	Teacher provides opportunities for developing a sense of compassion for, and commitment to, preserving and not destroying various forms of life (e.g., humans, animals, plants).	Teacher's instructional practices underscore the message that it is each student's responsibility to contribute to the collective welfare of the groups they belong to.
Examples	● Teacher gives students opportunities to identify characteristics of the communities they are a part of (e.g., their family, a soccer team, a classroom, a friend group). ● Teacher gives students opportunities to identify needs of the communities they are a part of (e.g., needs in their classroom, needs in their neighborhood, needs in their state). ● Teacher gives students opportunities to brainstorm ways to meet the needs of the communities they are a part of.	● Teacher gives students opportunities to consider a viewpoint outside of their own (e.g., someone in their class, in their neighborhood, or across the globe; someone who has a different opinion from theirs). ● Teacher gives students opportunities to learn about various forms of life and how they are connected (e.g., environmental impacts, how humans interact with their environments, how humans interact with animals). ● Teacher gives students opportunities to brainstorm solutions to environmental issues (e.g., in their neighborhood, community, state, country; on the planet).	● Teacher gives students opportunities to think about their roles within the groups they are a part of (e.g., leader, nurturer, provider of comedic relief, helper). ● Teacher gives students opportunities to think about their responsibilities within the groups they are a part of (e.g., On my soccer team I am responsible for __; In my classroom I am responsible for __). ● Teacher gives students opportunities to structure their own groups and teams, and to hold each other accountable (e.g., by choosing a captain, a notetaker, a timekeeper).

each lesson in the instructional unit, we specified each lesson as an event, using effect codes—representing the extent to which behavioral engagement during a given lesson differs from the overall mean rating of behavioral engagement across each lesson. We also accounted for between-person variation in student ratings of behavioral engagement by including person-mean scores of serving the community, serving humanity, and serving one another. These Level-2 predictors, which were person-mean centered, may be interpreted as the cumulative effect of students' STEM-based communal learning opportunities on person-specific ratings of behavioral engagement. We also modeled three variables as person-specific covariates: race (using effect codes to compare Black, Latinx, and all other ethnic groups in the sample), gender (using dummy codes to compare girls with boys), and classroom (using effect codes to account for differences in behavioral engagement across classrooms).

6.4.4. Analysis of observation ratings

We used observer ratings to calculate inter-rater reliability. Following previously established guidelines for selecting and reporting ICCs for reliability (Koo & Li, 2016), our ICC estimates were calculated using *Stata 15* (StataCorp, 2017), based on mean-rating ($k = 2$), consistency-agreement, 2-way mixed-effects models. Inter-rater reliability indicated moderate-to-good reliability for behavioral engagement (ICC = 0.63, $p < .001$), serving the community (ICC = 0.88, $p < .001$), serving humanity (ICC = 0.74, $p < .001$), and serving one another (ICC = 0.88, $p < .001$). As a final step, the lead researcher and the two teacher observers reflected together during debriefing sessions, and used their field notes to contextualize and reconcile observation ratings. These reconciled ratings were used in the analysis.

We conceptualized each classroom's sequence of observations as trajectories of motivational support over time. Specifically, we plotted trajectories on a two-dimensional grid in which teachers' support for communal learning opportunities (i.e., serving the community, serving humanity, and serving one another) was presented on the x-axis, and levels of students' behavioral engagement were presented on the y-axis. This visualization of student-teacher interactions using state-space grids also facilitated our efforts to develop contextualized illustrations that highlight transformative moments along the instructional unit in which teachers successfully provided communal forms of motivational support (see Hollenstein (2013) for a detailed overview of State-Space Grids).

6.5. Qualitative phase

By employing a case study approach within a larger mixed methods study, we could further detail the communal learning opportunities and experiences of individual teachers and students. For the present study, we used a case study observational research methodology (Morgan, Pullon, Macdonald, McKinlay, & Gray, 2017) that involves (1) analyzing observation data prior to the collection and analysis of non-observation data, (2) using the observation data to generate interview questions and identify probing areas, and (3) making explicit reference to observation data during the presentation of the case study. The approach also allowed for the integration of multiple units of analysis (state-space grids, teachers' perspectives, and students' voices) to robustly examine communal learning opportunities and behavioral engagement in context. The culmination of these data sources are represented in two illustrative cases to show (1) how teachers' culturalized perspectives of their students informed the instructional practices they employed, and (2) instances when teachers' curricular enactment translated into student engagement, evidenced by transformative moments when students had revelations about the communal purposes of scholastic activities.

6.5.1. Follow-up interviews and focus groups

To enrich our understanding of teachers' philosophies and knowledge that fostered communal teacher practices, we conducted

Table 5
What Students and Teachers Say about Classroom Dynamics Related to Communal Learning Opportunities and Behavioral Engagement.

