

# The Power of Partnership

Students, Staff, and Faculty  
Revolutionizing Higher Education

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Elon University Center for Engaged Learning  
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## CHAPTER 12

# **Increasing the Participation of Underrepresented Minorities in STEM Classes through Student-Instructor Partnerships**

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We began a pedagogic partnership in September 2014 exploring student engagement and participation patterns in an introductory astrophysics course at Haverford College in the United States. We returned to our work in early 2018 to reflect on our experiences and examine the data we'd collected. Several themes emerged in this reflection that tied together not only the goals we set for the course but also our partnership more broadly: clarifying expectations; pausing and checking in; and reassuring and acknowledging. These themes both implicitly and explicitly helped us create a classroom environment of inclusion and equity for all students. This chapter is our sense-making of those themes, and we share both individually and in collaboration. Throughout, we use the notes we took during our partnership as examples.

## Context

### *Sophia's Beginnings*

I first partnered with a professor during the second year of my undergraduate degree, when I was encouraged to participate in a program called Students as Learners and Teachers (SaLT). In this context, I observed my faculty partner's classes weekly, met one-on-one with them to share what I saw in the classroom through notes and other feedback, and met weekly with fellow student partners to reflect on my learning and practice framing feedback. The goal of the program is to make space for perspective sharing on the pedagogy of the classroom and provide real-time feedback for faculty on their teaching. For students, the opportunity to help shape a class and figure out ways to advocate for oneself and one's peers can be invaluable—and for me, this translated to a strong sense of agency in my interactions with all my professors. In my final year of undergrad, and my third year of SaLT, I got to partner with Desika on his class, Intro to Astrophysics. I had spent a lot of time in my prior experiences thinking deeply about voice and space in the classroom. I wondered how we could make classrooms more inclusive, and I developed a technique for myself of mapping the participation in a classroom to visually represent the ways people spoke to one another. So, I was both excited and scared to bring these interests and techniques to a partnership in astrophysics—an academic area that had always been a source of anxiety for me.

### *Desika's Beginnings*

My partnership with Sophia was my first engagement in any kind of student-teacher partnership. This course was only the second one I had taught (ever), and it was a critical one for ensuring that prospective majors approached their upper-level classes with the appropriate foundation. I was terrified. At the same time, I was encouraged to participate in this partnership within the context of a broader partnership between Haverford College (where I was employed) and Bryn Mawr College called the Teaching and Learning Initiative (TLI). Alongside weekly meetings with other faculty (and a professor leading the course), a major part of the TLI program is the student-teacher partnership. After being paired randomly with Sophia, we quickly realized that several techniques

we discussed in the context of increasing student engagement could be used to broaden the participation of underrepresented minorities in the class. At the time, we focused specifically on students that identified as women as the primary underrepresented minority group in the course, though there were also several students of color in the course. In retrospect, I wish we had thought a bit more carefully about quantifying the effectiveness of our methods on a broader range of students in the field, though, at the time, the weightiness of the new course, combined with attempting to raise participation inclusively, was the most I could handle as a junior faculty.

### **Clarifying Expectations**

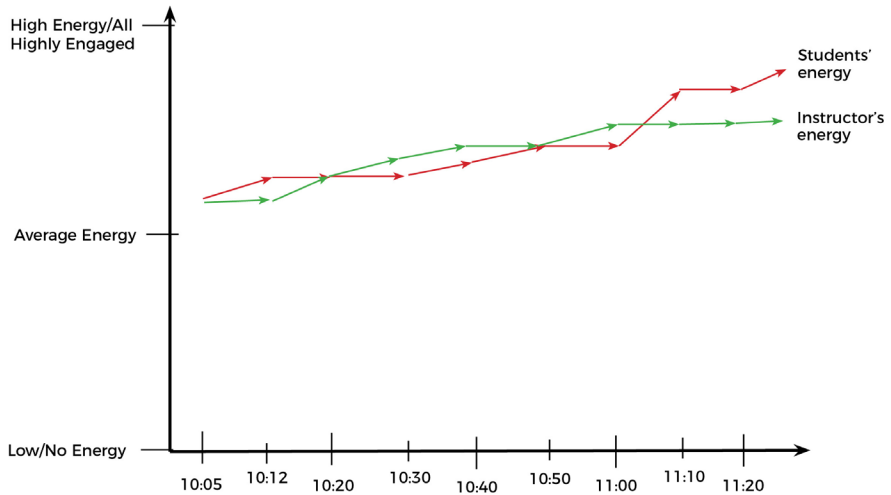
There was already a structure in place for us to begin our work together, which helped us start our partnership with clear expectations. After the first meeting, Sophia attended one of Desika's first classes to observe. We decided to focus our efforts on clarity in the class to ensure all students had equal access to the material, in spite of varied backgrounds in the field. Some students had a strong physics foundation because of their high school curricula, and others were studying this kind of science for the first time. We didn't want those students to feel they were already behind their peers. We were concerned that more well-prepared students in STEM fields might unknowingly marginalize students from weaker backgrounds (who have comparable talents) with a combination of their confidence and domination of the space; too frequently, under-preparedness goes hand-in-hand with marginalized student identities due to the inequitable distributions of resources in our society (Museus et al. 2011; National Academies of Sciences, Engineering, and Medicine 2016). It was an important goal for our partnership to level the playing field.

