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Pushing the Boundaries of Cultural Congruence Pedagogy in Science Education towards a Third Space

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FORUM

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Abstract This review explores Meyers and Crawford's "Teaching science as a cultural way of knowing: Merging authentic inquiry, nature of science, and multicultural strategies" by examining how they combine the use of inquiry-based science instruction with multicultural strategies. In this conversation, I point to the need of specific discourse strategies to help teachers and students create hybrid spaces to push the boundaries of cultural congruence as described in this article. These strategies include a reflective component to the explicit instruction that encourages an integration of home and science discourses. My response to this work expands on their use of multicultural strategies to push toward a congruent Third space that asks not only what happens to the students who do not participate in science, but also what happens to science when a diverse group of people does not participate?

Keywords Cultural Congruence · Third Space · Multicultural Strategies · Nature of Science

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A1 Forum response to Meyers and Crawford (2011). Teaching science as a cultural way of
A2 knowing: Merging authentic inquiry, nature of science, and multicultural strategies

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Meyers and Crawford article provided a thorough examination of how to address the problem of supporting diverse groups of students from underrepresented populations in learning science through the teaching of nature of science. This necessary article outlines the need for all students, particularly those from marginalized communities participating and engaging in science by understanding the nature of science (NOS). One issue with the current science education NOS literature is often a broad statement of students' understandings of nature of science aspects, without mention of race, socioeconomic background, or gender (Walls 2009). In this way, students' understandings of these constructs become generalized to refer to all students regardless of context. Moreover, for all students to become successful in science, all views of science must be included in the research base. As of current, because of the framework from which they were generated, the worldviews of many students, and marginalized students in particular, are viewed as something that needs to be overcome or changed.

Through examples of their own research, Meyers and Crawford call of the use of inquiry-based practices in combination with multicultural strategies. Specifically, they posit the use of culturally congruent instructional strategies with explicit instruction in nature of science. In this article, they set the stage with the first section titled, "Inquiry as Participation in Scientific Culture." Here, they adopt a meaning of inquiry as proposed by the National Research Council (NRC) as constructed in an authentic context and encourage the framing of inquiry as communities of practice. Here, the authors lay the foundation for moving beyond the current methods of NOS instruction and provide a framework for how to "support students in navigating the cultural divides between their everyday life-words, school, and school science." (p. 9) Next, Meyer and Crawford provide the background into why schools rarely emulate actual science practices and they highlight the opportunities for schools to become cultural homes where students can shape their ways of knowing if supported to do so. While I agree with Meyers and Crawford's demands for changes in science education, I argue that in addition to the goal that they outline for science educators of getting marginalized students participating in and engaged with science that we should also look at how science will continue to suffer without the participation of diverse populations in it. Therefore, I suggest that not only should cultural congruence with inquiry-based practices be incorporated but also that a different space *altogether* should be created in our science classrooms. This space, in which Gutierrez (2008) calls a Third Space, is a theoretical framework used to describe pedagogical practices that combine the worlds of students (first space) with the worlds of school science (second space) to construct a space where student feel comfortable dialoguing in science and no long see the two spaces (home and school) as in opposition to each other.

As Meyer and Crawford describe in their article, the language practices of school science are largely responsible for distancing marginalized students from science while providing support for more privileged students. Equitable instruction and assessment practices for diverse students involve consideration of their cultural experiences and local discourse, which enable them to connect with science and maintain their identities. By allowing students to maintain these identities, there is support for their funds of knowledge, which include the knowledge students' gain from their culture, communities, familial, and linguistic backgrounds they bring with them to school. Studies, such as the one Meyer and Crawford describe in their article that focus on congruence, pay close attention to the funds of knowledge that students bring to the classroom. Funds of knowledge include the knowledge students' gain from their culture, communities, familial, and linguistic backgrounds they bring with them to school (Gonzalez, Moll, and Amanti 2005). Meyer and Crawford describe specific instructional congruency approaches such as the linguistic scaffolding and use of everyday language in the classroom to access and encourage funds of knowledge in the classroom.