Major Theme	Codes	Operational Definition	Examples	
			Student Response	Teacher Response
Addressing Systemic Barriers to Students' Self-Perceptions as Change Agents	Community Development as an Education Standard	Teachers address the lack of connection between standards-based education and the applicability to students' communities	*[Teacher talks with students about serving the community] "A lot. I think that's the whole point of class."*	*"School doesn't teach them that, if they don't learn to take the knowledge or the resources that they could get in an educational environment and take them back to the community, it's essentially useless."*
	Developmental Significance of Making Community Connections	Discussing communal responsibility with their teacher represents a significant but new learning area for students transitioning from elementary school to middle school.	*" … I wasn't really thinking about it [making my community a better place] in elementary [school] until now [first semester in middle school]."*	*" … the first time we talked about their communities it … went over their heads and they didn't really understand why we were talking about it."*
Relevance of Communal Learning Opportunities for Proximal and Distal Goals	Instructional Opportunities	Expression of instruction (i.e., activity or discussion) as useful for future goals	*" When we get older we can actually do these things by keeping them in mind and know how to do them … we already know what to do, when to do it, and how to do it."*	*"I explained to them that their community is changing and that if they didn't start utilizing their resources here it was going to be … their lives were going to be very tough in the future."*
	Curricular Opportunities	Students and teachers discuss the lessons as opportunities for classroom community-building	*" … everybody was … collaborating, we kept acting on ideas and some of the stuff and some people was telling them what they should do and how they should do it, people was helping each other, it was all interacted."*	*" … very important for students to … come in and be autonomous learners and contribute to the whole team and understand why it's important to do that and why you can't just think about yourself and not contributing to the class."*
Relevance of Communal Learning Opportunities for Identities as Change Agents	Instructional Opportunities	Discussing instruction as opportunities for consciousness-raising.	*"I'm dealing with human lives and these lives could be affected in a big way, a big impact that could change the county or the city."*	*" … just like community value where in baby steps I think they can eventually get to a place where they are thinking about those things conscientiously."*
	Curricular Opportunities	Discussing planned activities as ways of fostering students' social-justice oriented perspectives.	*"… once I started building the house … homeless people came into my mind … I would make someone's, a homeless [person's,] life better."*	*" … to involve their community … and knowing how to incorporate why it's important to give back to their community and look back at their community and see what's going on there and relating that to lessons. I think this lesson is a big part of what I've learned."*
Impact on Behavioral Engagement	Choice to Personally Invest in Communal Activities	Evidence of students choosing to engage at a high level throughout the instructional unit	*"I was engaged a lot, because I remember like every single day I would think to … come early to class and do a little bit of the project."*	*"Students participating in the activity, the conversations they are about the lessons and not about other things, them being off their phones and participating."*

interviews and focus groups. Interview questions consisted of (1) one question that assessed teachers' understanding of student motivation; (2) three questions that integrated the single item measures of communal experiences from both the students' surveys and observational protocols; and (3) questions that probed teachers to respond to the observation patterns present in their classroom's state-space grids. In 60-min semistructured interviews, we probed to better understand their perceptions of student motivation, student engagement, and the importance of integrating communal messages into their instruction. In addition, we presented observation data from teachers' classrooms to elicit their feedback on the observed patterns of their instruction.

Consistent with recommended practices for culturally sensitive approaches to focus group data collection (Hughes & DuMont, 1993), we were intentional about student representation within our focus groups. The groups were homogenous in the sense that they each included students from the classrooms of the teachers who participated in the instructional unit. This within-group homogeneity was intended to help students to feel more comfortable in providing examples and in further elaborating on their shared experiences. The groups were heterogeneous in their racial and gender makeup: one Black male, one Black female, one Latino male, and one Latina female. This heterogeneity provided researchers the opportunity to understand multiple perspectives within a racially and gender-diverse classroom.

Focus group questions consisted of (1) one question that allowed students to reflect on their levels of engagement during the observed instructional units and (2) two questions to probe students for reflections and reactions of the activities and teacher practices based upon the theme of the instructional unit. In 30-min student focus groups, the focus group facilitator (and lead researcher) began each session by describing the purpose of the session, and then explained the group rules and asked each participant to introduce themselves. Following the introductions, the focus group facilitator led the group using discussion guides, which included verbal probes intended to elicit feedback from students about when they were engaged due to teacher support for communal experiences. Interview and focus group questions are provided in the Appendix.

6.5.2. Analytic approach for qualitative phase

The interviews and focus groups were recorded, transcribed, coded, and analyzed to identify significant statements that helped contextualize the results of the observations and the survey data collected in the first phase of the study. We chose to highlight two of the four participating teachers in case reports was based on a number of considerations including: (1) the patterns of variability found in state-space grids of their classroom ratings based on observations over the course of the instructional unit (e.g., student-teacher interactions in one classroom varied greatly from week to week, whereas the other these interactions varied very little in another classroom); (2) teachers' differing yet effective implementation of pedagogical techniques; (3) teachers' demonstrated success with curricular enactment; and (4) teachers' demonstration of leadership within the teachers' professional learning teams.

Two of the authors of this article analyzed interview and focus group transcripts by coding and then discussing participant responses that highlighted ways in which students and teachers recalled (1) the instructional practices that emphasized the communal affordances of the STEM activities in which they engaged; and (2) the students' thoughts, beliefs, and actions that resulted from these experiences. Employing in vivo coding with participants' own words and phrases (Miles, Huberman, & Saldana, 2014), we were able to better understand the teachers' and students' accounts of classroom dynamics during the instructional unit. The themes found in Table 5 were constructed by connecting and categorizing similar ideas (Ivankova et al., 2006), resulting in four distinct ways in which teachers and students perceived the instruction as meaningful and relevant. We integrated statements from multiple focus group and interviews with the quantitative results to construct two qualitative illustrations, each uniquely detailing (1) which lessons served as the defining moments of communal learning during observed classroom instruction, (2) how the philosophies of the teachers influenced their support for communal learning opportunities, and (3) how students experienced and recalled communal learning opportunities across an instructional unit.

7. Results and findings

7.1. RQ1: To what extent is variation in students' behavioral engagement during STEM activities explained by students' perceptions of these activities as communal learning opportunities?

The inclusion of communal learning opportunity predictors and effect codes for each lesson explained approximately 12% of the variance in students' ratings of behavioral engagement from one lesson to the next, $R^2_{\text{within}} = 0.12$, $p < .001$. As shown in Table 6, effect codes for all but one lesson were not significant, indicating that behavioral engagement did not significantly fluctuate over the course of the instructional unit. That one exception was Lesson 4, which was significantly higher in engagement levels than overall mean engagement levels, $\gamma = 0.11$, $p = .04$. However, results revealed significant associations between STEM-based communal learning opportunities and behavioral engagement.

