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How Teacher Questions Affect the Development of a  
Potential Hybrid Space in a Classroom  
with Latina/o Students

Casandra Helen Job

A thesis submitted to the faculty of  
Brigham Young University  
in partial fulfillment of the requirements for the degree of  
Master of Arts

Kate R. Johnson, Chair  
Daniel Siebert  
Steven R. Williams

Department of Mathematics Education  
Brigham Young University

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## ABSTRACT

### How Teacher Questions Affect the Development of a Potential Hybrid Space in a Classroom with Latina/o Students

Casandra Helen Job  
Department of Mathematics Education, BYU  
Master of Arts

Questions have been shown to aid in student understanding of mathematics, particularly “novel” questions (Mesa, Celis, & Lande, 2013) that do not have a predetermined answer. However, students do not always understand what is intended by questions posed by teachers, particularly those students who come from different cultural and lingual backgrounds than those dominant in the classroom discourse. This project investigated the relationship between how a mathematics teacher acknowledged students funds of knowledge in her questions and how Latina/o students responded. It shows some research based questioning techniques that allow Latina/o students greater opportunity to participate in the mathematical problem-solving process and how resulting classroom experience shows evidence of progression toward a hybrid space, as well as factors that limited progression toward a hybrid space. These results yield implications for English-speaking teachers instructing students who are bilingual in English and Spanish at varying degrees of proficiency.

Keywords: mathematics education, hybrid space, third space, discourse, Discourse, Latinas/os, teacher questions

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## CHAPTER 1: INTRODUCTION

Latina/o<sup>1</sup> students in the United States, even those whose families have been in the United States for generations, have historically been shown to underperform non-Hispanic Whites in mathematics. There have been periods of time when the use of Spanish in schools was forbidden and Latina/o culture was ignored. Latinas/os are the largest minority population in the United States (Lopez, Passel, & Rohal, 2015), and yet, they have the lowest standardized test scores (Varley Gutierrez, Willey, & Khisty, 2011). The fact that Latinas/os have the *lowest* standardized test scores indicates either an achievement gap (Haycock, 2001) or an opportunity gap (Flores, 2007; Ladson-Billings, 2006; Gutstein, 2006) that needs to be addressed. The lower test scores for Latina/o students may be accounted for by differences in language and discourse (MacGregor & Price, 1999). Teaching methods that address differences in language and culture need to be developed and used in classrooms so that there are equitable learning opportunities for Latinas/os. Although not all teachers of Latinas/os speak Spanish fluently, all teachers can adjust their discourse in English to better accommodate the lingual and cultural differences of their native Spanish-speaking students.

My personal grade school experience was that of a White, monolingual, English speaker in the rural part of the Willamette Valley, Oregon, U.S.A. At my school, about 98% of teachers were white and 50% of students were Latinas/os. I grew up comfortably in classes that were taught entirely in English, and ignored the 35% of my classes that were English Language

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<sup>1</sup>For the purposes of this study, I define Latinas/os as individuals whose ancestry comes from Central American countries who have varying levels of Spanish and English proficiency. They engage in Latin American cultural traditions and at least some Spanish is used at home. I use “Latinas/os” rather than other referents for this ethnic group because it mirrors common language used by those who identify as Latina or Latino, and does not obscure those who are not male, unlike “Latinos,” while still staying true to the linguistic gendered nature of Spanish.

Learners whose first language was Spanish. My school had limited language resources, and teachers who had emerging bilinguals in their classes necessarily had to develop their own pedagogical strategies for teaching Latina/o students. As I progressed to honors classes, the demographic of my classes grew more and more White. I drew from my grade school experience as motivation for the design of this study in order to better support Latinas/os in schools with White, English, monolingual teachers, though this study may also be used as a resource for bilingual teachers of Latina/o students.

When I graduated from college as a newly licensed teacher, I taught mathematics at a middle school with a 58% Latina/o population. I had minored in Spanish Education, and spoke conversational Spanish. I drew from my experiences with my sister-in-law's family, who were from Mexico, to relate to my Latina/o students. However, I still lacked understanding of their cultural practices and home discourses. Later, I also had the unique opportunity to teach Latina/o adults, children, and families in their homes. Consequently, I have developed a greater understanding of the differences between cultural customs and norms between non-Hispanic White Americans and Latinas/os, as well as how those differences are signaled in language use.

Through my experiences, I learned implicitly the difference between simply knowing the words of a language and knowing the connotations of those words, when to say them, what is polite in a different culture, and so on. Gee (1989) distinguishes between discourse, the words that a person says, and Discourse, the actions, values, and identities that a person of a particular group ascribes to themselves. Knowing that *adios* means "goodbye" in Spanish is one thing, but only saying *adios* when someone appears to be leaving for good or on a long trip, and *hasta luego* [until then] or *nos vemos* [see you later] in the majority of situations is a subtle discourse difference. It distinguishes those who have developed fluency in a Latina/o Discourse and those who have not. In further Latina/o Discourse, one learns that not only is it more appropriate to say

*hasta luego*, but it is also generally expected that the person leaving say goodbye to each individual in the gathering, giving them each a salutation by handshake, hug, or kiss, as is acceptable within the group. This distinguishing feature of the Discourse immediately identifies individuals who know how to appropriately participate in Latina/o Discourse as polite and those who do not know how to appropriately participate as either impolite or *gringas/os*. Similarly, in other Discourses, those who do not know how to engage in the group dynamics through distinguishing features of the Discourse are left out of the Discourse.

In academic Discourse, such distinguishing features can serve as gates, excluding those who have not yet learned the Discourse from academic opportunity (Gee, 1989). These gates can be diminished through the creation of hybrid spaces, which allow student discourses and Discourses to take more of a position of power (Moje et al., 2004). One way to make academic Discourse more accessible to students is through changing teacher discourse and the Discourses that that language use favors. Language use has been shown to be of supreme importance in mathematics education (Cuevas, 1984; Shreyar, Zolkower, & Pérez, 2009; Mesa et al., 2013). Language use, i.e. discourse, is one major way teachers communicate with students and the means by which students explore, justify, and reason in their mathematical work. Although language use does not encompass an entire Discourse, it cannot be separated from it. Many key differences between Discourses are evidenced in language. Values and ideas are communicated through discourse and the actions and intentions that accompany it.

The argument may be presented that adjusting discourse patterns in the classroom will not allow students to learn the Discourses of conventional mathematics or standardized tests. However, the current school Discourse patterns have been shown to create a gateway that precludes entry into school mathematics for certain students (Jorgensen, 2012; Gee, 1989). If students cannot even enter the discipline, they certainly will not learn the Discourse of

mathematics or standardized tests. An intermediate Discourse could offer students an opportunity to enter into the classroom Discourse and then be challenged and moved toward the Discourse of the field of mathematics. One significant component of classroom discourse is the types of questions teachers ask (Boaler & Brodie, 2004).

Questioning techniques differ between cultures. Lemke (1990) explored the use of the Initiate, Response, Feedback model of teacher questioning and found that, while middle class students understood the protocol, working class students did not, and class discussion was not as productive for working class students. Working class students were also unaccustomed to hearing rhetorical questions or questions used as directions. Thus, when such questions were posed in the classroom, they did not know how to respond. Jorgensen (2012) illustrated that aboriginal students found it odd that teachers pose questions to which they already knew the answers. In most cultures and languages, there are different uses for questions and commands and different ways to exact them. Yes-or-no questions in Spanish, for example, lack “Do you . . .?” Or “Did you . . .?” and indicate by the tone of voice that the verbalization is a question. For example, “Do you want to come over?” becomes “you want to come over?” in Spanish; contrarily, in English, the lack of “Do you” indicates informality or casual conversation. Additionally, Spanish speakers, rather than use future tense as seen in English, questions like, “Will you call me?”, will use the simpler present tense to indicate intent of a future action, “You call me?” Such lingual differences may cause difficulties of interpretation in the classroom setting. Many Latina/o students are in a low socioeconomic class, which can also contribute to their confusion at questions used in school, which tend to favor the middle class. Part of my study’s purpose was to identify questioning techniques that would be more effective for Latina/o students. More specifically, I started this study with the goal to find patterns in how verbal questions, directives, and descriptions of tasks were posed in such a way that supported Latina/o

students' ability to participate in the academic Discourses of the mathematics classroom by leading toward the creation of a hybrid space.

## CHAPTER 2: BACKGROUND

### Literature Review

Much effort has been done to research ways to better support Latinas/os. Below I elaborate efforts made to support all English Language Learners (e.g. Echevarría, Vogt, & Short, 2004), efforts to support Latinas/os with bilingual programs and bilingual teachers (e.g. Khisty & Chval, 2002; LópezLeiva & Khisty, 2014; Varley Gutierrez et al., 2011), and a culturally relevant way to teach and learn mathematics (Gutstein, 2003; Gutstein et al., 1997). Then, I draw from studies where an intermediate Discourse, or hybrid space, was created by acknowledging students' Discourses to better apprentice students in the classroom Discourse (Calabrese Barton & Tan, 2009; Cribbs & Linder, 2013) to outline a framework for creating a hybrid space with Latina/o students in a mathematics classroom.

Some researchers and educators strive to better support *all* English Language Learners, regardless of their native language, learn English better. Models exist to aid English-speaking teachers who seek to make their teaching accessible to English Language Learners (e.g. Echevarría, et al., 2004; Fisher et al., 2007). These models seek to give teachers versatile tools that are designed to support all learners of mathematics, including those whose native language is English. Some strategies include graphic organizers, word walls, and teacher modeling. These methods are research based and widely used. However, in the United States, Latinas/os are the largest minority population (Lopez, Passel, & Rohal, 2015), and it follows that the second most spoken language after English is Spanish (Central Intelligence Agency, 2017). Although demographics of classrooms vary, there are many classrooms where most students who are learning English speak Spanish as their native language. Teachers, then, should adjust their teaching to specifically benefit those students that they teach, and in those cases, should specifically address the needs of those whose first language is Spanish. Then they can address

their students according to the discourses and Discourses they bring into the classroom, rather than those in which they are *not* fluent.

Advocates for mathematics reform have also sought to promote equitable learning with general guidelines. One of the principles elaborated in *Principles and Standards for School Mathematics* is that of equity, which entails “high expectations and strong support for all students” (NCTM, 2000, p. 12). NCTM also provides general guidelines such as giving additional attention to those speak English as a second language, providing text and assessment materials in other languages, and responding to students’ prior knowledge. Reform instructional methods tend to include more student group work, class discussion, informal reasoning, and mathematical exploration. However, specific recommendations to address the needs of Latinas/os should not be developed from those general guidelines (Moschkovich, 1999); more research that specifically focuses on the language needs and cultural knowledge of Latina/o students is needed (Moschkovich, 1999).

Bilingual programs, an alternative option, have the advantage of addressing Spanish-speaking English Language Learners in their native language to support their learning English, while also providing support for students to be able to learn academic Spanish. My nephews, who are half Mexican, have been participants in bilingual elementary school programs, and they are able to read and write in both Spanish and English, though they rarely choose to speak in Spanish. Research shows that people who speak multiple languages are able to draw from their knowledge of with multiple languages at the same time (Lewis, Jones, & Baker, 2012), and an ideal bilingual program would be able to have students switch seamlessly between languages during written tasks and classroom discussions (Lewis et al., 2012). Even adult bilingual speakers usually have a preferred language for performing arithmetic operations, so students should be permitted to switch languages when performing computation (Moschkovich, 2007).

These points show that allowing the use of both English and Spanish is beneficial to bilingual student learning.

These advantages of bilingual programs were particularly evidenced in research studies where students were not only able to speak and learn in Spanish but were also able to use their cultural knowledge to better learn mathematics and fight injustices that exist toward Latinas/os. These programs addressed both the discourses and Discourses known by Latina/o students. In one such study by Varley Gutiérrez, Willey, and Khisty (2011), the researchers created a bilingual afterschool program in which Latina/o students explored mathematics through community-based activities. Students were able to communicate with program facilitators and in their small groups in both English and Spanish. In this different environment, students proposed ideas for how to use statistics to enact change around their communities which provided a stark contrast from their normal school experiences. Students were exposed to new ways to visualize and learn mathematics. Similar advantages were seen in a bilingual afterschool program in a study by LópezLeiva and Khisty (2014), where students who were able to communicate in both English and Spanish were empowered to learn and do mathematics; however, power was still associated with the English language in some groups by adults and students alike, positioning students who were uncomfortable with English as less capable. Such positioning can be avoided through intentional, culturally relevant teaching, but it takes work.

Other studies focus on incorporating knowledge of Mexican-American culture into the teaching of mathematics. In particular, Gutstein, Lipman, Hernandez, and de los Reyes (1997) provide anecdotes of a study of various teachers in bilingual classrooms in a school where 99% of students were Latino and 96% were Mexican American, most of whom were either first generation Americans with parents who immigrated from Mexico or Mexican immigrants themselves. Through the cases provided, Gutstein and his colleagues outline key principles



required for culturally relevant teaching. Teachers must achieve solidarity with their students and their students' families, see Latina/o culture clearly, and continually aim to challenge their students. Culturally relevant teaching addresses the specific Discourse differences of Latina/o students and provides them with more equitable learning opportunities. Similar studies have also been done with African-American students (Ladson-Billings, 1995; Tate, 1995).