Broadly, we focused on two major methods for increasing clarity of material:

- Increasing the focus and energy of students; and
- Increasing the transparency of what Desika intended students to take away on a given day.

Maintaining a high level of energy and focus throughout the course was critical to ensuring a thorough understanding of the material. You

can't learn if you aren't focused! Because the class was one of the first ones offered for the day, we acknowledged that students would often come in cold. The beginning of every class was therefore devoted to a brief (five-minute) recap of the relevant material from the previous lecture, followed by time for questions to warm up for the day.



Throughout the lecture, energy naturally waxes and wanes. But in the mapping Sophia began to do (above), we noticed that there was a close relationship between Desika's energy and his students' energy. While this process wasn't especially scientific, Sophia did try to capture her general sense of Desika's and the students' energy levels through their body language, facial expression, and tone of voice. Critical to our efforts of maintaining high energy levels was constantly changing the pace of the lecture. Desika would often start with a walk-through of a relatively dry mathematical equation to explain the root of key physics concepts, under the premise that the students' capacity to focus was likely to be highest at the beginning of class. As Sophia noticed, however, very quickly students' eyes would glaze over. To help engage them, we worked on different types of questions that Desika could ask the class throughout the derivation. When Desika began to warn students of difficult or dry work coming up and clarify how hard derivations connected to broader

themes of the class, students had the opportunity to develop their trust in him. In the same way that we practiced open communication in our partnership, Desika worked to foster that trust and reciprocity with students in the class. Their efforts to maintain focus and engagement reflect his trust in their capacity to do complex work.

In our second semester working together, Desika was especially intentional about the way he set the tone for his class of first-year students, as reflected in the following observation notes written by Sophia (with observations on the left and commentary on the right):

<b>Observation</b>	<b>Commentary</b>
<p>8:00 – You talk explicitly about collaboration and the honor code. You use student names in your example.</p> <p>You say, “If you have any questions about your level of collaboration or resources, ask me.”</p>	<p>This was something you were concerned about making clear. I think you did a great job of explaining what is appropriate and what is not. Your example was particularly helpful to me, both for understanding and for getting to know my classmates’ names. You’ve set a great tone for the semester!</p>
<p>You explain your participation grading and say, “This is an activities-based class. Attendance is mandatory.”</p> <p>You also explain what you mean by participation: “Not only that you are participating but that you are making sure everyone in your group has a voice . . .”</p>	<p>Thank you for noting this. I think it’s something you may need to remind students of, but I’m so glad this was present in the first class. You were clear about your expectations that this classroom be a community and a supportive, collaborative learning environment.</p>

<p>You go over the topics to be covered and write them up on the blackboard.</p> <p>You say, “If you don’t think neutron stars are cool, then you don’t know anything. They’re the most awesome things!” And you explain.</p> <p>Students are all highly engaged throughout, but especially here.</p>	<p>Your tone of excitement here is so engaging. Even I can’t wait to return to talking about neutron stars, and for me the topics feel familiar from last semester!</p>
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Based on our prior semester of work together, Desika was also especially intentional about defining what he meant by participation: “Not only that you are participating, but that you are making sure everyone in your group has a voice.” This distinction was born of something we struggled with in the prior semester: how to continue to show we value participation while balancing those students who may begin dominating the class discussion to the detriment of their peers? In the prior semester, some of this balancing began to happen naturally as Desika worked to create a community in his classroom, as described in the following notes:

<b>Observation</b>	<b>Commentary</b>
<p>A vocal student notices another student may have had a question as he’s about to speak and says, “Wait, were you going to ask something?” The student says no.</p>	<p>This is so great – even though the second student doesn’t have anything to say, it indicates an awareness of peers that I haven’t really seen before. Perhaps the group work is building class bonds?</p>

The above exchange happened in November, about two-thirds of the way through the first semester. In large part due to Desika’s intentionality and transparency about this goal, students seemed to do a much better job of accounting for one another in this second semester. It was thrilling



to see the ways they began to create spaces for each other to participate, and the ways the students began to practice what Desika modeled for them in clarifying their intentions in their interactions with one another.

### **Pausing and Checking in**

Early in our first semester, Sophia brought up the idea of checking in with the class mid-semester (in fact, we ultimately did three total check-ins with the class). Traditionally, Desika had used standard written evaluation forms that the students filled out. With Sophia's access and familiarity with the context through her observations, we were able to get significantly more meaningful feedback from the students in a facilitated conversation than the written medium alone provided. Pausing was important to us because we knew if we didn't check in with students early and often, we were far more likely to miss those who began to fall behind. We also hoped that asking for feedback would make students feel more comfortable approaching Desika at other times to share their thoughts or anxieties about the course.

Trust was an important aspect of the student-faculty partnership in adding to the value of the mid-semester check-in. By seeing one of their peers sitting in class weekly, as well as in Desika's office from time to time for our individual meetings, the students got to know Sophia as a quiet but regular staple of the course. As a result, we suspect they were more willing to open up to her than they might have been to others.

To start the evaluation process, Desika gave the students pre-written questions (the form he might have given them anyway had he not had access to a student partner), and then he left the room. The purpose of the written evaluations was to get them thinking about the course as a whole. After giving them time to write, Sophia engaged the class in a conversation for 15-20 minutes. While taking notes, she omitted any identifying information and specifics. Rather, what Sophia reported to Desika from the conversation were overall themes. How was his clarity? What more could he be doing to accentuate the delivery? How were the tests/homework? How did the students feel about class participation? The format of Sophia having a conversation with the students had several clear benefits. First, often one student would mention something, and

it was clear through facial expressions and verbal responses that the rest of the class hadn't thought of that (and therefore would not have included it in their written feedback), but they agreed. The "pile-on" effect at that point would make it clear to Sophia that this was an actual issue in the course that Desika needed to address. On the other hand, if a student mentioned something and they were alone in their opinion, that too became clear. Second, larger themes were easier to capture as it was more obvious to Sophia sitting in a conversation what the repeated ideas were, which is something that can sometimes be harder to parse out in written evaluations. Finally, the conversational tone led to new ideas.

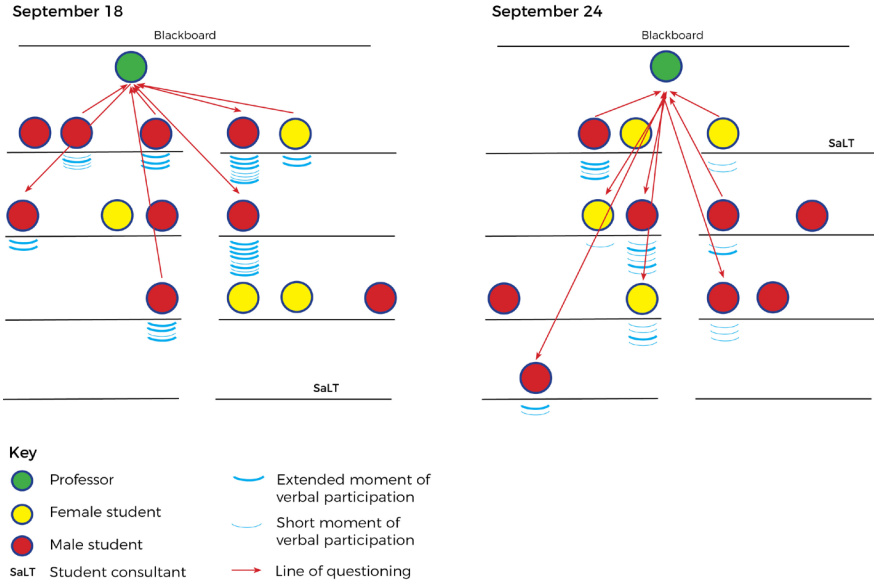
Students mentioned that it can be hard to remember what different variables stand for when you're deriving long equations. One student mentioned that it would be helpful if you wrote a key of variables on the side of the board before going through an equation.