Results revealed that students reported being more engaged on weeks that they rated their class lessons as being more relevant for serving humanity, $\gamma = 0.13$, $p < .001$. For each point higher that a student rated a lesson in terms of its relevance for protecting the lives of humans, animals, and plants, their engagement score was 0.13 points higher during that lesson. Results also revealed that students reported being more engaged on weeks that they rated class lessons as being more relevant for serving one another, $\gamma = 0.12$, $p < .001$. However, students did not report being more engaged on weeks that they rated their class lessons as being more relevant for serving the community, $\gamma = 0.04$, $p = .15$.

The inclusion of person-mean scores of communal learning opportunities—along with race, gender, and classroom—explained approximately 55% of the variance in students' overall ratings of behavioral

Table 6
Final Growth Model Predicting Behavioral Engagement, Using Full Maximum Likelihood Estimation.

	γ	SE	*t*	*p*
Intercept	**4.85**	**0.13**	**38.40**	**< 0.001**
Lesson 1	−0.10	0.08	−1.35	0.177
Lesson 2	0.06	0.07	0.88	0.380
Lesson 3	−0.10	0.07	−1.48	0.139
Lesson 4	**0.11**	**0.05**	**2.04**	**0.042**
Lesson 5	0.01	0.07	0.19	0.851
Black	**0.17**	**0.06**	**2.60**	**0.009**
Latinx	−0.12	0.07	−1.61	0.108
Male	−0.06	0.11	−0.50	0.616
Classroom 1	0.09	0.10	0.90	0.367
Classroom 2	−0.03	0.16	−0.17	0.863
Classroom 3	0.08	0.11	0.75	0.456
Communal Experiences $_{\text{Within-Student}}$				
Serving Community	0.04	0.03	1.43	0.154
Serving Humanity	**0.13**	**0.04**	**3.63**	**< 0.001**
Serving One Another	**0.12**	**0.04**	**3.46**	**0.001**
Communal Experiences $_{\text{Between-Student}}$				
Serving Community	0.05	0.06	0.95	0.344
Serving Humanity	**0.28**	**0.08**	**3.53**	**< 0.001**
Serving One Another	**0.25**	**0.09**	**2.85**	**0.004**

Note. Significant coefficients are bolded. Gender is coded as Girl = 0, Boy = 1. All other covariates covariates (i.e., ethnicity, classroom, and lesson) are specified as effect codes. Students who identified as multiracial, or an ethnicity other than Black and Latino serve as the reference group for ethnicity effect codes.

engagement, $R^2_{between} = 0.55$, $p < .001$. Students reported higher overall engagement when they had higher cumulative perceptions of serving humanity ($\gamma = 0.28$, $p < .001$) and of serving one another ($\gamma = 0.25$, $p = .004$), but not when they had higher cumulative perceptions of serving the community ($\gamma = 0.05$, $p = .34$). Although gender was not a significant predictor of behavioral engagement ($\gamma = -0.06$, $p = .62$), results revealed a significant association between students' race and their behavioral engagement. Relative to the mean engagement score across all ethnic groups in the sample, students who identified as Black reported being more engaged, $\gamma = 0.17$, $p = .009$. Students who identified as Latinx reported similar levels of engagement relative to the mean engagement score across all ethnic groups in the sample, $\gamma = -0.12$, $p = .11$. As demonstrated by the classroom effect codes in Table 6, students reported similar overall engagement levels across classrooms.

7.2. RQ2: When do teachers engage students in ways that support them in recognizing STEM activities as communal learning opportunities?

State-space grid results were used to visually examine the interaction between teachers' level of support for three types of communal learning opportunities and students' behavioral engagement throughout the instructional unit. Fig. 3 shows trajectories of student-teacher interaction across two classroom examples (additional state-space grids for other teachers are found in this article's supplemental file). The top panel represents observations made by students in Mr. Hutson's class and the bottom panel represents observations made by students in Ms. Wilkins's class. We represented teacher support for communal learning opportunities on the x-axis of the grids and students' behavioral engagement on the y-axis. We then plotted observed ratings of teacher support for communal learning opportunities and behavioral engagement on these grids, and connected these points. Mapping observations onto this two-dimensional space thus allowed us to characterize our observations as part of a complex dynamic system, which in this study resulted in unique classroom trajectories of student–teacher interactions across multiple classroom lessons.

Each panel in Fig. 3 contains three state-space grids, within which are cells. The cells depict the constellation of possible observation patterns of teacher-student interactions for each of the three focal aspects of communalism. To graphically represent trajectories of instructional support and students' uptake of this support for each observation day, each observation rating is represented by a dot. The numbers inside each dot are used to express the progression of each observation from one week to the next.

We highlighted a "favorable interaction region" within each state-space grid. Observations that lie within this region indicate that during a given class lesson: (1) the teacher demonstrated some support for STEM-based communal learning opportunities, and (2) students were clearly and/or consistently engaged during that lesson. This region was given a special designation among other possible cells in which observations could fall. As observations outside of this region would signal a mismatch between levels of motivational support and student engagement, the highlighted region represents a degree of synergism between the teacher and the students.