Along the same line, congruent Third Space (Moje, Tehani, Carillo, and Marx 2001) promotes the use of these strategies with a concentration on how to integrate discourses. Congruent Third Space centers on three discourses often present in urban classrooms: *instructional discourse* (pedagogical discourse or the discourse type the teacher uses to teach students such as question and answer techniques, instructions prior to a lesson or language used to reinforce classroom rules), *scientific discourse* (the discourse spoken in science settings such as scientific vocabulary, words and actions used to describe scientific processes-observation, inference, experimentation, or discourse techniques often reserved for science such as argumentation), and *everyday discourse* (the language that is spoken in everyday settings such as in the lunchroom, around the dinner table or phone conversations with friends). Using this framework of congruent Third Space, this educational focus is shifted to include achievement *and* equity by creating a space that allows/values/prioritizes instructional and everyday discourses to support and not compete with scientific discourse. In this way, one discourse is not privileged and allows students to bring their funds of knowledge into the classroom. For example, when Bianca (as described in Meyers and Crawford's article) is *allowed* to show her scientific knowledge both through the use of scientific words and through using non-academic, or everyday language (her funds of knowledge) and provides examples from her homes she is demonstrating her understanding of the nature of science. According to Third Space theory, these spaces are created when scientific, everyday, and instructional discourses are combined through authentic integration *by the student*. Authentic integration occurs when it is initiated and/or confirmed by the students; it is asserted during these moments that students understand scientific concepts and are able to assimilate into their everyday discourse. In the case of Bianca, through the description of how scientists' views can differ, she integrated scientific understanding into her everyday discourse and used appropriate contextual examples (based on a conversation with her dad and brother) to initiate her own meaning making of academic knowledge.

Including the Reflective Component for Student to "Talk Science"

Science education is a social activity that occurs within institutional and cultural frameworks. From this perspective, science education should include the role of social interaction in teaching and learning science. It also means making the role of social interaction necessary for learning. Human beings cooperate; communication is one of the necessary processes for cooperation, and because we cooperate we have formed larger scale organizations like families, schools, churches, community centers, gyms, university, and Internet chat rooms. Knowledge sharing occurs through these communities. In this way, our lives provide us with ways for making sense of the world through languages, pictures, belief systems, values, and specific discourse types. However, how this knowledge sharing occurs, the way we learn and what we believe and value is dependent on both time and space and specific to our ever-changing culture. When students share their knowledge with their teacher, learning is occurring. Similarly to the way Meyers and Crawford describe how Paula struggled with the way school science was different from what she was observing at home—learning is happening. Moreover, it is telling us much about their culture at that specific moment, one defined by time and her space. Through the explicit-instruction of NOS aspects, the authors were able to understand Paula's understanding of NOS through conversations with her.

Moreover, Meyer and Crawford describe explicit instruction in NOS as involving, "deconstructing science and framing science content matter within its epistemological framework." (p. 23) While I agree with this statement, I argue that including the reflective component could also provide an other opportunity for students to practice integrating discourses of home and school and would attend to the "both/and" approach the authors highlight throughout their article. Science educators have discovered explicit reflective instruction is crucial for both teachers and students to develop understandings of NOS aspect. Explicit reflective instruction "should be planned for instead of being anticipated as a side effect or secondary product" (Akindehin 1988, p. 73), meaning forethought into the types of questions going to be asked and how the aspects are going to be explicitly taught are essential to effective NOS instruction. The reflection component of explicit reflective instruction includes providing students with opportunities to reflect on the class activities from the different NOS aspects. This reflection piece is critical for students and teachers to develop an understanding of how science is a way of knowing or their epistemology of science. By explicitly and reflectively teaching certain aspects of NOS, teachers can ensure that the same detail is give to NOS aspects as is given to the traditional science content which is critical for students to become both scientifically literate and active citizens in their community.