Although these principles provide excellent guidelines for teachers, unless a teacher already has baseline knowledge of the culture and heritage of Latina/o students, these principles are difficult to apply. The examples used in Gutstein et al.'s work highlight the work of bilingual teachers, already familiar with the Discourses of their students. Without specific guidelines for how to frame classroom discussions and what real-life examples a teacher should use, those who currently lack cultural knowledge of their students are left wanting to change their teaching, but with few resources. Willey, Gatzka, and Flessner (2017) share a case study of a White, monolingual teacher's struggle to engage an emerging bilingual student in classroom work. Uncomfortable trying to communicate with a student whose native language was Spanish, she pushed much of the burden of translation between discourses to his bilingual table-mates, and consequently, he could not participate in the classroom for weeks. This situation is not unique; 88% of the nation's teachers are White (Ladson-Billings, 2005). White, monolingual teachers need pedagogical resources to be able to effectively support their Latina/o students.

However, I found principles for how to acknowledge student Discourses in Gutstein's work (1997, 2003) and Khisty and Chval's work (2002) that would be useful for monolingual teachers. Though not bilingual nor Latino, Gutstein welcomes student Discourses into the classroom by having them mathematically investigate issues that affect them, such as wealth distribution and the biases shown in map projections (Gutstein, 2003). Khisty and Chval (2002) outline how a bilingual teacher models mathematical talk and has her bilingual students make

connections between their discourse and mathematical discourse. My study addresses how a monolingual teacher might use these principles and others in their questions to allow for the creation of a hybrid space in their classroom with Latina/o students.

A “hybrid space,” or “third space” is the combination of a “first space” or primary Discourse and a “second space” or secondary Discourse, or Discourse to be learned, into one space where neither is preferred over the other (Moje et al., 2004; Gutierrez, Baquedano-López & Tejeda, 1999). In a hybrid space in the classroom, a teacher makes use of students’ “funds of knowledge,” (Calabrese Barton & Tan, 2009; Hogg, 2011) or strategic knowledge students have acquired from other sources, such as friends, family, and popular culture, to adapt the classroom Discourses for the students’ learning. I consider these funds to include not only facts, but also practices and beliefs—items incorporated by student Discourses.

The creation of a hybrid space has been beneficial in supporting students to participate more and perform better in classroom evaluations (Calabrese Barton & Tan, 2009). In classrooms where a hybrid space was present, students were able to draw from experiences from their families to make connections with science content they were learning (Calabrese Barton & Tan, 2009) and the mathematical concept of measurement (Cribbs & Linder, 2013). In the transformational hybrid space present in Calabrese Barton and Tan’s study (2009), students benefited from having more power in the classroom and from having more diverse roles in classroom learning. Over time, students in classrooms that are hybrid spaces are also more likely to show higher motivation than other students (Cribbs & Linder, 2013).

Teachers spur the creation of hybrid spaces through acknowledging students’ funds of knowledge (Moje et al., 2004). As I extrapolated from the studies done by Calabrese Barton and Tan (2009) and Cribbs and Linder (2013), teachers acknowledge student funds of knowledge when they: 1) ask higher level questions and allow students to grapple with them; 2) provide

ways for students to use prior experiences as scaffolding for future experiences; 3) allow students to use peers for additional explanation or exploration; 4) have students utilize outside resources such as their family, friends, or the internet and make it a key part of the class; and 5) set student authority higher in the classroom. The consistent implementation of these strategies allows for the potential creation of a hybrid space.

Evidence that teachers are successfully acknowledging students' funds of knowledge and the class is moving toward the creation of a successful hybrid space follows a similar fashion. Students in a successful hybrid space 1) grapple with higher level questions and actively participate, 2) use their prior experiences and connect them to classroom content and Discourse, 3) explain concepts to their classmates and learn from their peers, 4) use outside resources such as their family, friends, or the internet as a key part of class, and 5) have more authority in the classroom. I will elaborate specifically how each of these teacher and student actions exhibit themselves in the next section.

### **Theoretical Framework**

Seeking a way to analyze how English-speaking teachers, who know little Spanish and little about Latin American culture, can improve the participation and success of their students, I draw from the "third space" or "hybrid space" framework as defined by Moje et al. (2004). A third space is created by merging a "first space" and a "second space," theoretical spaces in which certain distinct actions, beliefs, language, and attitudes, i.e. Discourses, are favored. In school settings, more traditional academic Discourses are usually favored, with a discourse dominated by academic English. The third space provides an environment in which neither students' primary or home Discourse, nor the academic Discourse is given preferential treatment, but funds of knowledge from all participants are acknowledged and used (Moje et al., 2004). In

the third space framework, students are able to use the Discourse in which they already are fluent in conjunction with a second, perhaps more privileged Discourse.

I find the lens of third space to be advantageous because it acknowledges that all participants within have Discourse practices and funds of knowledge that might not be held by others in the space. In other frameworks dealing specifically with multilingual situations, the teacher is generally assumed to be able to enter the same Discourses as the students and be proficient in those Discourses (e.g. Lewis, Jones, & Baker, 2012). The third space framework acknowledges that students may engage in practices of Discourse that the teacher does not. It is important that other discourses and Discourses are acknowledged in the classroom space, as it has been shown that bilingual students think in and draw from both languages they know, even when they are not speaking them (Hoshino & Thierry, 2011; Thierry & Wu, 2007; Wu & Thierry, 2010, as cited in Lewis et al., 2012).

Although I find the lens of third space to be advantageous to my study, it must be carefully defined in order to be useful. As noted by Moje et. al (2004), there are three main views of a third space, which all highlight different aspects of the combination of Discourses. The first view is that of a transitional space which is thought of as a bridge from students' non-academic Discourses to academic knowledges and Discourses. The goal of this transitional third space is to prepare students to be successful in the traditional schooling atmosphere. The second view is that of a navigational third or hybrid space, a space in which those present can navigate between Discourses and identify connections between them. The third view is that of a transformative third space. As seen in Calabrese Barton and Tan's (2009) work, a transformative third space has the potential to change what knowledge is valued and change the very knowledge that is learned, as well as transform a classroom physically, pedagogically, and politically.

For the purposes of my study, I focus mainly on a transitional hybrid space, that is, a hybrid space where students can bridge *from* their primary Discourse *to* the academic mathematical Discourse of the classroom. I focus on this view of a hybrid space for two reasons. First, a transitional hybrid space focuses on enabling students to participate in school Discourses. If the goal is to provide more marginalized students opportunities, in the current climate of United States' education, those marginalized students must be able to participate in current academic Discourse. While I do not agree that current academic Discourse is necessarily the most correct Discourse and values the most useful knowledge, traditional school Discourse is that which is currently valued in the nation's educational and professional systems. Second, in the short two week span I had to perform my study, a transitional hybrid space is the one I would most likely be able to view. A navigational hybrid space requires at least bi-directional travel between academic and primary Discourse, so it would require more time to be able to evaluate conditions and identify. A transformative hybrid space requires not only bi-directional travel, but the *changing* of knowledge, a change which may require more time to create or evidence. Thus, for practical reasons, I employ the transitional view of a hybrid space.

Funds of knowledge are frequently referred to in the third space framework. Funds of knowledge include the beliefs, actions, and practices that form individuals' Discourses (Calabrese Barton & Tan, 2009; Gonzalez & Moll, 2002; Moll & Greenberg, 1990) They are strategic knowledge students have acquired from other sources, such as friends, family, and popular culture (Hogg, 2011; Calabrese Barton & Tan, 2009; Cribbs & Linder, 2013). Cribbs and Linder (2013) adopted two general categories for funds of knowledge from Calabrese Barton and Tan (2009): peer funds of knowledge and family funds of knowledge. From their family funds, students bring their experiences, familiarity with certain materials, ideas and cultural traditions as well as the discourse of more informal Spanish. From their peer funds, they receive peer

assistance as well as communication and interactions in informal English. These funds contribute to how students make sense of interactions and mathematical practices in the classroom.

### **Teacher Actions**

As noted previously, a review of the research on hybrid spaces (Cribbs & Linder, 2013; Calabrese Barton & Tan, 2009; Moje et al., 2001; Moje et al., 2004; Gutierrez, Rhymes, & Larsen, 1995) yielded a list of pedagogical actions that allow for the development of a hybrid space. An aspect of this study was to focus on how teacher questions and directives, guided by this research-based framework, contribute to the development of a hybrid space. Particularly, teachers acknowledge student funds of knowledge, and in turn, promote the creation of a hybrid space when they:

- 1) Ask higher level questions and allow students to grapple with them;
- 2) Provide ways for students to use prior experiences as scaffolding for future experiences;
- 3) Allow students to use peers for additional explanation or exploration;
- 4) Have students utilize outside resources such as their family, friends, or the internet and make it a key part of the class; and
- 5) Set student authority higher in the classroom.

Each of the above acknowledges funds of knowledge which students already have. For example, when students are allowed to use peers for additional explanation and can help their peers, they can speak in a Discourse in which they already understand the interactions, and also be apprenticed or apprentice others into the classroom Discourse through peer resources. I clarify each of these five points below.

Teachers promote the creation of a hybrid space when they ask higher level questions and allow students to grapple with them. Higher level questions, or novel questions (Mesa et al.,

2013), are questions require that students to reason and justify their conclusions or engage in a problem that they do not yet know how to solve. Calabrese Barton and Tan (2009) quoted teacher questions that focused on application to students' lives, as well as questions that asked for student reasoning behind decisions. If there are a lot more lower level questions than higher level questions, the ability for students to be able to use and apply their prior knowledge is limited, and teachers funnel students toward an answer. If teachers answer their own questions, they do not allow for the use of students' funds of knowledge and Discourse with the use of that question. I will account for this element in my analysis, because if there are a limited number of novel questions, then the teacher is not acknowledging student funds of knowledge in this way.

Second, when teachers provide ways for students to use prior experiences as scaffolding for future experiences, they ask for students' prior experiences and follow up on them when students mention them. Teachers use those prior experiences (Calabrese Barton & Tan, 2009) as a backdrop for their lessons and tasks. In a science classroom where a teacher was attempting to address student funds of knowledge, the inadequate use of student prior knowledge was a major setback to the creation of a hybrid space (Moje et al., 2001). Moje et al. suggested that, in their specific classroom study, perhaps more follow-up on student experiences shared, or having students write about their lived experiences would have been more fruitful in the successful merging of Discourses. Questions that indicate that teachers are using students' prior experiences would reflect that teachers are following up on students' prior knowledge expressed, inquiring after student knowledge, or referring to a common experience held by the general population. For example, in the study performed by Cribbs & Linder (2013), during a lesson on capacity, the teacher asked "Where have you seen pounds and ounces used?" Teachers may also use what students have expressed as a lead-in to a question.

Next, teachers acknowledge student funds of knowledge when they allow students to use peers for additional explanation or exploration—meaning that the classroom is set up in such a manner that students will clarify and compare their ideas with their peers. Students develop a support system (Calabrese Barton & Tan, 2009) and see classwork as a team effort rather than just an individual one. Students are able to explain concepts to each other when there is misunderstanding (Cribbs & Linder, 2013.). Teachers would show this in their questions by referring to peers and groups as the entity to which the question is addressed or by deliberately asking students to work together, compare answers, or build off of the answers of others.

Teachers who acknowledge student funds of knowledge have students utilize outside resources such as their family, friends, or the internet and make it a key part of class. Therefore, assignments could incorporate students asking their family members or people they know, or investigating concepts using the internet. In Calabrese Barton and Tan's (2009) study, for example, students shared family recipes in a science unit on nutrition. In another study (Cribbs & Linder, 2013), the teacher had students talk about capacity by bringing in objects and containers with which the students were already familiar. Outside sources are not limited to that listed above, but could include physical materials, television, newspapers, or any fund of knowledge with which students regularly come into contact. If it is an outside resource, but not one with which *students* come into contact, then it is not acknowledging *students'* funds of knowledge and Discourses, but rather other funds of knowledge and Discourses that exist. Introducing multiple Discourses simultaneously in which students are not fluent is counterproductive and confusing to students, as indicated by Moje et al. (2001). Rather than a mere sideshow, building off of student use of their outside resources needs to be a regular part of classroom assignments. Teacher questions of this category would indicate reference to class-initiated use of outside resources for knowledge. The difference between having students use outside resources and the first method



mentioned, providing ways for students to use their prior experiences as scaffolding, is that the use of outside resources and experiences outside of class is initiated by the teacher and classroom assignments rather than already present in students' normal everyday experiences. The teacher provides students the opportunity to delve deeper in their funds of knowledge and Discourses to create experiences that connect to classroom content.