There were noticeable differences in the state-space grid trajectories for the two teachers depicted in the illustrative cases. As can be seen in Fig. 3 in the top panel of the state-space grids, Mr. Hutson was observed providing particularly high levels of communally supportive messages (i.e., serving the community, serving humanity, and serving one another) to students during Lesson 1 of the instructional unit. This lesson set the stage for students' high levels of engagement throughout the unit. The state-space grids in the subsequent lessons show that there

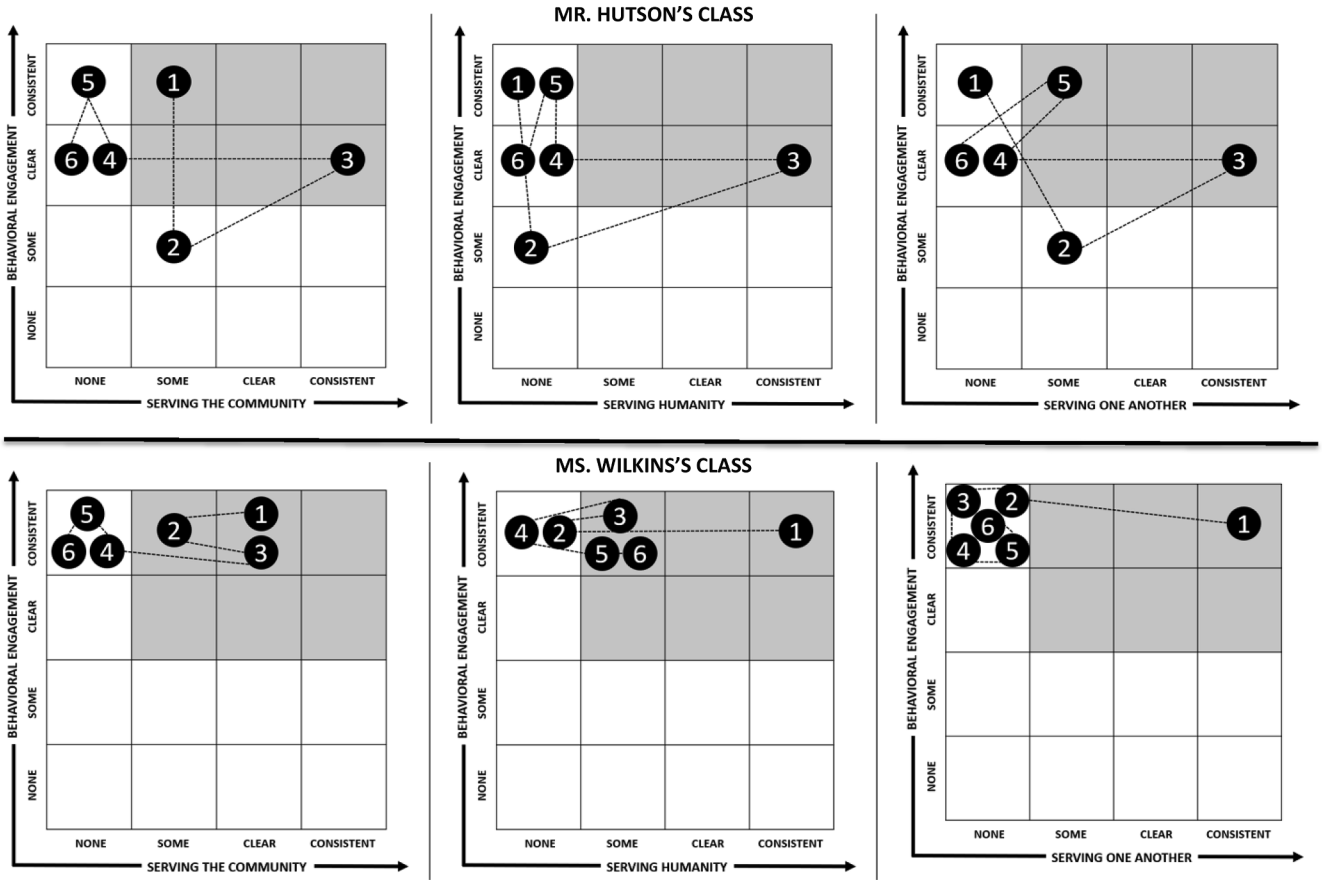


Fig. 3. State-Space Grids of Two Design and Modeling Teachers, Representing Six Observations per Classroom.

was very little variability in the placement of each observation from one week to the next.

Reflecting a different trajectory in her classroom, Ms. Wilkins was highly effective at setting a communally supportive instructional climate during Lesson 3. However, her teaching during the instructional unit did not start out this way. Relative to Mr. Hutson's state-space grids, note the higher degree of variability that observers recorded in Ms. Wilkins's classroom—as evidenced by the placement of the unfilled dots from one observation to the next. Her philosophies and her responsive approach to connecting with students underlies this observed trajectory. We describe these teachers' trajectories in greater detail below, with special attention devoted to those days when observations of teacher-student interactions fell within the favorable interaction region across each of the three areas of communal support.

7.3. RQ3: How do curricular and instructional opportunities for communal learning contribute to students' engagement in STEM activities?

7.3.1. Mr. Hutson frames lessons to support communal interpretations of STEM activities

Mr. Hutson is a second-year lateral-entry teacher who identifies as an African American male. The importance he places on the empowerment of historically marginalized populations is reflected in his instructional approach and in the overall state-space grid trajectory. He embraces this philosophy not only at school but also on his urban farm that he runs with Black adolescent males to provide community members access to fresh food in an area that had become a food desert. From Mr. Hutson's perspective, the overwhelming reinforcement of deficit-oriented notions of competence in schools takes attention away from more pressing issues, such as why academic content is important for students to be learning in the first place. Below are excerpts from an interview with Mr. Hutson.