Beyond Border Crossing

Meyer and Crawford spend time with the ideas of cultural border crossing and encourage multicultural education strategies in the science classroom. They employ Erickson's (1993/1996) idea of students' ability to negotiate differences in cultural understandings and they apply them to the challenges in for diverse groups in science classrooms. While I find cultural border crossing important for science educators to understand, I worry that encouraging cultural border crossing often requires assimilation of culture. In this way, science competes with the students' worldviews, and school science encourages students to abandon their ways of knowing. Therefore, the challenge is to consider how science teaching and learning might look if the students were supported in becoming fluent in school science while encouraging their ways of knowing and not abandoning them. For example, Lugones (1987) examines her shift from her own world of an African-American woman to the often-hostile world of science as a medical doctor. In her ethnography, she describes her successful border crossing and uses the metaphor "world-traveling." She observes flexibility and playfulness are required as she shifts from her mainstream world to the scientific world, where she is an outsider. She insists this is achieved because she is playful, which allows her to be a different person in a different world without losing herself. Interestingly, she attributes this successful crossing into the scientific community with being fluent speaker of science, agreeing with the norms of that culture, being humanly bonded with people of that culture, as well as having a sense of shared history. She describes these as the ingredients for successful border crossing into the science world. Throughout this study, Lugones discusses how she felt at ease in both cultures. Although Lugones attempts to provide a framework for other students to become comfortable in the science world, this type of border crossing is difficult and places extreme demands on the student. By suggesting it is the student who needs to conform to the cultural norms of science, the student is forced to leave their funds of knowledge out of science. I am reminded that if science educators continue to ask students to leave their funds at the door, what knowledge is science omitting?

Additionally, Lugones, as a medical doctor, is able to become fluent in the language of science, but if students have difficulty relating these new scientific terms into their language and are not allowed to call on their previous cultural experiences, it can lead to isolation of the students. The fact is that there *is* a scientific language and Lugones is able to successfully navigate both worlds; however, I argue when reconstructing spaces, students are not forced to live in two worlds, but rather their language and knowledge should be validated and in this Third Space. Although Lugones is able to successfully transition in and out of scientific and local discourse, Brown (2006) discovers many African-American students have extreme difficulty with this technique. He identifies how students' assimilation into the science classroom reflected their interpretation of science itself in relation to their academic identities. The results demonstrate students experience relative ease in appropriating the epistemic and cultural behaviors of science, whereas they express a great deal of difficulty in appropriating the discursive practices of science. They describe discursive practices of science as "unique," "intensive." and "distant." When students discuss management techniques for integrating scientific discourse into their daily language, they remark that their ethnic identity plays a role in their ability to become scientists as they point to their own lack of discipline and patience as reasons why it was difficult to become scientists. They explore issues of self-efficacy from a perspective grounded in their beliefs of their own ethnic identity. This is related to Discursive Identity or the identity that is defined by the symbols that serve as a subtext to their primary meaning (Brown 2004). For example, a student from the southern states may be expected to say "y'all, " to denote a plural form of "you," while an Australian student may have an "idea-r," rather than an "idea." Discursive Identity needs to be examined to further explore how language is used to maintain identity, as Third Space reconstruction may be able to create the space for students to incorporate these identities in the classroom. Moreover, the implications of these findings reflect the broader need to place greater emphasis on the relationship between students' identity and their scientific literacy development. Brown's study touches on the need further inquiries into the areas code switching (the switch of one language into another language for various reasons) and the transition from specialized languages into everyday languages. Ultimately, Third Space reconstruction needs to attend to these issues to ensure an authentic integration of first and second space.

Understanding Funds of Knowledge Home Language to Understand Congruence

The first space of discourse describes the home discourse used by the students. I utilize the concept of first space similarly to Moje and Hinchman (2004) to mean "the everyday world that is close or common to people" (p. 41). Because I am conceptualizing this space as an everyday world of students, I am including studies that originate in their home, incorporate funds of knowledge, and emphasize local knowledge. Thus, I encapsulate the capital "D" of Discourse as Gee (1996) did, by including knowledge, language, and culture. Here, I argue first space is marginalized in schools while the second space, or instructional space, is dominant. This first space, along with instructional discourse is used to reconstruct Third Space.