The example above shows the way students collaborated to offer feedback and suggestions. This particular suggestion improved the clarity of material so much that it's a technique Desika still uses today, four years later!

Students had the opportunity to develop trust in seeing Sophia regularly in class, and this was reinforced when Desika publicly responded to student feedback in class. In those moments—either seeing Desika take and apply a student suggestion or explain why a particular aspect of the course was necessary for student learning—students could see that the feedback process was genuine and their relationships with Desika were reciprocal.

Another method Desika adopted to shift energy and make space for new voices was to ask students to physically occupy different areas of the classroom. In the beginning of the semester as students developed patterns of seating and participation, we realized that if Desika asked a question and expected a response to come from a particular region of the classroom, he would look to that space. As that expectation became

a habit, fewer and fewer students would participate because Desika’s (and any instructor’s!) natural fear of awkward silence would encourage him to seek out a reliable student. However, if students moved around the classroom semi-regularly, Desika would end up looking to different students to respond.



We see two class sessions in the maps above. The map on the left is early in the semester as students are beginning to establish patterns of speaking. On the right is the following week after Desika asked students to “sit on a different side and in a different row” from where they generally sat. While the total number of students speaking only increased by one, the number of female students speaking increased threefold and the range of students speaking shifted considerably. Desika invited a diverse set of new voices to fill the metaphorical spaces by asking students to shift the physical spaces they occupied in the classroom. Students continued to shift around the classroom in the following weeks. While this movement didn’t entirely “solve” the issue of equity in class participation, it did noticeably shift the culture of the class.

## Reassuring and Acknowledging

**Sophia:** I had a lot of anxiety coming into the partnership around working with an astrophysicist because I'd had such negative physics experiences in the past. In prior experiences, the field seemed filled with memorization of complex equations that I could never keep straight. I harbored an assumption that physicists were naturally good at their subject, immediately understanding this new language and easily grasping the importance of topics I struggled with. Embedded in this assumption was the idea that a physicist would be too distanced from my experience of the subject to empathize with what made it difficult. As a woman who did not see herself reflected in her male teachers and professors in physics and complex math, this fear was compounded.

I tried not to let that bias interfere with our work together, but my anxiety was quickly eased. As soon as Desika started by framing the class with the words "We're going to start with what I think is going to be a harder part" and acknowledging the anxiety that might accompany that challenge, I knew this space would feel different.

**Desika:** I have never been particularly good at physics, astronomy, or math compared to my peers as both a physics major in college and in my astronomy PhD program. I vividly remember being confused about a lecture, going into the next lecture, which started where we left off, which meant I was starting from a place of having no idea what was going on. This was true in both undergraduate and graduate school, which only served to feed my imposter syndrome (a syndrome that, while widespread, particularly impacts minorities in a given field of study; see Lindemann, Britton, and Zundl 2016; Ramsey and Brown 2017). This was something I was (and continue to be) keen on mitigating for students. Identifying topics that are weak links in the overall narrative that might make understanding difficult for students was a primary goal of mine in the student-teacher partnership. This was particularly challenging in the derivation-heavy courses that Sophia and I partnered in, and it was an area where having a student such as Sophia pay attention to the overall flow of a given class was particularly useful.

At the same time, when reflecting on my own insecurities from my experience with STEM courses as an undergraduate student and talking with Sophia about her self-identified anxiety in physics, I wanted students to feel as though I “got” that it was hard. One of the most frustrating aspects of my own education was being taught by professors who didn’t understand why I didn’t get it. Throughout a lecture, Sophia and I would try to identify areas that we knew would be sticking points and be transparent with the students about that aspect of the lecture. Similarly, recalling areas that I found tricky as an undergraduate in the same course and sharing that with the students was a pedagogical strategy that Sophia and I were able to identify as successful in preventing students from “checking out” when a hard topic arose.