> *Facilitator*: To what extent do you believe that it's important for students to invest in their own communities by devoting time and effort to issues that impact their communities?
> *Mr. Hutson:* I think it's very important—because school doesn't teach them that. So if they don't learn to take the knowledge and the resources that they get in an educational environment and take them back to the community, it's essentially useless. If you can't get that information, education isn't beneficial. I think a lot of what happens is there's so much that we focus on in school that is, "make sure you're understanding this, make sure you're understanding that"; but then when you go looking around the city, you don't see the benefit of a kid who learned a standard. If you can't apply the information and you don't understand the problems in your community, what are you in school for?

Students recognized the consistency with which Mr. Hutson framed lessons to emphasize the communal affordances of their class activities. In an end-of-semester focus group, students were asked whether Mr. Hutson talked about making the community a better place more than other teachers did. All the students answered *Yes*. One student stated, "Oh yeah, he does." Another student added, "A lot. I think that's the whole point of the class." Students noted that Mr. Hutson's methods (which are primarily question-driven) were his way of framing lessons while also engaging students by honoring their voices. For example, one student said, "There were times where he was asking us certain questions that I, like, really didn't understand. So I'd ask him and he would explain it to us, and after he explains it to us, I would try to find a good answer to it."

Referring back to the state-space grids (Fig. 3), observations of Lesson 1 reflected the highest evidence of Mr. Hutson implementing support for communal learning opportunities. During that lesson, students built windmill prototypes using available resources (e.g., Styrofoam cups, plastic spoons, straws)—similar to how William Kamkwamba from Malawi built a windmill at age 14 out of scraps from junkyards to provide electricity to those in his community (Kamkwamba & Mealer, 2010). Mr. Hutson taught the windmill lesson nearly two months prior to our end-of-semester student focus groups; yet their comments revealed this was the lesson during which they were most impacted by the instructional content and pedagogical strategies implemented. The students still remembered key takeaway messages from the lessons—indicating in part how important it is to explain the "why" behind STEM activities.

> *Facilitator:* Windmills—okay, tell me more about that windmill challenge. I came to your class that day. I remember that the PowerPoint was working, but there was a video that Mr. Hutson wanted to show that was not working.
> *Student 1:* Oh, I had this book in my book bag. It was called *The Boy Who Harnessed the Wind*. It was about this guy who was from Malawi. It's a country near South Africa. They had electricity, it was like the late 70s, early 80s, and his family didn't have a lot of electricity, and the electricity costs a lot. And even if they did have electricity, there'd be some outages and then you would be at fault for these outages. So he was like 14 when he tried. He started reading books in the library, and he read a lot of them, and then he would try to learn about them, and then he started trying to make electricity using this windmill. He dropped out of school because his family didn't have enough money.
> *Facilitator:* So how did the lesson that you were learning connect to that idea?
> *Student 1:* It connected that like, we don't have to pay other people to do our stuff, we can do it ourselves.
> *Student 2:* Like don't depend on other people, you can do it yourself.

In describing the idea of doing "it yourself," Mr. Hutson's students were emphasizing that relying on those in one's own community (rather than on community outsiders or on those in positions of power) can be sufficient for bringing change to one's community. This framing was early in the instructional unit, and contributed to students' sustained interdependence during classroom activities: When students asked Mr. Hutson for assistance, he repeatedly told them to "rely on one another and consider what contributions you each need to make in order to accomplish the task." Scaffolding students' collaborative reasoning in this way is known as the *promotion of student ownership over discussion* (Baker et al., 2017); and in Mr. Hutson's classroom, this framing was a way to structure opportunities for students to engage in serving one another. As shown in the panel of the state-space grids for Mr. Hutson in Fig. 3, students remained engaged for the remainder of the instructional unit—even when Mr. Hutson did not frame the lessons in terms of having a communal purpose and instead provided technical support during technology-rich activities.

7.4. Ms. Wilkins scaffolds an appreciation of the communal purposes of STEM activities

Ms. Wilkins, a self-identified Black and Latina woman, with a teaching certification in technology engineering and design education, is a sixth-year teacher who conceptualized support for communal STEM opportunities from a developmental perspective. When students in her class were asked about communal forms of school participation in their elementary school classrooms during the prior academic year—particularly about serving one's community—they said that such participation was rare. As a result, although Ms. Wilkins viewed communalism as important to supporting students' engagement, she also acknowledged that students' understanding of community would need to be cultivated in order for students to more deeply engage in STEM-based communal learning opportunities.

> *Facilitator:* Is the emphasis on community always possible within the allotted time that you have in the class?
> *Ms. Wilkins:* I really think that's possible. I think I mentioned this

earlier: I feel like they had to kind of struggle through the barrier of not even understanding what it is. So with them not understanding, it was hard for them to engage and understand why it was relevant to them. But once we started talking about it more and they understood that—"Oh, wait, wait, this is my community, and I do care about my community and what happens in my community, and I do want to help"—I feel their engagement was a little bit more. Because when kids don't understand something, they check out. I found that with the hands-on projects that I do in my class, a lot of times there are teachers that say, "Oh man, this is a horrible student." I'm like, "Really? He comes to my class and he does great!" Maybe on that day we're making them read or do math and skills that they really don't understand. I feel that when students understand, and they feel like they can be successful, they don't check out. But if a student is feeling like they can't be successful, I think that cuts off their engagement right away.

Ms. Wilkins emphasized students' competency beliefs and success experiences as a point of intervention.

Facilitator: What do you say to them to make them feel like they can be successful?
Ms. Wilkins: Basically, a lot of times with the stuff that I'm dealing with … they're not even trying. So I tell them that I'm just reinforcing that you're smart, you can do this. And I'm getting them to kind of buy in, and at least try it. Or first I'm giving them something that I know they will be successful at, to boost their self-esteem. And then I give them something that's a little more challenging once they know that they are capable of doing it.