Lastly, a hybrid space cannot be created unless teachers set student authority higher in the classroom. A teacher maintaining his or her authority can create a roadblock to creating a hybrid space (Moje et al., 2001). Rather than the teacher being the sole authority in the classroom as to whether mathematics is correct, the teacher shares authority with students. Student input is vital to the evaluation of mathematical reasoning and task execution. In Calabrese Barton and Tan's study (2009), students were even included in the unit planning process. In a hybrid space, there are more student turns than teacher turns in classroom discussion. A teacher would give student authority a higher place in her classroom with her questions by turning student questions over to the class, asking for student reasoning rather than explaining points herself, and using student input in her directions.

### **Student Responses**

While teachers may intend to create a hybrid space by their question framing and actions in the classroom, their level of success is determined by the resultant responses of students and the resultant classroom atmosphere (Calabrese Barton & Tan, 2009). Students must show comfort and power in the classroom, and use their own Discourses as well as engage in academic Discourse. Thus, to identify a hybrid space, student responses to teacher questions that indicate a hybrid space must also be defined. I develop a framework for student actions in classrooms with hybrid spaces based on the accounts from Calabrese Barton and Tan (2009); Cribbs and Linder

(2013); Moje et al. (2001); Moje et al. (2004); and Gutierrez, Rymes, and Larson (1995). In a classroom developing toward a successful hybrid space, students:

- 1) Grapple with higher level questions and actively participate,
- 2) Use their prior experiences and connect them to classroom content and Discourse,
- 3) Explain concepts to their classmates and learn from their peers,
- 4) Use outside resources such as family, friends, or the internet as a key part of class, and
- 5) Have more authority in the classroom.

These student action items naturally follow from the guidelines for teachers listed above, because all teacher guidelines refer to some intended outcome for students. I focus on these particular items because when students and teachers work toward these, power differentials are changed, and students have a greater ability to engage in multiple Discourses. I detail what corresponding student responses to teacher questions are for each of the five points below.

First, when students are engaged in a successful hybrid space, they grapple with higher level questions and actively participate in mathematics. Calabrese Barton and Tan (2009) showed that students in a science classroom in which a hybrid space was present participated more willingly, turned in more homework, and performed better on unit tests. Higher level, or novel questions (Mesa et al., 2013), ask students to perform tasks they do not already know how to approach or ask students to explain their reasoning. Students engaged in a hybrid space where such questioning techniques are present more readily provide reasoning behind their decisions and grapple with the questions asked by the teacher. Students will ask novel questions of their own. If there is not a proper merging of Discourses in the classroom, or the students are unaccustomed to higher level questions, students will be more unlikely to actually engage in answering the higher-level questions posed by the teacher. Similarly, if a teacher aims to ask a higher-level question, but students do not understand the discourse enough to engage in

answering it or the teacher answers it themselves, the question does not contribute to the development of a hybrid space.

Second, students in a hybrid space use their prior experiences and connect them to classroom content and Discourse. If teachers who try to acknowledge student funds of knowledge seek after and build upon students' prior knowledge and experiences, students in a hybrid space then use those prior experiences to respond to teacher questions and engage in classroom tasks. They would readily draw upon experience to help them with tasks and to explain their thinking (Cribbs & Linder, 2013; Calabrese Barton & Tan, 2009). The connection to classroom Discourse is key, because, as evidenced by Gutierrez et al. (1995), frequently students and teachers engage in different discourses, where students dwell in the realm of their experience, but do not use it when engaging in discourse with the teacher. It is not enough for students to share their personal experiences in class, but they must be able to use those personal experiences to shape and grow their understanding of mathematics.

Next, students explain concepts to their classmates and learn from their peers in a hybrid space. Students not only interact with their peers, but develop solidarity with their peers and form a support group (Calabrese Barton & Tan, 2009). Students show concern for other students' academic success (Cribbs & Linder, 2013) and success in general. Students respond to teacher questions and directives as a team effort, and willingly include other students in their mathematical activity.

Students in a classroom with a successful hybrid space use outside resources such as family, friends, or the internet as a key part of class. Not only would they do so at their teacher's request, but they would come up with additional ideas to be able to bring in outside resources to contribute to classroom ideas. In Calabrese Barton and Tan's study (2009), students were eager to bring more resources for a school nutrition unit and parents also got more involved. Students

would use outside resources such as friends, the internet, and their families as additional means to increase their learning. In a developing hybrid space, I looked for students actually using funds of knowledge they had access to in response to teacher questions and directives. They might be using the internet to look up information and resources, asking their parents for personal information, using materials from home, etc. They use their outside resources as their teacher directs, but also find additional ways to answer teacher questions using their outside resources on their own.

Additionally, in a productive hybrid space, students would have more authority in the classroom. The classroom is student focused, rather than teacher focused (Gutierrez et al. 1995), and there are more student turns than teacher turns (e.g. Cribbs & Linder, 2013). Not only are students active participants in the classroom, but students can influence executive decisions in the classroom by contributing to unit and assignment decisions (Calabrese Barton & Tan, 2009). Students question and argue about what is valid practice in the discipline (Moje et al., 2004). Students participate in class freely (Calabrese Barton & Tan, 2009), and have higher levels of motivation (Cribbs & Linder, 2009). As discussed earlier, students would be mathematical authorities, and determine what is correct mathematically through their own reasoning. Students would also have greater authority in the classroom itself.

In all points of evidence, in order for a hybrid space to be considered successful in this study, it must be mathematically and educationally productive. In order to truly be a bridge between Discourses, students must engage in more academic Discourse than that in which they are already currently fluent. In a mathematics classroom, students, then, should become more comfortable with new mathematical language and text and do more advanced mathematical activity. An example of a more advanced progression in academics by progressing through a third, or hybrid space, comes from Wallace (2004) who cited students as using more scientific

language with their own to describe new phenomena. As they entered the hybrid space, students were able to describe with more scientific vocabulary phenomena they had previously not been able to describe. In a mathematics classroom, students would exhibit some sort of progression in their mathematical vocabulary and what mathematical activities they could perform (e.g. justifying, providing evidence, performing operations) by progressing in and through a hybrid space. Thus, in order to justify the presence of a hybrid space, some mathematical productivity must be observed. If students respond in some of the five ways mentioned earlier, but do not progress in their use of mathematical Discourse, there is not a transitional hybrid space present.

### **Research Question**

Having elaborated the lens through which I plan to investigate teacher questions and the resulting student responses, my research question is as follows:

- In what ways do teacher actions acknowledging student funds of knowledge and Discourses according to a research-based framework allow for the development of a potential hybrid space in a mathematics classroom including Latina/o students?

## CHAPTER 3: METHODS

### Participants and Data Collection

My study took place in a suburban middle school classroom located in the Rocky Mountain West. I observed one 8<sup>th</sup> grade 45-minute class period over the course of two consecutive weeks, through the entire unit on transformations which lasted eleven days. Out of those two weeks, I chose not to include the days the teacher reviewed material, because the material covered was very routine. This resulted in 9 days of recorded data to analyze. I recorded data with a video camera set up in the back of the classroom, an audio recorder in the middle of the classroom, and a notebook in which I recorded field notes. I also wrote down brief field notes of conversations I held with the classroom teacher after class.

To choose the participant teacher, I contacted principals of nearby middle schools that had a Latina/o student population of at least 20% of the total student body and asked for recommendations for teachers who would be willing to participate in my study who exemplified good teaching. Ms. Abbott was recommended by her principal as someone I could observe. Ms. Abbott had been teaching for 6 years, had received a master's degree in the field of education, and was familiar with the research process. She expressed a desire to support her Latina/o students in her mathematics classroom. I observed one of her 8<sup>th</sup> grade math classes, in which 8 out of 17 students were ELLs whose first language was Spanish. Two of the Latina/o students did not consent to be digitally recorded. One of whom stated that her contributions could be written down, but all the contributions of those two students were edited out of the video and audio data.

My role as participant researcher was mainly to record classroom activities. However, in order to ease my interpretation of data and to better understand classroom interactions, I went to students periodically, especially Latinas/os, to ask them questions about what they were working

on. Sometimes I just looked at what they had written down during individual work time in order to determine how they were responding to teacher questions. I was mostly an observer and interacted very little with students or the teacher in the classroom. I did not directly influence classroom instruction during class time, so as to be able to maintain the integrity of the space that is created by the teacher and students.

After a period of four days observing teacher questions and student responses in class, I suggested to the teacher that she extend student reasoning in order to see how students responded to higher-level questions. Throughout the rest of the research study, I complimented the teacher when she followed up on student questions or successfully referred to students' prior experiences. These actions served as a minor intervention to encourage the teacher to use the principles of creating a hybrid space.

### **Data Analysis**

In analyzing my data, I drew from Gee's discourse analysis (2011), by interrogating the transcribed classroom data through the lens of a hybrid space (Calabrese Barton & Tan, 2009; Cribbs & Linder, 2013; Moje et al., 2004; Gutierrez et al., 1995). Discourse analysis lent itself to my research question because, in order to find potential for a successful hybrid space, involving student Discourses as well as academic Discourses, I need to investigate the discourse and Discourses of the classroom in detail. I looked for indications that the teacher's questions lent to creating a potential hybrid space by evaluating teacher questions, namely, that the teacher:

- 1) Asked higher level questions and allowed students to grapple with them;
- 2) Provided ways for students to use prior experiences as scaffolding for future experiences;
- 3) Allowed students to use peers for additional explanation or exploration;

4) Had students utilize outside resources such as their family, friends, or the internet and made it a key part of the class; and

5) Set student authority higher in the classroom.

Similarly, I examined student responses for evidence that they:

1) Grappled with higher level questions and actively participated,

2) Used their prior experiences and connected them to classroom content and Discourse,

3) Explained concepts to their classmates and learned from their peers,

4) Used outside resources such as family, friends, and the internet, and

5) Had more authority in the classroom.

Below I outline the four phases of analysis I used to use my framework to interrogate my data.

In the first phase of analysis, I chunked the data into teacher questions and students' corresponding responses (the phases of analysis are summarized in Table 1). I defined questions according to the perceived intent of the teacher: if her speech indicated the expectation of a student response, whether verbal or non-verbal, then I coded that section of speech as a question. In general, longer sections of speech that ended with a question were coded as one question. I determined what questions corresponded with student responses usually by what question immediately preceded the response. It was different when a teacher was asking questions to one student during individual work and another student's response was coded. Then, that student's response was coded as correlating with the previous question the teacher had made to the class as a whole. Sometimes, students reacted to a question or statement that seemed rhetorical. In these cases, I coded the previous teacher statement or rhetorical question as being a question, because the students responded that way.



In the second phase of my analysis, I used the five points of how teachers acknowledge student funds of knowledge to interrogate the teacher questions. I looked at whether or not questions fit the first point by seeing if they were novel questions, meaning that they were not questions students already knew how to find the answer. Then, I continued through the rest of the five points by identifying if the teacher appeared to be 1) providing opportunities for students to use their prior experiences, 2) allowing and encouraging students to explain to and learn from their peers, 3) having students use outside resources and funds of knowledge, and 4) setting student authority higher in the classroom.

I used the following indications for whether or not I classified Ms. Abbott's questions as fulfilling each different way to acknowledge students' funds of knowledge.

The teacher's question indicated that she was providing opportunities for Latina/o students to use their prior knowledge if she followed up on an experience shared by the student or invited students to refer to their previous experience when exploring a mathematical principle. If referring to assumed academic knowledge based on standards, I did not code that the question contributed to a successful hybrid space in this way, because the question did not address students' nonacademic Discourses.

I coded that the teacher showed in her question that she was allowing and encouraging students to explain to and learn from their peers when her question invited students to do so. However, smaller items of discourse also indicated that the teacher was acknowledging students' peer funds of knowledge, like if she addressed students by their groups rather than by individuals, and if she were to use "we" and thus makes the classroom mathematics a collaborative effort, rather than a competitive one. As I coded, I also discovered that sometimes the teacher showed in her actions an enforcement of the expectation that students should help each other, like if she asked a student to help another student, and then walked away when the

student tried to ask her instead. Those instances were then also coded as an expectation of a response, or a question that invited students to work with their peers.

A teacher's questions indicated that she was having students use outside resources and funds of knowledge when she referred to use of outside resources for knowledge that was initiated during class, or when she invited students to use those outside sources for a task or assignment. Because students should encounter the mathematics in a way that corresponds with their non-academic Discourses, outside resources were to be ones that were actually used by the students. For example, if Ms. Abbott had students use a math website that she introduced to them to complete an assignment, she would not be having them use outside resources that correspond with their Discourses, but rather, her own. Textbooks were also not included.

In order for a question to be aimed at setting student authority higher in the classroom, the teacher must have, in some way, been referring to students as mathematical or classroom community authorities. She might have done this by having students explain answers to student questions, by referring to student input in classroom decisions, or by asking students for their input on classroom assignments. She might ask, "Is this valid? Why or why not? What do you think?" and have students elaborate their points. I also looked for instances where the teacher appeared to imply a classroom community decision, by, once again, using words like "we," or in some cases, "you guys." If she used "we," but implied a definite expectation of what she wanted students to do, that instance was not included as an attempt to bolster student authority. If she were to ask a question that she genuinely did not know the answer to, or convey a genuine curiosity to class, through the type of question and her tone, that would also set student authority higher in the classroom. Questions or directives where the teacher followed student prompts for conversation or student suggestions were also coded as setting student authority higher in the classroom.