**Sophia and Desika:** Our shared anxieties helped us focus in our partnership on trying to help students feel welcome in a space that may not have traditionally welcomed them. Desika’s intentionality in this area helped to create a close community in the classroom. In the example below, he makes a point of reassuring a student who isn’t sure about asking a question. In this instance, he makes sure students know this is a place where asking questions is not only acceptable but encouraged:

<b>Observation</b>	<b>Commentary</b>
10:39 – A student who usually doesn’t speak up in class asks a question. He starts by saying, “Sorry” and you say, “No, don’t be sorry!”	Thank you for both noticing this and responding—you reinforced, to me, your commitment to answering student questions regardless of where you are in the lecture.

While Desika was able to reassure students that making mistakes is part of the learning process, Sophia was able to reassure him that his own mistakes in class—missing a step when modeling a derivation or forgetting to mention a concept—was a part of teaching and being in a learning community.

Students appreciated when you corrected yourself and/or accepted students' corrections/feedback in class. One noted that when you went over equations and explained where you made a mistake, he learned where one might become confused and was able to not fall into that same trap. Other students appreciated your honesty and that you didn't seem to "need to be right" all the time. They noted that made you more approachable and it was therefore easier for them to ask questions or speak up about their confusion.

Desika had been worried that if he miswrote something or made a small mistake while deriving an equation in class, students would find it confusing and potentially frustrating. Instead, we found, and Sophia was able to share, that this made space for students to more deeply understand and created a community in which mistakes happen and can be fixed.

### **Building Inclusion through Participation and Community**

We came into this partnership informed by our shared experiences of not always feeling comfortable in STEM classrooms. Sophia is a woman who thought maybe she "just wasn't a math person," and Desika faced stumbling blocks in classes where the professor seemed to think this should come easily and naturally. Our partnership allowed us to focus on not reproducing those same feelings of discomfort for any of the students in the class, but most especially for the women and students of color in the class who don't often see successful examples of themselves in physics classrooms.

Our process wasn't particularly scientific. We experimented with many small efforts to build community: using students' names regularly, asking students to move around and meet new peers, frequently changing how students were grouped and encouraging productive group dynamics, encouraging the development of study groups outside of class, regularly checking in with students for feedback, and asking struggling students to meet one-on-one. Women and students of color were underrepresented in both of the semesters we partnered together, but we were thrilled

to see that many continued in the field following their experiences in these classes.

As an example, in the fall class we taught, we had a *100% retention rate* into the subsequent spring semester course. This course had twelve students, of whom four identified as women and five were people of color (totaling seven underrepresented minority students, accounting for intersectionality). Of those twelve students, seven have gone on to graduate school in a STEM field, and of those, four are underrepresented minorities. These are nearly identical statistics—58% of the students enrolled were underrepresented minorities, while 57% of the students who went to graduate school were underrepresented minorities. Given the “leaky pipeline” in STEM fields (a phenomenon in which a regular fraction of women and students of color leave the field at every juncture, for example from undergraduate school to graduate school or graduate school to postdoc; see Dubois-Shaik and Fusulier 2015; Flaherty 2018), even maintaining constant numbers is a success. We attribute much of this success to the various techniques that we employed to increase clarity and energy. A beneficial consequence of these techniques was the increased participation and broader empowerment in the sciences of underrepresented minorities. While this is a small sample in formal terms, it’s huge for those four students who were so inspired in that first class they decided to make this their disciplinary home.

### **Final Reflection**

**Sophia:** Our partnership was one of hope and joy. I still remember a particular class in which Desika discussed black hole formation, and while I’m not a physicist by any means, I’m far more comfortable and enthusiastic now being a casual consumer of scientific research and work. Finally, I’m inspired by the many ways Desika opened his process up to examination and change, and I often give examples drawn from this partnership in my work with other faculty.

**Desika:** I view this partnership as simply transformative for my pedagogical style. I grew up in large university systems (and continue to teach in one) where the style was often combative between students

and professors. This partnership taught me how to approach lectures with particular care toward increasing clarity and energy, which has the effect of deepening the in-class relationship between me and the students. At the same time, I have been encouraged by the efficacy of these methods in broadening participation and retention of underrepresented minorities in the field. The viewpoints provided by a student partner in the room, which generated both “general feeling/energy,” as well as quantitative evidence of the impact of different pedagogical techniques, were critical to shaping my view of the student-professor relationship in the classroom.

### Reflection Questions for Readers

- How can small moments instill a sense of belonging in the classroom and in a partnership?
- What factors have affected your sense of belonging in higher education? What steps can you take (from your position) to positively instill that sense of belonging in others?
- How have classroom activities affected your sense of enthusiasm in a class?

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