Ms. Wilkins's strategy of getting students to *try* STEM activities can be seen in her trajectory of student-teacher interactions, shown on the bottom panel of Fig. 3: Students were engaged on the first observation day of Ms. Wilkins's class, even though she did not provide any motivational support for communalism. During Lesson 2 instructional time had been cut short because Ms. Wilkins had to deescalate an altercation between two students that broke out in the hallway right outside her classroom door. As a result, her students were not fully immersed in the classroom activities, and they were observed as being relatively disengaged. Witnessing that altercation also affected the way Ms. Wilkins' students construed communal learning opportunities on the third observation day. In characterizing this individual case, we place a special emphasis on Lesson 3 of Ms. Wilkins's instructional unit because it represents a transformative moment along her trajectory of teacher-student interaction.

Among Ms. Wilkins's assignments was tasking her students to identify problems in their community that would involve technology. One group presented an idea to battle bullying by using drones to report incidents, along with getting churches and the broader community more involved in the effort of addressing such community problems. Another group focused on battling the racism and insensitivity to various cultural groups that exist within the school. Ms. Wilkins opted to focus the class's attention on those two issues—using them as springboards for further discussions about honoring the voices of students who have experienced or witnessed peer victimization in the school. As shown in the state-space grids for Ms. Wilkins, Lesson 3 included a defining moment that set the stage for sustained engagement through the remainder of the instructional unit. Students were asked to recall their levels of engagement in activities that followed this lesson:

Facilitator: Do you remember any times during the semester in Design and Modeling when you and your classmates really paid attention, weren't distracted, were really focused, and were actually trying to do the activity?
Student 6: Oh, the Tiny House project, I would say.
Student 5: Oh yeah.
Student 6: Everybody was like doing this and we was, like, collaborating. We kept on acting on ideas for some of the stuff … and some people was telling them what they should do and how should they do it. People was helping each other, it was all interactive. It was like we all did everything but we did it separately, so, like, it wasn't group work but we built it by ourselves.
Facilitator: Well, what made you all pay attention so much and really try on that particular lesson? What was it about the lesson?
Student 6: Well, we was building like a tiny house. I was doing one to build like a city off of it. But what made it so focusing is because we was doing it on this new idea, like SketchUp Pro. So we kept on building it. We wanted to mess with this. And also we thought it would be really cool because we would see it in 3-D. And if we didn't do it with our hands-on, I don't think it would be as good as it would be, like it was on the computer.
Facilitator: Okay, what about you guys—the same questions: What made it so interesting for you? Do you want to say any more about it?
Student 7: … we got to work together and got to know our classmates more and get along.

Similar to the state-space grids developed from observing Mr. Hutson's class, the state-space grids shown for Ms. Wilkins illustrate that students were observed being engaged during subsequent lessons, even though she spent the majority of her class time in the rest of the instructional unit providing more technical support and very little time conveying the communal value of scholastic activities.

8. Discussion

Historically, educational psychology research has been characterized as "culturally unattentive" (Portes, 1996) and "lacking in cultural imagination" (King, McInerney, & Pitliya, 2018). Our study speaks directly to this issue by highlighting the nuanced ways in which communal learning experiences are linked with the engagement patterns of Black and Latinx students. Our decision to use complementary survey- and observation-based approaches over time pushes the theoretical boundaries of research at the intersection of culture and motivation. Had we examined only the way students' perceptions of STEM-based communal learning opportunities predicted their trajectories of behavioral engagement, we would have missed an opportunity to observe the dynamic ways in which student engagement and teacher support for communal learning opportunities shape one another during classroom instruction. The mixed-methods approach that we employed to contextualize the classroom observations enabled a more in-depth exploration of how teachers' beliefs, students' prior experiences, and teachers' and students' value of communal learning opportunities impacted student engagement. The codes from follow-up conversations with teachers and students were helpful for contextualizing a finding that surprised us: although other forms of communal support were significantly associated with behavioral engagement, communal learning opportunities to serve the community were not significantly associated with elevations in behavioral engagement. Scholars note that "society and schools cultivate resistance through persistent and pervasive practices that treat ethnic and cultural diversity as contentious, negative, insignificant, or nonexistent" (Gay, 2013, p. 56); and these teachers had to first address the novelty of classroom conversations about community-building in order to provide students with community-based learning activities that were both meaningful and culturally relevant.

8.1. Teachers' flexible use of time: cultural implications for relevance interventions

The findings presented herein have cultural implications for educational psychologists seeking to support teachers in implementing developmentally appropriate strategies for supporting students' motivation during STEM learning activities. Researchers have made

theoretical arguments that relevance interventions targeting students' identities are likely to be the most meaningful, but that they are also difficult to target for interventions (Priniski et al., 2018). One reason for this may be because doing so requires going beyond relating academic content to students' lives; it also involves taking time to leverage students' own experiences and cultural backgrounds as a part of making content meaningful—a process that is "at odds with the current state of education in the United States, where teachers are pressured to cover many concepts and practices in a school year" (Tsurusaki et al., 2013).

Using *The Afrocentric Praxis of Teaching for Freedom* (King & Swartz, 2016), we observed the ways in which teachers' philosophies and instructional strategies aligned with the time they carved out to enact two emancipatory pedagogies: (1) *question-driven pedagogy* and (2) *multiple ways of knowing*. Question-driven pedagogy reflects the practice of building on students' prior knowledge while also privileging their voices within academic spaces. The multiple ways of knowing pedagogy reflects the practice of appreciating various ways that people come to make sense of the world around them.