With each teacher question and student response chunk, I indicated in my analysis which of the above the teacher appeared to be doing, as well as my justification why.

In the third phase, I turned to the student responses to see if what the student responses showed corresponded with what the teacher questions indicated the teacher was trying to do. If the teacher question, for example, showed that the teacher asked students to confer with their peers, but then students did not confer with their peers about the mathematical ideas, the attempt to acknowledge that fund of knowledge was unsuccessful. Ideally, teacher acknowledgement of student funds of knowledge in their questions would correlate with student actions indicating a successful hybrid space created on both ends.

To see if Latina/o students were sufficiently grappling with Ms. Abbott's novel questions. I looked for whether or not Latina/o students were actively participating in responding to her questions and directives. Students would show their participation through working to answer the question posed by the teacher and might even extend the question with their own novel questions. There were a couple instances where students asked their own novel questions without the teacher having asked a novel question, which I also coded in this category. Because student responses were sometimes limited in length, if they appeared to be genuinely trying to answer the teacher's higher-level question, even if they only spoke for a sentence, I coded their response as grappling with novel questions.

I coded that students showed they were using their prior experiences and connecting them to classroom content and Discourse when they readily drew upon their experiences to explain their thinking (Cribbs & Linder, 2013; Calabrese Barton & Tan, 2009). They responded to teacher invitations to use their prior experiences by doing so. They would connect their discourse and Discourse with that of academic mathematics and transition between the two accurately.

Because instances where students explicitly showed that they were connecting their Discourse to

classroom Discourse were limited, my codes ended up being broader—when students referred to prior experiences in class that still connected somehow to the classroom conversation, I coded that they were using their prior experiences. Then, after identifying all student responses that indicated one of the five ways of referring to funds of knowledge, I evaluated whether or not those instances as a whole appeared to contribute to students’ ability to connect to classroom Discourse.

When students were supportive of each others’ efforts in the classroom or explained concepts to their peers, I coded it as an instance of students relying on their peers. These instances showed up not only in students’ supporting each other in mathematics, but also in supporting each other to challenge consequences the teacher had given them.

Students showed they were using outside resources, such as their family, the internet, etc. when they took initiative to look for answers to mathematical questions using the outside resources and other funds of knowledge that they have. They would be using those outside resources effectively when they discovered useful answers to questions posed by the teacher from those outside resources.

Students’ responses were coded that they showed an increase of authority for various reasons. They would rely upon their own reasoning to determine mathematical validity and would help make decisions in the classroom. They would feel free to participate and would not “self-censor” (Calabrese Barton & Tan, 2009, p. 70). They would not ask such questions such as, “Am I right?” frequently and would not feel the need to be led throughout all of a problem. When students appeared to be more comfortable engaging with the mathematics in general, I coded it as an increase in student authority. In addition, if they were to give the teacher or the class as a whole a direction which was followed, that was also coded as an increase of student authority. Although weaker, when more students participated after a teacher questioned a

particular student's answer, I also included this in my data set of positive instances where students took on more authority in the classroom.

I initially started coding teacher questions first, then student responses, but then I moved to coding what each response showed chronologically. I chunked all the questions and Latina/o student responses in a lesson, then moved through and coded each question and each response as I read according to the criteria I described above for whether or not student funds of knowledge were addressed. I also found coding to be easier when I did not worry about which student response corresponded with a teacher question until after I had discovered that the teacher was acknowledging student funds of knowledge or that students were accessing their funds of knowledge. Thus, after I had found that a question acknowledged student funds of knowledge, I determined which student responses immediately correlated with that question. If I found that a student response showed that students were using their funds of knowledge, I would look toward questions that were previously occurred and determine which one best corresponded with that student question. This method was not entirely perfect, because sometimes student responses referred to what Ms. Abbott had said on a prior day, but it seemed to work well for most cases. I account for when Ms. Abbott said something that students referred to on later days in my results section. Out of my 9 days of transcribed data, I found 156 question-response pairings where either the teacher or one or more students referred to students' funds of knowledge.

In the final stage of analysis, I compared what Ms. Abbott tried to acknowledge with what students do to construct a hybrid space and looked for patterns as to when Ms. Abbott successfully acknowledged student funds of knowledge and when those funds were acknowledged in different ways than expected. To do this, I arranged all instances that positively matched one of the five points by either students or the teacher in a spreadsheet. I listed what the question was, which point(s) it addressed, why I coded that point as being addressed, what the

student response was, which point(s) it addressed, and why I coded that point as being addressed by the student response. Then I could search for a particular number (e.g. 3 for instances when the teacher invited students to rely upon peers) and look for patterns among the reasons as well as what student responses followed the teacher questions, and what the teacher questions appeared to do for students in order for students to evidence characteristics of a successful hybrid space. In this table, I re-evaluated all my codes to check that they were consistent with each other and with the definitions that I set forth in the previous paragraphs for each of the five ways of acknowledging or using student funds of knowledge. Those that appeared to stretch the definition too far (mostly questions that had appeared novel, but then looked like the teacher was expecting a certain answer) I eliminated from my analysis.

*Table 1.* An overview of the phases of data analysis

Phase of Analysis	Brief description of phase	Questions used to interrogate data
Phase 1	Chunk data into teacher question and student response pairings	Does the teacher's speech in this segment indicate an expectation of a student verbal or non-verbal response?  Which student responses are Latina/o student responses? Where do those responses begin and end?
Phase 2	Identify in which ways teacher questions are acknowledging student funds of knowledge	Is this teacher question or directive one that would be considered high level or novel?  Does this question:  Provide ways for students to use prior experiences as scaffolding for future experiences?  Allow students to use peers for additional explanation or exploration?

		<p>Have students utilize outside resources such as their family, friends, or the internet and make it a key part of the class?</p> <p>Set student authority higher in the classroom?</p>
Phase 3	Identify which ways students are responding in a way that reflects development toward a hybrid space	<p>Do students:</p> <p>Grapple with higher level questions and actively participate?</p> <p>Use their prior experiences and connect them to classroom content and Discourse?</p> <p>Explain concepts to their classmates and learn from their peers or support their peers in other ways?</p> <p>Use outside resources such as family, friends, or the internet as a key part of class?</p> <p>Show more authority in the classroom by more comfortably participating in class or influencing class or teacher decisions?</p>
Phase 4	Compare different teacher question and student response pairings	<p>Which student responses correspond with this teacher question where funds of knowledge appeared to be acknowledged?</p> <p>Which teacher question corresponds with this instance where students appeared to use their funds of knowledge?</p> <p>Do the ways teachers try acknowledge funds of knowledge correspond with the ways students react?</p>

		<p>What common ways does the teacher appear to acknowledge student funds of knowledge?</p> <p>What causes students to use their funds of knowledge when a teacher question does not immediately prompt them to do so?</p> <p>Why might students be responding to the teachers' invitation to have them use a particular fund of knowledge?</p>
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Below, I elaborate an example of the analysis process using a portion of transcript from the first day of class. Ms. Abbott previewed with her students each of the transformations they would be using and asked them to use their experience to show or tell her what they thought each word meant. This example starts with when she got to the last transformation, dilations.

*Excerpt 1*

*Italicized* text indicates an emphasis on those syllables.

Teacher: *And the last* one is dilation. Who has heard of what dilated—

Juan: Dilated pupils!

Teacher: *Yes!* What does that mean?

4 Juan: That means they they grow bigger or smaller.

Teacher: They grow bigger—or smaller (motions growing and shrinking with fingers). Yes, that's what a dilation does. It grows bigger or smaller. Now you can't really do that with your hand. You can pretend, like, do this (Moves fingers in and out from palm), but not really. If your hand is  
8 really dilating, it's probably going to take like, several years to do that, and it can't actually go smaller, just only bigger. Unless, maybe it's swelled up from an insect sting and then—

Carson: You could put it in acid.

Teacher: That sounds dangerous—

12 Carson: (Laughs) It'd shrink!

Teacher: —Let's not do that (laughs slightly)



Teacher: *So*, How many transformations—(points to words on the board) are there?

Juan: Four!

16 Carson: Too many.

Teacher: Four. (points to board) And today we're learning about the first one: translation.

Juan: How does this apply to math?

In Phase 1, I would count lines 1 and 3 as teacher questions, with lines 2 and 4 as their corresponding responses from a Latino student. The teacher's speech starting at line 5 does qualify as a question because the teacher expects students to follow her in motioning a dilation, however, since students are mostly copying her hand motions, and Carson is not a Latino student, there is no student response recorded immediately after it. The conversation between lines 9 and 13 is solely between the teacher and Carson, so it was not included in my analysis. Then the teacher's, "So, how many transformations are there?" would be included as a question for analysis, because the teacher waits for students to answer. Juan's "Four!" would be included in the data, but Carson's "Too many" would not, as I am looking specifically at Latina/o student actions. Then because Juan asks a question in line 18, I also included the teacher's previous speech, which appeared to trigger his response, as a question. The excerpt is re-posted below, with the teacher's questions that I included in my analysis in brackets and the student responses underlined.

#### *Excerpt 1 Analyzed*

*Italicized* words indicate an emphasis on those syllables.

Teacher: [*And the last* one is dilation. Who has heard of what dilated—]

Juan: Dilated pupils!

Teacher: [*Yes!* What does that mean?]

4 Juan: That means they they grow bigger or smaller.

Teacher: [They grow bigger—or smaller (motions growing and shrinking with fingers). Yes, that's what a dilation does. It grows bigger or smaller. Now you can't really do that with your hand. You can pretend, like, do this (Moves fingers in and out from palm), but not really. If your hand is really dilating, it's probably going to take like, several years to do that, and it can't actually go smaller, just only bigger. Unless, maybe it's swelled up from an insect sting and then—]

8

- Carson: You could put it in acid.
- Teacher: That sounds dangerous—
- 12 Carson: (Laughs) It'd shrink!
- Teacher: —Let's not do that (laughs slightly)
- Teacher: [*So*, How many transformations—(points to words on the board) are there?]
- Juan: Four!
- 16 Carson: Too many.
- Teacher: [Four. (points to board) And today we're learning about the first one: translation.]
- Juan: How does this apply to math?

I performed phase 2 and phase 3 simultaneously as proceeded chronologically through each statement. That way, I could know the context for what students were saying. So, I next evaluated each of the bracketed and underlined segments for whether or not they acknowledged or used any of the students' funds of knowledge. With the teacher's question in line 1, she appears to be acknowledging student funds of knowledge in the second way, by referring to their prior experiences so that they can use them as scaffolding for learning the mathematics of her classroom, because she's asking them if they have heard of the word "dilated" before. Juan immediately responds with "Dilated pupils!" which I coded as meaning that he was referring to his prior experience in that instance, so he uses his funds of knowledge also in the second way. Then, the teacher's follow-up question in line 3 and Juan's response in line 4 are still referring to Juan's prior experience with dilated pupils, so they both are also coded as using student funds of knowledge in the second way. The teacher's speech in line 5, where she expects students to follow her hand motions, does not ask students to refer to their prior experience, because they are just copying her motions, so I coded it as "none."

The teacher's questions in lines 15 and 18 are also coded as "none," because she's asking students to refer to what they have gone over in class. This does not count as a prior experience, because it does not come from students' own Discourses. However, Juan's question in line 20 is

a question that is new to him and requires the teacher to draw connections. Because he is asking a question that requires the teacher to connect to what he's already known, I coded his question as him using his funds of knowledge in the first way, by responding with a novel question.

In the final phase, I put together the teacher questions that appear to correspond with student responses as well as the reasons why in I coded them that way into the excel document. I only put in the pair if either the teacher question or the student response showed one of the five points for acknowledging student funds of knowledge. So, I included in the document the following pairings:

- The teacher's "*And the last one is dilation. Who has heard of what dilated—*" with Juan's "Dilated pupils!"
- The teacher's "*Yes! What does that mean?*" and Juan's "That means they they grow bigger or smaller."
- The teacher's "Four. (points to board) And today we're learning about the first one: translation," and Juan's "How does this apply to math?"

As I compared these pairings to other ones, I noticed that when the teacher appeared to ask students about their prior experiences, they engaged readily, as Juan did in this sample, but they rarely showed explicit evidence of connecting their prior experience to the classroom Discourse. In this case, Juan talked about what "dilated" means in the case of pupils, but he did not verbally connect it to what would happen to shapes in a dilation. Juan's asking a novel question appeared to come from his comfort level in the classroom, but from this excerpt (and the previous ten minutes in class), there did not appear to be anything the teacher did that spurred him to ask that question, except that he felt comfortable engaging with other questions that addressed his prior experiences. I compared this with another instance where a Latina student

asked a novel question without prompting, and it appeared to be for the same reason—she was engaged and felt comfortable learning the mathematics and that led her to ask her own question.