8.1.1. Mr. Hutson's classes

During the first observation of Mr. Hutson's instructional unit, we saw that he was so passionate about framing the activities in ways that conveyed the communal affordances of the activities that his students never actually got to finish their class activity during his Lesson 1. Yet, his line of questioning helped students to consider the communal purposes of what they were learning. His approach was also emancipatory in the sense that his question-driven pedagogy helped students see that the point of their engagement in subsequent STEM learning activities was to build their efficacy around believing they were capable of improving the social and physical spaces in which they live. His communal emphasis represented what he felt his students needed in order to make their learning experiences meaningful—so much so that the concept of being a change agent in one's community was described by one student as "the whole point of the class."

8.1.2. Ms. Wilkins's classes

If we had observed Ms. Wilkins's classroom only during her Lesson 1, we would have concluded that she was not providing motivational support to the students and instead wished to portray STEM learning as fun—the type of image that Brophy (2008, p. 137) describes as "well suited for recreational activities but not activities focused on acquiring and using K-12 content." Further, we would have concluded that Ms. Wilkins should have provided students opportunities to be empowered through self-expression and self-realization. However, we came to understand that for Ms. Wilkins, letting students "play" served a larger purpose.

We also observed Ms. Wilkins providing other forms of motivational support outside of emphasizing the communal purposes of STEM activities. In a more traditional sense of considering students' self-efficacy (Bandura, 1986), her concerns about students' competency perceptions led her to occasionally abandon a lesson so as to enable her students to experience success and to feel that they could successfully engage in technology-rich STEM activities. Ms. Wilkins then used the emancipatory pedagogy of multiple ways of knowing by privileging relational ways of knowing and empathy. By pausing from allowing students to play with technology and instead focusing on acknowledging students' humanity, she provided students opportunities to develop a more nuanced understanding of their peers and to better understand the roles that each classmate plays in setting a climate that affirms others as learners and as human beings.

Boykin (1986) argued that educators and psychologists focus heavily on questions of competence (e.g., Can students learn this?), when more cultural interpretations of students' behavior requires an emphasis on relevance (e.g., Should I learn this?). In part as a result of observing Ms. Wilkins's techniques, we broadened our focus toward multiple instructional strategies at play in the classroom (e.g., *multiple ways of knowing* and *allowing students to play*) and developed new interpretations of cultural perspectives on motivational support. Namely, that—even in a culturally affirming academic space—self-perceptions of ability that students evidence in the classroom may first need to be unpacked. Relinquishing some instructional time in the short term appeared to be a worthwhile exchange for the long-term benefits such as meaningful student exchanges and deeper engagement.

8.1.3. Teaching for communal benefit

We also found that during the second half of the instructional unit, teachers did not provide very much support for communal learning opportunities. After observing their classrooms over several lessons, it soon became clear why this was the case: Enacting instructional strategies that support students' communal learning opportunities takes time; and these teachers went off-script in order to break down the concept of communal responsibility during their planned activities—a decision that enabled them to apply their knowledge of their students, and to build on the thoughts and behaviors that students expressed during the lessons. After the teachers created time to emphasize the communal structure of the learning environment, they were able to provide students with technical support on their projects in subsequent lessons—with students remaining highly immersed in their daily activities.

8.2. Limitations and future directions

A few considerations must be acknowledged when interpreting findings in the present study about our research-practice partnership. First, our partnering teachers were afforded a great deal of flexibility by school administrators regarding the types of curricular activities and instructional practices they could incorporate in their classrooms. This administrative decision was in large part due to the rapport that we established with them and their school leaders before starting the project, along with recognition of their expertise and experience as teachers of STEM elective courses. Thus, these teachers were not subjected to the same pressures of high-stakes testing and scripted curricula experienced by teachers of core academic subject areas.

Second, the complex nature of cultural processes cannot be captured within a single motivation study (Urdan & Bruchmann, 2018). The time-intensive approach to survey methods, observations, focus groups, and teacher consultations that we employed in our partnership is an important first step in supporting a higher volume of teachers and students. In light of recommended practices for conducting research at scale (Coburn, 2003), we propose that the instructional strategies of framing and scaffolding (Brophy, 2008) be shared in district-wide professional development sessions—as vehicles for supporting communal learning opportunities. Future studies could document the evolution of language, district practices, and policies that support teachers in prioritizing communal learning experiences in their classrooms—particularly after the launch of school initiatives focusing on enhancing student engagement, utility value, or culturally relevant and responsive education. In a study serving a larger number of students, a complementary analysis could involve a quasi-experimental study investigating attendance, discipline, and academic performance. As with recent quasi-experimental research that evaluated the impact of elective courses with a culturally relevant pedagogical focus (Dee & Penner, 2017), causal inferences stemming from regression discontinuity designs (such as comparing students who did meet some eligibility criteria for a STEM elective course with those who did not) could further inform considerations of scale. Examples might include determining who benefits from enrollment in such classrooms (e.g., based on such demographics as race, ethnicity, socioeconomic status, and/or gender), pinpointing when taking such a course is optimal for students (e.g., first semester vs. second semester of middle school), and/or evaluating how the number of times students enroll in a culturally anchored STEM elective course—assuming they are eligible to take STEM electives more

than once—affects their academic trajectories.

Third, future studies may further examine psychological mechanisms responsible for quantitative findings in the present study. In terms of within-person effects, the relation between communal opportunities and engagement is presumed to be driven by the developmental imperative for belonging (Diekman et al., 2017). Mechanisms for this anticipated association may be tested in the future, along with mechanisms for unanticipated findings. For example, in the present study Black students were significantly more likely than other ethnic groups to be engaged in the lessons. During the focus groups, the Black students were quicker to recall cultural connections to the content taught in their lessons (e.g., having previously read about an African man from Milawi who engineered windmills from scraps prior to the teacher introducing this story to the class). These more apparent cultural connections may in part be explained by the lesson planning of the teachers in this study (three of whom are Black, and one who is Black and Latinx) and/or our professional development framing on culturally relevant teaching using an Afrocentric praxis.

We wish to acknowledge that between-group comparisons can sometimes be harmful or destructive, as they have the propensity to cast a deficit-oriented lens on one ethnic group, relative to another ethnic group. Such critiques are traditionally levied against studies that (1) use traditional metrics of achievement (e.g., standardized test scores or grades) as the dependent variable, (2) compare an ethnic majority group to an ethic minority group, and (3) essentialize the experiences of one ethnic group by using a second ethnic group as the standard for making sense of research trends among individuals from the first ethnic group. For this reason, we were intentional in our use of effect coding (as opposed to dummy coding), which has been described as an approach for more equitable reporting of ethnic group patterns in quantitative research (Mayhew & Simonoff, 2015). This approach facilitated our efforts to understand the extent to which teachers were effectively engaging students from different historically marginalized populations, relative to an overall engagement score for the entire sample. Based on the finding that overall engagement scores were consistently high, and that Black students' engagement scores were significantly higher than the average engagement score across ethnic groups, we came to two conclusions: This culturally affirming climate engaged students of different ethnic backgrounds and, still, Black students were particularly receptive to the communal structure set by teachers in this study. Although our qualitative data helps contextualize these findings, more remains to be understood about ways to structure communal learning opportunities moving forward. Student interviews can be useful for gaining a more fine-grained interpretation of the experiences of different cultural groups within the same intervention classroom. Moreover, a deeper and more critical understanding of these experiences may be achieved through future investigations that take an intersectional approach to understanding differences within and across historically marginalized populations (Jang, 2018).

Culturally sensitive observation protocols and trainings are also needed. For example, in the present study, it was difficult for researchers to disentangle if and how the behavioral engagement observation measure and/or the training of observers contributed to the less-than-ideal reliability score for behavioral engagement. Although observer training included viewing, rating, and developing consensus on aspects of observed classroom instruction, a higher volume of practice videos in culturally diverse classrooms would have enabled us to calculate an interrater reliability during trial observations. For example, a study by Kane and Staiger (2012) provided 17–25 h of training to observers prior to the collection of observation data. The Measures of Effective Teaching (MET) Collection—with data from approximately 3000 participating teachers—can be helpful for this purpose because this data set contains videos of instructional settings diverse in teacher demographics, subject areas, instructional practices, and student ethnic representation. Access to a larger volume of classroom instructional videos such as the Measures of Effective Teaching (MET) Collection could also be an effective means of developing and evaluating culturally sensitive observation protocols.

Going forward, we would like to engage in work that considers ways to build on existing measures of support for communal learning opportunities. The design of investigations within this literature base has relied either on single items as a means of reducing cognitive load across repeated ratings—as was the case in the present study, or because single items perform as well as multiple items of communal experience—as in studies by Brown, Smith, et al. (2015). In addition, further investigation is warranted to determine whether item development approaches, such as understanding students' perspectives on alternative wording (e.g., using the term *neighborhood* rather than *community*) may be better suited for assessing students' perceptions of serving the community (which emerged as a non-significant predictor of behavioral engagement in our quantitative analyses).

9. Conclusion and practical insights

We urge educational psychologists to support educators in considering the construct of relevance from a communal lens. Doing so may help increase the chances that culturally and ethnically diverse adolescents will have communal-oriented experiences that provide them with a sense of fit within STEM environments (Diekman et al., 2017). Moreover, the concept of communalism may not fit neatly into every lesson. Effective teaching is not stable (Patrick & Mantzicopoulos, 2016); and from a dynamic systems perspective, nor should it be (Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014). From this perspective, we suggest that school reform efforts involving educational psychologists include collaboration with teachers to embed opportunities for communal experiences into lesson framing and instructional scaffolding—given that teachers play a vital role in helping students to develop an appreciation of the relevance of scholastic activities (Brophy, 2008).

Appendix A. Teacher interview questions and student focus group questions

A.1. Teacher interview questions

- How do you currently define student motivation?
  - o Probe: To what extent do you believe it can be cultivated or influenced?
  - o Probe: Do you think about student motivation any differently now than you did at the beginning of the semester?

  Please elaborate.

- To what extent do you believe it is important for students to invest in their community by devoting time and effort to addressing issues that impact community members?
- To what extent do you believe it is important for students to develop a sense of compassion for, and commitment to, preserving and not destroying various forms of life (e.g., humans, animals, plants)?
- To what extent do you believe it is important to use instructional practices that emphasize the idea that it is each student's responsibility to contribute to the collective welfare of the groups to which they belong?
- Looking at this diagram of your classroom observations, what are your initial thoughts?
  - o Aside from providing students with communal experiences, were there any other strategies that you used to motivate students during the lessons?
  - o Is there other information (e.g., instruction-time considerations, students' backgrounds, students' history, larger societal contexts) that would help us understand these classroom observation patterns?

A.2. Student focus group questions

- Do you remember any times during the semester in your Design and Modeling class when you and your peers were really paying attention, not distracted, focused on the activity, and actually doing the activity?
  - Probe: Were there things your teachers said or things about the lessons that kept your attention on these days?
- Do you remember any times during the semester in your Design and Modeling class when the activities seemed like they could be useful for making your community a better place?
  - Probe: On these days, how likely were you to pay attention, not be distracted, focus on the activity, and actually do the activity?
- Were there things your teacher said or did that made you think about how to make your community a better place?
  - Probe: Compared to your other classes this semester, did your teacher give you fewer or more opportunities to think about how to make your community a better place?
  - Probe: Compared to the classes you took in elementary school, did your teacher give you fewer or more opportunities to think about how to make your community a better place?

Appendix B. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cedpsych.2019.101833.

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