As I continued throughout the analysis, I searched for patterns. In places where the teacher did not appear to do anything to acknowledge student funds of knowledge in the question before a Latina/o student responded by accessing their funds of knowledge, I looked for indications from previous questions and teacher statements for why the student might have responded in that way.

## CHAPTER 4: RESULTS

This chapter is divided into two sections, findings and discussion. The first relates what the data showed about the teacher's attempts to acknowledge students' funds of knowledge and Latina/o student responses. In the second, I discuss how the data relates to the progression toward a hybrid space.

### Findings

In this section I show how the teacher's acknowledgement of students' funds of knowledge through her questions promoted evidence of a potential hybrid space through Latina/o students' actions, as well as when the teacher's attempts appeared less effective. I proceed numerically through the five ways that teachers acknowledge student funds of knowledge as gathered from the literature (Cribbs & Linder, 2013; Calabrese Barton & Tan, 2009; Moje et al., 2001; Moje et al., 2004; Gutierrez et al., 1995), namely, that they:

- 1) Ask higher level questions and allow students to grapple with them;
- 2) Provide ways for students to use prior experiences as scaffolding for future experiences;
- 3) Allow students to use peers for additional explanation or exploration;
- 4) Have students utilize outside resources such as their family, friends, or the internet and make it a key part of the class; and
- 5) Seek to set student authority higher in the classroom.

With each of the five ways, I will first identify how the teacher acknowledged student funds of knowledge in that particular way with her questions, then the different ways students responded to the teacher questions. Finally, I will detail when Latina/o students showed the corresponding action evidencing a hybrid space without the teacher first acknowledging their funds of knowledge.

## 1. Higher level questions

First, the teacher asked higher level questions by following up on a student reasoning, asking students to predict an outcome, or by asking them a procedural question for which it did not appear they had sufficient prior scaffolding. Out of 18 higher level questions, 9 were following up on student reasoning, 5 of them asked students to make a prediction, and 3 of them were questions with limited scaffolding. There was also one question where the teacher attempted to normalize wrong answers by asking, “what do wrong answers tell me?” The teacher followed up on student reasoning with questions like, “How come this one’s a dilation, but this one’s not?” and “What do you mean by that?” Ms. Abbott asked students to make a prediction when she asked what would happen in a dilation with a scale factor between 0 and 1, and what transformations would get them from one shape to another. Procedural questions were ones where Ms. Abbott asked for what calculation students would do as in “How do we figure out if something’s a dilation?” I counted this question because Ms. Abbott explained how to calculate a dilation, but had not explained how to verify a dilation. For some questions of all categories, the teacher appeared to have a specific answer in mind, either because of the teacher’s tone, or as evidenced by subsequent dialogue, which lessened their power as higher level questions.

When the teacher asked higher level questions, Latina/o students would engage with the questions more than with low-level questions where there was clearly one answer. By “more,” I mean that there were either more Latina/o students responding, or that the same students said more in their response. To typical questions, students responded with answers that were about 1 to 3 words. In response to higher-level questions, when students engaged with them, their response increased in length to full sentences. Their answers, when they engaged, generally reflected original thought, rather than parroted responses that the teacher had previously told them. Successful novel questions that were asked to the class (as opposed to following up on one

student's reasoning) increased the number of student turns per teacher turn, changing it from 1 student response to 3 or 4. Additionally, while there were many occasions in which Latina/o students made off topic comments, none were made in response to a higher-level question. Even though higher-level questions generally showed gains in engagement, only 3 of the 8 Latina/o students participated in answering them and the other 5 did not engage with the questions. Students did not usually speak more than a couple sentences in response to any of the teacher questions, higher-level questions included. One explanation for this is that most of class discussion was teacher-led, putting a sense of urgency on student answers. If an answer required more reflection or explanation, students rarely were able to spend time grappling with the question. In terms of think time, when Ms. Abbott asked higher-level questions, there was no longer than a 5 second silence before a student responded to the question. There were two instances where Ofelia thought out loud through an idea, and one where Juan struggled out loud to explain his thinking, but otherwise, students were unable to spend much time grappling with novel questions.

In excerpt 2 below, I share an instance where the teacher followed up on a Latino student response and urged the student to explain his thinking in greater detail. I share this example because it was the only time when a student explained their thinking about a mathematical idea in more than a sentence. It also showed a change in the focus of the classroom from the teacher to a student. This instance thus shows the change in the teacher-student power differential that could occur when more higher-level questions are asked. This example also shows the tensions that can occur that prevent a teacher from asking higher-level questions and students from engaging in answering them.

Ms. Abbott was going through an example at the board where students were reflecting a shape across the  $x$ -axis and she asked what she should do with each point. Juan, a Latino student,

responded that she should put it on the other side of the  $x$ -axis. Ms. Abbott asked him how she should do that. At first, Juan was startled and did not understand why the teacher was following up on his answer. Ms. Abbott appeared to get defensive, but then explained that she wanted to know the details of what Juan was thinking. Juan then attempted to explain his thinking with the teacher following along with his explanation on her whiteboard. After a minute, he gave up trying to make the class understand. Although rough, this episode illustrated an increase of Juan's authority in the classroom as well as peers supporting him as he grapples with a higher-level question, showing three of the factors evidencing that students were using their funds of knowledge.

*Excerpt 2*

Teacher: So, what should we do with them then?

Carson: You should take them 4 below it.

Juan: We should, uh, take it, and, uh, put it on the other side.

4 Teacher: The other side of what?

Juan: The  $x$ -axis.

Teacher: The other side of the  $x$ -axis. How do we do that?

Juan: You just do it. Why you asking *me*?

8 Teacher: (Defensively) *Because you're answering questions*, so I wanna hear the rest of the answer. I'm getting details.

Juan: You, you subtract. And then you add it. On the  $x$ .

[Carson and Juan both comment that their brains hurt.]

12 Teacher: Let's clarify what Juan was answering. He said that you have to take it to the other side of the  $x$ -axis. That's what you said so far, right?

Juan: Well, you— (waves arm for her to move on) Ignore me, I was being stupid. (Pause) No, look! You go *down* two units, so basically you're subtracting two units. Go down. (teacher goes down to the  $x$ -axis with her pen) You're going negative, kay. So you subtract two units.

16

Teacher: From what?

Juan: Teacher, look, go back to the dot, where you were at. (Teacher goes to a different vertex) No. (She moves to the lowest vertex) That one. Kay. Go down. Keep going negative now, so you go down (sigh).

20

Jose: Just go show her!

Francisco: What are you talking ab-out?! Bro.

Juan: I'm too advanced for you guys. I'm too advanced for you guys, sorry!



When Juan asked why the teacher was asking him to extend his reasoning on line 7, it showed that he was unaccustomed to justifying his answers. In fact, it appeared that the teacher was asking this question as part of an effort to respond to a request I made the previous day that she follow up on and extend student reasoning more. Juan then tried three times to explain his thinking, as seen on lines 10, 14, and 18. When the teacher followed him as he attempted to explain, by saying, “That’s what you said so far, right?” and following what he said on the board, it granted him higher authority in the interaction. Juan’s multiple attempts to explain himself showed that he genuinely was accepting a position of mathematical authority and the need to communicate his ideas. However, other students seemed confused. Jose’s “Just go show her!” showed both impatience, but also a respect for his friend’s ideas. Francisco showed frustration when he says “What are you talking about?!” So classmates showed both respect for their classmate’s ideas and confusion at what he was explaining.

In my discussion with Ms. Abbott after class, she reflected that the episode from Excerpt 2 was a “bit of a train wreck.” Hence, I see this episode as only partial progress toward a hybrid space. The explanation was focused on Juan’s thinking rather than the teacher’s. He accepted mathematical authority over his ideas, and his classmates appeared to accept his taking over the interchange. However, the confusion of his classmates and his ending the conversation without showing successful communication of the mathematical concept of reflection shows that the transition to mathematical Discourse was incomplete. With more instances of students explaining their reasoning and answering higher level questions, students might be able to develop the ability to organize their own and make sense of other students’ messy thinking, but this instance shows students were unable to transition to a mathematical Discourse from a higher-level question alone. Because they did not successfully engage in classroom mathematical Discourse, a successful hybrid space was not created.

Students asked higher-level questions themselves twice during the research period. They did not ask novel questions in response to a question the teacher had asked—their novel questions were usually unbidden by teacher action.

## **2. References to prior experiences**

Ms. Abbott provided ways for students to use their prior experiences as scaffolding through 19 questions during the two-week time period. She did so by asking students to say or show what they thought a word means based on their experience, making a reference to popular culture, referring to a common life experience, and switching problems into a more familiar context. Six of the 19 times she referred to students' prior experiences it was for them to think about what a word might mean based on their experience. This happened especially as she was introducing the unit, like when she asked them, "Rotation. Does anyone know what rotation is? Try to do a rotation with your hand, think about what that might mean." And "What does 'pre' normally mean? Like what's pre-school?" In another 6 questions, Ms. Abbott referred to students' prior experiences when she referred to a more common life experience, like in using waving goodbye to an ex to remember what an x-axis reflection was, or prompting students about what would happen in a scenario where an English speaker would have to talk to someone who speaks Spanish. The remaining seven questions included 3 references to popular culture, two questions where she switched a percentage problem into a money situation to help students deal with decimals, and one instance where she follows up on an experience that a student brought up.

When the teacher referred to students' prior experience, Latina/o students engaged in the conversation and eagerly responded with contributions. Every time Ms. Abbott asked a question that referred to students' prior experience, Latina/o students responded to her question, referring to their prior experience. Whether or not they successfully linked their prior experiences to

classroom discourse, a necessary characteristic for a hybrid space, is unclear from the in-the-moment conversations. The students spoke purely in the discourse of their prior experiences, without explicitly making a connection between their prior experiences and the mathematical situations. Generally, Ms. Abbott would attempt to support their making the connection by stating how the life situation or cultural reference was analogous to the mathematical situation in class, but students themselves were not verbally making the connections, as shown in excerpt 3 below.

Excerpt 3 shows a typical example of how Latina/o students engaged with the teacher's questions that referred to their prior experiences. Ms. Abbott realized students did not remember the word for a transformation that moves a shape left, right, up, or down, but does not change its orientation. She attempted to connect the word, translation, to their everyday life experience by referring to what translation means when referring to language. Students, including Latina/o students, understood what she was talking about when she mentioned translating from English to Spanish, but did not show any evidence of having connected that instance of translation with translations of geometric shapes.

*Excerpt 3*

- 1 Teacher: Kay, so you're gonna have to write that for number three. It's a translation. If you can't remember that word, think about this: If I wanted to talk to someone who spoke Spanish and I didn't speak very good Spanish, what would I have to do?
- 4 Juan: Hola.  
Jose: Translate  
Teacher: Translate, right? So that would be a translation. So this would be the same thing.  
Carson: Learn Spanish.
- 8 Student: Hola  
Teacher: It's the same word, it has a different meaning, but it's the same word. Alright, are you writing down the answer for number 3? What's the answer for number 3 again?  
Jose: Did you just say arty?

Ms. Abbott asked students for input about a situation where a non-Spanish speaker is attempting to talk to a Spanish speaker. This was a situation with which Latina/o students were familiar. They immediately responded with what they would do in that situation, with “Hola,” and “Translate.” Then, Ms. Abbott said, “That would be a translation. So this would be the same thing,” leaving students to make the connection between the two situations mentally, which connection was not readily apparent. Upon further thought, Ms. Abbott makes a connection *for* her students with “it’s the same word, it has a different meaning, but it’s the same word,” implying that a word’s different meaning is analogous to a shape’s different location. This example had the potential to connect the meaning of a geometric translation to students’ Discourse, but the students appeared to focus more on surface-level issues of speech (e.g. “Hola.”) than on the underlying relationship between the two types of translation. While the teacher was making a bridge for herself between the two Discourses, students did not appear to have joined her.

While Latina/o students did not appear to connect their prior experiences with classroom Discourse in conversation, they did show some greater success when the teacher attempted to relate mathematical situations and vocabulary to their prior experiences. While students misused the words, “translation” and “reflection,” they never misused “dilation,” which Ms. Abbott explicitly had them connect to their prior experience on more than one occasion. Through a mnemonic device Ms. Abbott created using Optimus Prime from transformers, Latina/o students were able to remember that to find a scale factor in a dilation, “Primes go first;” that is, that the image is the dividend and the preimage is the divisor. These instances indicate some success in progress toward a hybrid space because students successfully learned mathematical vocabulary; however, they did not bridge into mathematical Discourse completely because they did not engage in reasoning why these connections between vocabulary worked.

When Ms. Abbott referred to a popular culture reference that students did not understand, Juan told her to “pick a better one.” The subsequent playful banter about which reference she should use raised the students’ authority in the classroom, because, as the teacher was attempting to relate the mathematics to something they had experience with, they could dictate the terms to how that relation occurred. Thus, referring to students’ prior experience also gave students greater authority in the classroom. However, this conversation, like many, did not result in students verbally making connections between the new context Ms. Abbott used and the mathematical ideas, because they were focused on whether or not they related to the context.

Students later initiated their own connections to their prior experiences. First, they did so by referring to previous examples that the teacher had initiated in later conversations when the same concept came up. Whenever students had to find a scale factor, they remembered that Optimus Prime would win in a race, so they divided the shape with primes by the shape that did not. They also brought up dilating eyes when they were talking about dilations on future days. Latina/o students showed uninitiated use of other Discourse when they spoke in Spanish to urge each other to continue working or by playing with words that sounded like the mathematics words they were using (e.g. translation reminded them of transversal and transgender and octagon led them to think about octopus). The teacher could have capitalized on students’ bringing up their own discourses in relationship to mathematics by strengthening the connection (e.g. trans means “across,” so that’s why it’s used in all those words), but she only used connections that she had initiated.

### **3. Reliance on Peers**

Next, 13 of Ms. Abbott’s questions were invitations or indications that students should work with their peers. Four of those questions were invitations to the whole class that students work together. Before releasing students to seatwork, Ms. Abbott said, for example, “Kay, I want

you guys to be working on this, but it doesn't have to be silent; you can help each other." In five questions, she indicated that a specific student help another student who was struggling during independent work, as in "Lily, can you teach her how to graph it?" Two directions occurred when Bella struggled to respond and Ms. Abbott encouraged her to take suggested answers from other students during the class discussion. The last two instances included one where Ms. Abbott asked students to add responses to one student's response to a question and one where she asked a student if she would like an escort to go to the office.

Students sometimes responded to the teacher's general invitations to work together. There were a couple groups that included Latina/o students who consistently responded to the teacher's general requests that students work together. Most of the class appeared to prefer working alone, then talked to each other when they were finished with their work. With a classroom set up in rows, it was difficult for students to work together, because sometimes, when students were to work with a peer, the closest person was in front of them or behind them. On one occasion, Juan, who sat at the back of the class, asked if he could move closer to a friend. The teacher suggested that he could work with Carlos, who sat in front of him. Juan said it would be awkward because then Carlos would have to turn around. While Juan may not have been motivated to actually *work* with his friend, his comment highlights that the classroom setup did not encourage students to work together.

When Ms. Abbott asked specific students to help other struggling students, they helped each other, although once the teacher had to repeat her direction before they did. However, because the teacher only asked specific students to help others when someone was struggling, students could interpret the need to work with someone else as implying they had limited intelligence, as in the following conversation.

*Excerpt 4*

1 Teacher: Okay. Luis, can you help Carson?

Carson: I know how to do this, I'm not stupid!

Teacher: No, you're doing it wrong, Carson.

Carson: I may be special, but I won't accept it.

5 Teacher: Regardless, I'm asking Luis to help you and he's gonna help you.

[Carson then asked Luis to check his work and after he understood, Luis turned back around and they both continued working individually]

Carson's protests on lines 2 and 4 should be noted; if a teacher creates an atmosphere in which it is inconvenient and unusual to work with other students, students may feel that needing to work with other students indicates that they are "stupid" or "special." If Carson believed in racial stereotypes, he may have also seen it as lowering his status of intelligence needing to receive help from Luis, a Latino student who rarely talked during class. Because Carson and Luis only worked together until an understanding was reached, this instance was only a temporary reliance on a peer, rather than a longstanding one.

On the occasion that Ms. Abbott suggested that Bella accept suggestions from her peers, Ms. Abbott had asked a procedural question to Bella specifically and other students responded. Talking to Bella, Ms. Abbott said, "Carson just told you a minute ago," and "Lily just told you," and waited for Bella to respond to the question. Bella responded with what Carson and Lily had answered. So, while Bella did participate, her reliance on peers was a bit superficial. She knew the answers given by her peers were correct, because Ms. Abbott had already validated them. She was relying on her teacher rather than her peers and participating out of obligation. However, she participated in class rarely, so her participation in this instance, although perfunctory, was an improvement and would not have occurred if Ms. Abbott had told her the answer herself.

Latina/o students occasionally showed their reliance on peers and the willingness to help their peers without being impelled to by their teacher. Many of these instances were ones in which Jose, Juan, and Francisco were trying to defend each other from consequences they had received that they perceived as unfair. When Ms. Abbott wrote a check on the board next to one of their names, sometimes the other two would object, saying he did nothing wrong. Once, Juan suggested he might text his mom to check him out early to avoid having to stay extra after class, and when Juan's phone was taken away, Jose offered to text Juan's mom for him. These students formed a support system—but rather than a support system to support each other's learning, they sought to prevent each other from receiving punishment. Because this support system was rarely used for mathematical purposes, it did not prove a successful bridge to mathematical Discourse. Therefore, it did not evidence a successful hybrid space.

Three instances of students relying on each other without teacher direction were when Juan asked other students for help when it appeared that the teacher was unavailable to help him. He would ask the teacher a question during individual work, and when she did not hear him, he would ask the students around him. Students also helped each other by backing each other up in non-academic arguments, helping each other with supplies, encouraging each other to work, and helping each other during class discussion. All of these instances only happened once during the course of the study, however, so I will not detail them further. On another note, Jose and Juan refused help when the teacher offered it on three occasions, but never refused the help of their peers.

#### **4. Use of Outside Resources**

For whatever reason, whether because of lack of classroom resources or a difficult number of mathematical standards to address, Ms. Abbott did not invite students to utilize their outside resources, such as their family or the internet. She usually had students rely on their



textbook or her class explanations for information about this unit. However, on two separate occasions, Juan offered that he could look up information on his phone. In the following excerpt, he looked up a definition on his phone.

*Excerpt 5*

In this excerpt, the use of hyphens between syllables indicates that the person speaks word slowly and brokenly.

- 1 Teacher: That **is** a definition of orientation, but we are **not** using that one. We are using the one about shapes.
- Juan: May I ask my phone?
- Teacher: No. Put your phone away.
- 5 Juan: (Smiles and holds his phone up to his face) Orientation.  
Julia, Amanda, Luis, and some others laugh a little.
- 7 Juan: The act of processing, of or-i-enting uh-wuh. Ask someone else, teacher.

Juan's volunteering to ask his phone in line 3 indicates not only that he is challenging the teacher's authority, but also that he shows a preference for the information he can receive on his phone over the information he can glean from his book. Juan frequently would scroll on his phone during class, or jokingly pull out his phone to tease Ms. Abbott. He clearly showed greater ease using his phone than using his textbook. However, when he attempted to use his phone to help him with the definition of orientation, his attempt was unsuccessful, because in line 7, he could not make sense of the definition given to him by his phone. Perhaps with more structured opportunities to use technological resources in class, he might be able to use this resource more easily and find ways to have more success in academic discourse. However, in this instance, the use of outside resources alone did not allow Juan to successfully enter mathematical Discourse and did not contribute to a successful hybrid space.

## **5. Student Authority**

Out of 27 questions where Ms. Abbott invited Latina/o students to claim greater authority, in 17 of them, she invited the class to evaluate an answer that a student shared and in 6 instances, she

followed student threads of conversation. Ms. Abbott indicated a desire for class evaluation of a student answer by repeating what a student said with a questioning tone in her voice, and occasionally asking, “Do you agree?”. By “following student threads of conversation,” I mean that a student would bring up an adjacent topic to what the teacher had been addressing, whether mathematically helpful or not, and the teacher would join in talking about that topic.

Ms. Abbott’s invitations for the class to evaluate student answers had mixed results. When Ms. Abbott invited the class to evaluate an answer that a student had shared, more students usually responded than had responded at first, usually one or two more. However, sometimes the same student would respond, perhaps interpreting Ms. Abbott’s question as if she had not heard the answer the first time. Sometimes, other students answered, but appeared swayed by the tone of Ms. Abbott’s voice, or the academic status of the student who had answered. Many times, the ability to perceive overall change in student authority was limited because student answers to these questions were usually only a sentence or less. The lack of student speech signals that authority was placed upon the teacher, and students responded merely to match the degree of her expectation. In Excerpt 6, an example of Ms. Abbott’s repeated prompting for students to interpret a mathematical rule for a translation shows that the initial replies came from two non-Latina/o students, but then student participation gradually increased. Of the data, Excerpt 6 was chosen because asking students to evaluate the correctness of an answer was the most frequently occurring cue for authority and in Excerpt 6 the most students responded to the teacher’s cue the out of all the instances.

*Excerpt 6*

Teacher: Kay, thank you. So what does the  $x$  minus 2 tell you to do?

Carson: It means, take it (points exuberantly to the left)

Lily: Subtract.

4 Teacher: Subtract? Kay.

- Carson: (In accent) You take it to ze left.
- Teacher: You take it to the left? What do you think? (To Sara)
- Sara: You minus two on the x (gestures to the left)
- 8 Joaquin: (Gestures to the left)
- Teacher: You minus 2 on the x? Like this? (Points to the students' left)
- Sara: Yeah.
- Teacher: Do you guys agree? Do you think that's right? Should you go to the left two?
- 12 Carson: (in accent) Go to the left.
- Teacher: That's what Sara and Carson are saying.
- Carson: (In accent) Subtract it by two.
- Teacher: Think about it. What is the x that we're talking about? We're talking about these x's right here. (Gestures to x-axis on coordinate grid whiteboard), right?... If it says x minus 2, which way would that go?\_\_ Everybody point which way that would go.
- 16 (About half of students and half of Latinos point left, though most close to their body.)
- 19 Teacher: Okay, I think everybody's pointing that way (points to the students' left).

While Ms. Abbott's repeated inquiries as to students' interpretation of what the rule meant increased participation, they did not appear to greatly increase student authority. At first, specifically asking Sara to respond, a Latina student who participated less frequently in class, appeared to give more authority to Sara and Joaquin to respond, but when Ms. Abbott repeated the query again, Carson, who had responded previously, appeared to dominate the conversation. In an effort to increase student participation, the teacher had everyone point in the direction they think the shape should go. Student participation increased, so then half of the class was contributing, but the quality and the thought behind the response was diminished. Half of the class did not engage in her direction, and the lack of enthusiasm in the response shows a lack of buy-in from students. Multiple examples like this appeared in the data where students' classroom authority did appear to increase marginally as shown by their increased participation, but students were merely capitulating to the teacher's requests, rather than taking ownership of the mathematical activity.

When Ms. Abbott followed student threads of conversation, Latina/o students showed more authority in the classroom. They showed more authority by initiating their own learning experiences and directing the class discussion, in addition to participating more. Juan was able to continue thinking through aloud an example of scale factor because Ms. Abbott re-voiced and followed his reasoning. Sara asked, while the teacher was helping a student with a geography question, if they could continue on to the next question. Ms. Abbott's helping Julia understand what a rhombus was encouraged Julia, Francisco and Carson to continue thinking of examples of shapes and what they were and play with what the prefix "octo" meant. When Julia blurted out about Transformers while the class was talking about transformations and Ms. Abbott connected her reference into the class conversation, Juan and Julia appeared more comfortable participating in the conversation. Following student ideas and student threads of conversation, even when they did not appear to completely relate to classroom work, showed that Ms. Abbott valued student ideas and also put classroom Discourse into a zone in which students were more comfortable. It also encouraged students to take more accountability for their classroom learning, since they had greater power in initiating learning experiences.

Students demonstrated greater authority when Ms. Abbott acknowledged their other funds of knowledge. As I mentioned before, when Ms. Abbott asked Juan to offer his reasoning behind his answer, Juan showed greater authority in the classroom, since he became the focus of the conversation. When she referred to their prior experiences, students also showed greater authority by participating more, as well as dictating in what context the conversation should be. When teachers acknowledge student funds of knowledge, students are more comfortable learning in the classroom.

Students showed a greater desire for authority 35 times and that was the most frequently occurring unprompted Latina/o student response. Every time Latina/o students fought for

authority was when the teacher had not acknowledged their funds of knowledge in any way. For 19 of those responses, Ms. Abbott had asserted her own authority through assigning negative consequence. As discussed previously, when Ms. Abbott gave out punishment that Juan, Jose, and Francisco perceived as unfair, they fought against the punishment, supporting each other as they did so. Sometimes, Juan, Jose, and Francisco were not fighting punishment, but rather attributes of the academic system. Francisco playfully refused to pull out his math book and pretended he did not see it. Juan brought out his phone during class to taunt Ms. Abbott. Students fighting for authority shows an absence of their own authority and autonomy in the classroom. They do not have it, so they are fighting for it. That this response occurred most frequently among Latina/o students suggests that most of the duration of the study, students were not in a hybrid space because they lacked and craved more authority in the classroom. Their lack of authority also indicates that their Discourses were not privileged in the space.

Juan in particular had more instances of fighting for authority than any other student. He also had peculiar instances in which he showed more authority. He was the one who dictated that Ms. Abbott's use of a Harry Potter context to clarify an instance where a person's eyes do not dilate the same amount in all directions was unrelatable and had to be changed. Ms. Abbott also admitted in class to Juan being the inspiration for her mnemonic device using Optimus Prime by saying, "I don't know, something about you makes me think I have to come up with a better way to remember stuff. . . . Like I look at you and I'm like, 'I've gotta be more creative. Juan's gonna judge me.'" Ms. Abbott had a respect for her student's opinion that influenced her instructional decisions granting him more authority. It could be that Juan's fighting for authority granted him a position where he had more authority.

### **Discussion**

In the previous section, I shared how Ms. Abbott acknowledged students' funds of knowledge through her questions, how Latina/o students responded to her invitations to access their funds of knowledge, and how students used their funds of knowledge without prior prompting from their teacher. I will discuss how these ways of acknowledging funds of knowledge contribute to the overall potential development of a hybrid space, as well as limiting factors that prevent the development of a hybrid space from occurring when a teacher attempts to acknowledge student funds of knowledge in each way.

As I developed in my research-based framework, teachers acknowledge students funds of knowledge when they:

- 1) Ask higher level questions and allow students to grapple with them;
- 2) Provide ways for students to use prior experiences as scaffolding for future experiences;
- 3) Allow students to use peers for additional explanation or exploration;
- 4) Have students utilize outside resources such as their family, friends, or the internet and make it a key part of the class; and
- 5) Seek to set student authority higher in the classroom.

### **1. Higher-Level Questions**

When Ms. Abbott asked higher-level questions and allowed students to grapple with them, it opened up the way for students to be able to bring their own Discourses into the classroom, providing them a greater means of authority (which could lead to a productive hybrid space). Particularly when she followed up on Juan's answer and then followed his reasoning as to how he was performing a reflection, he was able to directly introduce his Discourse into the classroom. Compared to questions that were more routine, when students were answering higher-level questions, they showed more authority and a higher comfort level. More students answered

higher-level questions on average than lower-level questions; all students, including Latinas/os had longer contributions; and Latina/o students did not make off topic contributions to higher-level questions. When students have the opportunity to engage with higher-level questions, they are allowed to introduce their Discourse into the space. With the different questions I investigated, the ones where students were asked to explain their thinking were particularly successful in initiating student responses because the teacher was directly inquiring into what students had already considered, i.e. a Discourse or way of being to which they were already accustomed.

Higher-level questions sometimes lost their power to transform the classroom into a productive hybrid space. We see this in the example when Juan explains his thinking. Because explaining thinking was something Juan was unaccustomed to, and it was done on the spot in a whole class discussion, Juan's minute of explanation did not yield any mathematically fruitful results. While breaking away from the norm does tend to show misunderstandings, if Latina/o students only have unsuccessful attempts grappling with higher-level questions, they, and their teacher, may come to the conclusion that mathematical discourse is not something they can understand or explain, excluding them from the Discourse. The whole class format also put pressure on the conversation in other ways. Because of the high pressure of a whole class discussion with no preparatory think time, students were not always able to grapple with higher-level questions, and fewer students were able to engage with each higher-level question. Conversation hinged on the teacher deciding students understood the material enough to move on to the next question, lessening the possibility for inclusion of student Discourses and lowering student authority. The teacher's role in the full class discussion was particularly limiting to the potential of novel questions to allow student Discourses when she appeared to have a specific answer in mind to her higher-level questions. With that answer as a goal to reach that would

indicate that students understood, she would lead them to that answer, lessening the freedom of students to think through the question.

## 2. References to Prior Experiences

When Latina/o students were given opportunities to refer to their prior experience in Ms. Abbott's class, they participated readily, were comfortable participating and accepting authority in the conversation, and learned mathematical vocabulary. Students engaged readily when Ms. Abbott asked what 'pre' normally meant and when she referred to a non-Spanish speaking person having to communicate with someone who only spoke Spanish. They had more success learning what a dilation was because of this reference to their prior experience with the word than other vocabulary with which they had not referred to their own experience. Even when Ms. Abbott attempted to use examples that connected with students' prior experience and students did not relate to her examples, students then gained authority by telling her to "pick a better" context. Students' resulting increased authority even when they did not relate to the context implies that the *attempt* at connecting mathematics to contexts with which students are more familiar contributes to progress toward including student Discourses in the classroom. However, since students did not make explicit connections from their prior experiences to mathematical Discourse, the classroom did not enter a transitional hybrid space in these instances.

The power of referring to students' prior experiences is lessened if students do not have sufficient opportunity to connect their prior experiences to the classroom Discourse or if the teacher uses something students have not experienced as an example. In Excerpt 3, when Ms. Abbott referred to translation in language, Latina/o students were able to insert themselves in the situation where they would have to translate, but did not make the connection between language translation and the translation of shapes. Because students did not make the connection between what a translation is in both Discourses, they were not able to use their prior knowledge to their



learning advantage. Without the ability to use one's own Discourse to bridge into classroom Discourse, a hybrid space cannot be created. A hybrid space is also prevented from existing if examples that a teacher uses do not actually come from students' Discourse. For a rotation, the teacher talked about rotating tires, a concept with which students do not have a lot of experience. The presence of the example or action must exist in students' Discourses or a bridge to classroom Discourse cannot be made.

### **3. Reliance on Peers**

When students rely on and encourage their peers, it helps open the way for a hybrid space to develop by raising student power in the classroom. As seen, Latina/o students sometimes refused the teacher's offers to explain concepts to them, but never refused offers from their peers. The students' differing responses for peers might be because the power differential between the teacher and students could make personal interactions between students and the teacher uncomfortable. The teacher would check students work for correctness or to see how much students accomplished. Students would help each other when help was desired, so that might account for the easier relationship between students. When students explained to other students, they generally did it without fanfare and turned back to their work once the other student said they understood whereas the teacher would sometimes verify that students were writing things down and spoke at a volume where the whole class could hear. The greater trust and lack of pressure exhibited by their peers raised the power of the student being explained to in the interaction. With more power to each student in the interaction, peer interactions could possibly open up the way for a hybrid space to develop.

When helping other students is not a clear Discourse that students draw upon regularly, peer work does not have the power to initiate a hybrid space. When Ms. Abbott asked Luis to help Carson, Carson at first did not accept help because he refused to accept that he was

“stupid.” Carson’s assumption that receiving help made him stupid shows that students did not engage in helping their peers as a regular part of the class. Helping explain concepts to peers was described as a “studenting” Discourse by Calabrese Barton and Tan (2009), but if explaining concepts to peers is not a part of being a math student, this is not a Discourse that students have. One contributing factor to limited peer interactions was the setup of the classroom. Because it was set up in rows, it discouraged peer interactions, so students were less likely to use their peer funds of knowledge.

Another limiting factor to peer interactions’ potential to contribute to a hybrid space is what the Discourses of those peer interactions are. When peers interacted in this classroom, they appeared to either be communicating solely in academic Discourse, or solely in non-academic Discourse. While there is not enough data to be certain, there was insufficient evidence that peer interactions helped students bridge between their non-academic Discourses and mathematical Discourse.

#### **4. Use of Outside Resources**

From the little data I have where Juan used his phone, the use of outside resources appeared to grant him more comfort and authority in the classroom discussion. He turned to his phone when he did not know the definition of orientation; mentioned that he could find rules for transformations in his phone, rather than relying on the textbook; and leveraged asking his phone to challenge the authority of the teacher (and successfully assert his own more authority). From these instances, Juan showed more comfort using the internet, an outside resource, than his textbook for mathematical explanations. He challenged teacher authority by looking up the definition of orientation on his phone when Ms. Abbott told him not to. Judging by the reaction of the class—there seemed to be a stunned, but eager silence—Juan had the focus of the class and therefore had greater authority in the interaction. Because Juan was more comfortable using

his phone, using the internet is a fund of knowledge for Juan. Juan's initiation of the use of the internet as an outside resource illustrates that students *want* to use outside resources to learn in the classroom. His using an outside resource did not help him to bridge to mathematical Discourse, however.

The use of outside resources is difficult for teachers to coordinate. In the case of Calabrese Barton and Tan's study (2009), the unit that drew upon students' outside resources, such as the internet and students' families, required a research team and student input to create. In Cribbs and Linder (2013), the classroom teacher who brought materials from children's daily lives into her classroom for her mathematics lesson had 20 years of teaching experience. Allowing and providing opportunities for students to use outside resources is not necessarily enough to promote the development of a hybrid space. Juan showed difficulty interpreting the definition of orientation his phone brought up. While students are comfortable using outside resources for learning in other spaces, they may need scaffolding to be able to use outside resources to learn mathematical concepts, or at least more opportunities to gain fluency in using them in mathematics class. Creating the opportunities and scaffolding for students to be successful can be challenging, especially with pacing schedules, limited teacher resources, and lack of training. All these factors can limit the potential outside resources have to help students enter classroom Discourse.

## **5. Student Authority**

Students having some degree of authority in the classroom is a prerequisite to the development of a hybrid space (Moje et al., 2001; Calabrese Barton & Tan, 2009; Cribbs & Linder, 2013; Flessner, 2009). Increases of student authority were evidenced in my study by students perceived comfort levels increasing, students participating more in class, students influencing instruction decisions and the course of classroom discussion, students showing

confidence in their answers, students evaluating each others' reasoning, and students asserting their own authority in the classroom. As seen through the ways student authority was shown, students' comfort and authority in the classroom are necessary for them to be able to participate in classroom Discourse and learn mathematics.

Limiting factors to the potential development of a hybrid space when the teacher attempted to raise student authority were the teacher's disciplinary actions, students misinterpreting the teacher's attempts to have them evaluate each other's reasoning and the teacher repeating her questions too many times. The teacher's disciplinary actions, which consisted of putting students' names on the board and adding consequences for each checkmark put after a student's name, lowered students' authority publicly and inspired students to fight for authority. Because of the subsequent power struggles that resulted, students lost motivation to work in class, and valuable instructional time was lost. Such time spent debating over consequences and student actions detracted from the potential for a hybrid space. While classroom management is necessary, students fighting for authority makes the teacher assert more authority to gain control, and the resulting power struggle can de-track the class from learning important mathematics. When students misinterpreted the teacher's attempts to have them evaluate each other's answers as asking for the original student response, it made it so that the burden of deciding if reasoning was valid was more likely to still fall on the teacher, or that student authority remained solely with the student who originally contributed. When the teacher repeated her questions with the intent to get more students to contribute, student participation increased, but only half the class in Excerpt 6 ended up responding after four reiterations of the question. At that point of asking the same question four times, the pacing of the class feels much slower, which could give students the impression that they should just respond as students have

done before them to get the teacher to move on. Participation at that point seems obligatory rather than natural and undermines student authority in the interaction.

### **Overarching Themes**

In this section, I discuss themes that arise from seeing the results of the study as a whole. First, it can be difficult for a classroom teacher to acknowledge student funds of knowledge, even when participating in a research study. Next, I address the complicated nature of students' fighting for authority and how it both detracts from and adds to the classroom environment and the ability students have to engage in classroom Discourse. I conclude this section with principles to consider in the situation of a White monolingual teacher acknowledging student funds of knowledge.

It can be difficult for a classroom teacher to acknowledge student funds of knowledge, even when participating in a research study. Ms. Abbott knew generally what type of data I was looking for and was familiar with principles of research, having done a Master's thesis herself. She posed many questions in her teaching, but only 156 of them were included in my analysis. Teaching is a complex work that requires teachers to think about their students' hypothetical learning trajectories and adjust them (Simon, 1995), manage their classroom and discipline students when necessary, and attempt to support students in accomplishing an exorbitant number of mathematical standards (Boaler, 2015). Ms. Abbott saw her first major attempt to follow up on student reasoning in the study, where she asked Juan how he would move a point to the other side of the  $x$ -axis for an  $x$ -axis reflection, as being a "train wreck." Juan definitely appeared to struggle because he was not accustomed to explaining his thinking. Even though he experienced greater authority, he was unsuccessful in getting the teacher or the class to follow his description of how to perform reflections. Because the explanation did not reach a satisfactory form of closure, it did not appear to progress the classroom conversation. From Ms. Abbott's perspective

immediately following the class that day, the explanation presented a roadblock. When a teacher begins acknowledging student funds of knowledge in new ways, they may not see student responses as being productive. As a teacher, I have had similar experiences when I tried something new with my students and have fallen back on tried and true “traditional” teaching when I perceived students as not responding in an optimal way. Thus, for all these reasons it can be difficult for classroom teachers to see acknowledging student funds of knowledge as productive.

Students challenging authority both detracted from and added to the classroom potential to develop a hybrid space. Students challenged authority when their funds of knowledge had not been acknowledged by their teacher, so when students were fighting for authority it evidenced that they were not in a position to use their Discourses to better access academic Discourse and a hybrid space could not develop. Sometimes, when students fought for authority, Ms. Abbott asserted her own authority, which led to a power struggle that prevented mathematical progress. The resultant power struggles then continued to detract from the potential the classroom space had to develop into a hybrid space.

However, Juan, being a student who fought for authority the most, seemed to have developed his own position of power. He felt comfortable engaging in the mathematics when he wanted to, even if it did not appear immediately applicable to his Discourses. When he challenged Ms. Abbott’s authority, it was often in a joking tone, which appeared to be half playful, like it was his way of developing a relationship with his teacher. Juan had gained authority through his fighting for authority over time. Then, when he chose to engage in classroom Discourse, he created his own potential hybrid space, where he had access to the mathematical ideas in class. If he was not interested or could not immediately understand what

was being taught, he withdrew into his phone, positioning himself in an intellectual space where he felt comfortable.

The case of Juan is interesting, because it shows that students, through trying to fight for and assert their own authority, can claim authority in the classroom. However, this authority is not beneficial to their learning when they choose to engage in other activities. The cultivation of a successful hybrid space therefore depends on both teacher and student action.

A White, monolingual teacher might be able to help cultivate a hybrid space beneficial to Latina/o students by acknowledging students' funds of knowledge if she does not seek to control too many aspects of how students' funds of knowledge are used. As seen by my results, even when the teacher tried to refer to students' prior experiences by using an example from Harry Potter, students increased their authority and were more engaged, although they did not understand the reference. The episode in which Ms. Abbott asked Juan to explain his reasoning also increased his authority in the class discussion, although he was not able to successfully communicate his mathematical ideas. Inconsistent or novice-level application of the five ways to acknowledge students' funds of knowledge still raises student authority in the classroom and cultivates an environment closer to that in which a hybrid space could occur. Acknowledging student funds of knowledge did not increase the potential for the development of a hybrid space in cases when the teacher kept too much control over how students' funds of knowledge were used. For example, Ms. Abbott specifically requested that Luis help Carson with a specific problem when he did not understand. She gave a specific example for how rotating is used in real life (i.e. rotating tires) with which students had no experience, rather than asking students where they had heard the word. Novel questions that were less powerful were ones for which Ms. Abbott had a specific answer in mind and then guided students toward that answer. Times when Ms. Abbott sought to increase students' mathematical authority where students showed their

agreement using yes or no answers or through gestures (e.g. pointing to the left), were not effective at increasing students' comfort level in participating. When the teacher dictates exactly how students use their funds of knowledge, then they are no longer students' funds of knowledge, because they cannot utilize them in a way that is derived from their Discourses. Without exerting too much control, however, a teacher might be able to successfully acknowledge student funds of knowledge and cultivate an environment in which a hybrid space can develop.



## CHAPTER 5: CONCLUSION

Latina/o students are often unable to participate in classroom discourses and Discourses. This inability to participate contributes to the “opportunity gap” (Gladson-Billings, 2006) they experience. When mathematics teachers cultivate a classroom environment where Latina/o students can use their own Discourses to learn mathematical content, they invite the creation of a hybrid space that enables their Latina/o students to participate successfully. In this study, I demonstrated how one teacher’s efforts to acknowledge students’ funds of knowledge and Discourses in her questions were responded to by her students. I identified specific ways of questioning and classroom factors that prevented students from using their funds of knowledge, as well as times when students appeared to progress closer toward a hybrid space. Below, I specifically detail what contributions and implications my study makes to the field of mathematics education research, as well as some limitations and directions for further research.

### **Contributions**

My study makes three major contributions to the field of mathematics education. First, my study highlights that the interaction between teacher actions and student actions is paramount to predict the presence of a hybrid space. Second, I identify that a lack of student authority in the classroom can prevent the development of a hybrid space and identify additional areas of classroom culture over which students should have authority. Lastly, I suggest that simply having students use their funds of knowledge is not enough to develop a hybrid space; they must be using their funds of knowledge so that they can transition to classroom mathematical Discourse.

First, the interaction between teacher actions and student actions is vital to the existence or absence of a hybrid space. Rather than analyzing teacher actions and students’ accessing funds

of knowledge incidental to each other, my research investigated the interaction between teacher questions that acknowledged student funds of knowledge and students' corresponding responses. I found that, frequently, when the Ms. Abbott was making pedagogical moves to suggest that she was inviting students to use their funds of knowledge, those moves were not taken up by her Latina/o students. For example, Ms. Abbott's invitations for students to evaluate the responses of their peers were sometimes misinterpreted by students as an invitation to repeat their original response. Her general invitations for students to work with their peers were taken up by less than half of the class and her specific invitations for students to work together were sometimes responded to with reluctance, as shown by the instance when Carson resisted, thinking that receiving help from his peer made him "stupid." In other instances, students responded in less-than-ideal ways, like when Juan struggled to explain how to perform a reflection and the conversation ended in confusion, or when students spurned Ms. Abbott's attempt to popular culture because they were not familiar with her example. These occurrences highlight that teacher attempts may not be taken up by their students and teachers may have to adjust their questions and techniques according to students' responses in order to better acknowledge students' funds of knowledge.

Second, my study shows that the lack of student authority and agency in decisions such as classroom consequences and what funds of knowledge students were able to use limited the potential development of a hybrid space. Other studies highlight student choice in what subject they study (Gutierrez et al., 1999), and what activities students engage in to learn a particular subject (Calabrese Barton & Tan) as important contributions to the presence of a hybrid space. In this classroom, instances where students were engaged in power struggles about what consequences they received prevented the presence of a hybrid space. Students should not only have some degree of authority in curricular decisions, but also in classroom consequences.

Students should have some degree of say in what happens to them so that they have a greater position of power in the classroom, which in turn would greater privilege their Discourse.

Students should also have authority in what funds of knowledge they use and how they use them. When the teacher's attempts to acknowledge student funds of knowledge were less than successful, it appeared to be because the teacher maintained too much control over the learning situation. The teacher's dictation of what problems students should help each other with and who should help who, for example, limited the power students had in utilizing their peer funds of knowledge. Additionally, when the teacher had too much control over what examples students could reference to learn new vocabulary, students focused on whether or not they could relate to the example, rather than on the actual connection between that example and the mathematical Discourse they were attempting to learn. While teachers should seek to learn more about student funds of knowledge and incorporate them into classroom (Hogg, 2011), they should also allow students to choose what funds of knowledge they use in order to transition between their non-academic Discourses and the classroom mathematical Discourse.

Lastly, simply acknowledging students' funds of knowledge and encouraging them to use them is not enough to develop a hybrid space; students must be using their funds of knowledge to leverage their transition into classroom mathematical Discourse. As I defined earlier, a hybrid space for the purposes of supporting Latina/o students is a transitional space where students can develop the ability to be able to participate in classroom mathematical Discourse. In developing my framework for teacher actions and students' corresponding responses, I followed the conclusion drawn by the literature that acknowledging student funds of knowledge cultivates an environment where a hybrid space can occur (Calabrese Barton & Tan, 2009; Cribbs & Linder, 2013; Moje et al., 2004; Gutiérrez et al., 1995; Gutiérrez et al., 1999). I drew categories of teacher actions from the literature and identified those teacher actions with a participant teacher

in her classroom. I have shown instances where students showed greater authority and greater participation, so their Discourse had become more privileged in the classroom, but they did not explicitly connect their prior experiences and funds of knowledge with the aims of the mathematics course. By students' conversation and actions, they appeared to mentally dwell in the realm of their previous experience and it did not observably help them progress their mathematical understanding. Because students did not make a transition from their experiences to mathematical Discourse, a hybrid space was not present. Thus, I have shown that students' use of their funds of knowledge does not guarantee a hybrid space.

### **Implications**

In the previous section, I detailed the contributions my study makes to mathematics education research; namely, by highlighting the interaction between teacher actions and student actions to indicate the presence of a hybrid space, identifying that a lack of student authority in the classroom can prevent the development of a hybrid space and additional areas over which students should have authority, and suggesting that students must be using their funds of knowledge in a way to transition to classroom mathematical Discourse in order for a hybrid space to occur.

In this section, I describe the implications for mathematics education research and for teacher practice associated with each contribution above. I will first discuss implications for research, then the implications for teacher practice.

First, more research can be done on the relationship between teacher and student actions, demonstrated beliefs, and items of speech and how they affect the development of a hybrid space. When at a smaller grain size, more specific ways for improving teacher education can be revealed. Because my study shows how students act *in response* to teacher questions, both the teacher and the student are accounted for in the space, rather than just one or the other. Future

research should follow suit and look for the intricate relationship between teacher and student Discourses.

Future research can improve upon my framework to account for limiting factors that I have identified. For example, what teacher actions can build off of student responses to better encourage students' use of their funds of knowledge? Future research can also focus on how to eliminate issues where students fight for authority in the classroom. How can teachers create an atmosphere where students can make progress toward being fluent in the established mathematical classroom Discourse, while allowing students to have authority over what consequences they receive and how they use their funds of knowledge? What additional elements are necessary for a hybrid space to occur? These are questions that future research can and should address.

Since I have highlighted that students could use their funds of knowledge without successfully transitioning to classroom Discourse, future research can look into what is necessary for students to make the transition and what can enable students to make connections between their Discourse and classroom Discourse. To do this, future research might study the transition of one particular student or a group of students and identify points where the students struggle.

Next, I discuss implications for teacher practice that arise with each contribution my study makes to mathematics education research.

Because teacher attempts to acknowledge student funds of knowledge were shown to not always be taken up by students, teachers ought to be aware of how students respond to their attempts to connect to student prior experiences. When Ms. Abbott used a reference to popular culture that students did not relate to, for example, she refrained from using that example in the future. Having students provide their own examples and responding to and incorporating student contributions in lessons can help students make connections between what they know and

mathematical discourse. Teachers can continually keep tabs on what Discourses and knowledge students bring into the classroom, rather than referring to experiences of prior students.

Teachers should allow an element of student agency in determining classroom consequences, what elements of student funds of knowledge are used in classroom Discourse, and what connections are drawn between Discourses. In Calabrese Barton and Tan's (2009) study and Gutiérrez, Baquedano-López, and Tejada's study (1999) an element of student agency was present. In Calabrese Barton and Tan's study, students were involved in creating the nutrition unit for the science, and some of the assignments were based off of their suggestions. Gutiérrez, Baquedano-López, and Tejada's study shows a unit on reproduction that spawned out of students' desire to discuss it. My study identifies that if students do not also have authority in what punishments they receive and what funds of knowledge they can use to connect with mathematical classroom Discourse, it prevents the existence of a hybrid space. Teachers can investigate what parts of their classroom culture they can allow students to consult with them and reflect upon their current classroom management practices. They can also ask questions investigating into students' prior experiences and knowledge and allow students to bring in their own examples to connect with mathematical Discourse.

Lastly, teachers can be more aware of who is making connections between student Discourses and classroom Discourse. If they find that they are the ones making connections, they can seek ways that they can scaffold students making their own connections between their own personal examples and classroom Discourse and vocabulary.

### **Limitations and Directions for Future Research**

Because of lack of time and given the circumstances, my research study was less than ideal. I was only able to observe a traditional classroom, which limited student contributions. I was unable to conduct interviews with students, so no student feedback was received other than

what students said in class. Two students preferred to be off camera and audio, so my camera and audio recorder stayed in one location the entire duration of the study. Because my efforts were focused on writing down what points of the video data to edit out, my field notes were very limited. All of the participant Latina/o students spoke at least conversational English, which limits the applicability of my results.

To document the development of a hybrid space, future research on acknowledging student funds of knowledge in the mathematics classroom should take place in a classroom that is more student-centered to receive as much student feedback on teacher actions as possible. I would recommend student interviews to get student perspectives to determine the presence of a successful hybrid space, as well as student work to see how students applied their Discourses to successfully participate in the classroom Discourse. In a classroom where all participants are willing, with the ability to focus in on certain student interactions and collect data from different locations in the room, more data could be gathered to better analyze the effectiveness of a teacher's attempt to acknowledge student funds of knowledge.

With the limitations of my study, I was only able to document the ways that my participant teacher, Ms. Abbott acknowledged student funds of knowledge, and a class-wide hybrid space did not actually occur. With more data, future research could compare the effectiveness of specific ways that teachers acknowledge funds of knowledge and could document when hybrid spaces occur in relation to the specific questions that teachers ask and how they respond to their students.

While I created my framework for teacher and student actions evidencing the acknowledgement and use of student funds of knowledge based upon a thorough read of mathematics education and science education research evidencing the presence of a hybrid space, my framework is still based upon my interpretation of the research and is, therefore,

incomplete. I tried to overcome this limitation by finding specific evidences from multiple works for each point of my framework. Future research could improve upon my framework by incorporating additional items for how teachers respond to students and by documenting the antecedents to successful hybrid spaces.

Questions that teachers ask to invite their students to contribute to classroom Discourse can help students utilize their funds of knowledge and Discourses. In this study, I identified ways that a classroom teacher acknowledged Latina/o students' funds of knowledge that increased student power in the classroom; however, students were not able to successfully transition to mathematical classroom Discourse. With future investigation into how teachers can acknowledge student funds of knowledge in ways that promote students' transition to academic Discourse, students who have previously been locked out of successful participation in classroom Discourse will hopefully be provided better opportunities in the mathematics classroom.



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