As Meyer and Crawford attest, it is critical to examine not only knowledges and Discourses themselves but also the funds in which these knowledges and Discourses are generated. Funds help to make visible the construction of knowledges and Discourses and enable us to understand how students learn. In contrast to schools, households rarely function alone. They are connected to other homes or social institutions such as churches, community centers, or even local restaurants. In marginalized communities, these networks are how these people survive—instead of relying on a plumbing company to fix their water pipe, they call their uncle, who performs the task in exchange for a meal rather than money the company requires (Moll 1992). In this way, these social networks are relational, serving critical functions in families, and solving problems through political actions in the community. Although the connections between these networks are diverse, they are mutually beneficial. Velez-Ibanez (1988) demonstrates the complexity and interrelatedness of these relationships by studying a Mexican community. He documents through interactions with family members that these networks provide essential knowledge and skills to the Mexican community. These networks of exchange are based on a simple but critical premise: people are competent and have knowledge, and their life experiences give them that knowledge. What is noteworthy is this simple premise led to much research in the area of first space of discourse. Unfortunately, there is still little understanding of the importance of this knowledge in science classrooms. Much science education literature conflates funds of knowledge with prior knowledge. However, the danger in this is prior knowledge is often confused as static in that it is knowledge *prior* to gaining new and truthful scientific knowledge. While on the one hand, not legitimizing funds of knowledge can isolate students. On the other hand, it excludes a crucial body of knowledge from entering the classroom and informing science education. If we do not allow certain knowledge in the science classroom, what knowledge are we missing?

First space researchers stimulate other educators to study what counts as science and how that science is taught in our schools. It foregrounds the challenges marginalized students face, while building theory that leads to funds of knowledge research. By analyzing the first space of people's home, community, and peer networks and their languages, they document the funds of knowledge and languages that shape the experiences and academic success of these students. Furthermore, it enables teachers to use knowledge of their students' ways of knowing in the classroom. Importantly, this research points to the necessity of viewing classrooms as constantly changing cultures. This research also looks at the relevance towards, students' lives. By rethinking the ways we look at classrooms and learning to include a dynamic viewpoint of culture as described by Meyers and Crawford, it leads to research working in language practices of marginalized students as a silenced discourse that is often devalued in the educational community. Funds of knowledge researchers provide a framework for teachers and students as co-creators of curricula and knowledge in the classroom without removing culture from the classroom. As our schools become increasingly complex, we face the challenge of creating science classrooms that allow students to become active participants in their education. When considering this complexity, researchers need to address urbanization and globalization connection students' funds of knowledge. In some cases, these effects increase the connection to their home language and knowledge through e-mail, Internet, and transportation. In addition, these globalizing effects suggest that students access a wide variety of possible funds of knowledge. By thinking of funds of knowledge in this manner, they are not longer a hindrance to the curricula—they are the backbone to creating it. In this way, it is critical that teachers, educators, and curricula developers understand not only the ways to access students' funds of knowledge but encourage students to participate in the creation of the curricula. By listening carefully to the way students learn their funds of knowledge; we are giving credence to the intended function of funds of knowledge. In this way, we are including different types of knowledge systems, which not only promote equity but also hold promise for the future of science.

Rationale for Congruent Third Space Construction

Science has a specialized system of words that require a particular set of language dependent on concepts and themes. These ideas are not readily made available to the students and can be difficult as they encounter new ways of talking, reading, and writing. In general, school science requires students to integrate the practices of prediction, observation, analysis, and presentation with science reading, writing, and language use. This ability to 'talk science' has served as a gatekeeper to the sciences for many students' access to academic success.

Gutiérrez (2008) believes language and literacy learning can be improved by adding a congruent Third Space, one that is not physical but communicative: language; the social organization of learning; and, curriculum and pedagogy. She sees these spaces as overlapping and related. As described previously, Third Space research originated with funds of knowledge and centers on bringing in the funds of knowledge into the classroom with discourse types that are inclusive of this knowledge and home language (See Figure 1). In this figure, I describe how congruent Third Space is generated. The first circle represents the physical spaces where we learn. These are the first spaces (home or other community networks such as church, community centers, or neighborhoods) and the second spaces (here, school). The second circle represents the capital "D" Discourses at play during the physical spaces. Again, capital "D" Discourse is inclusive the words we speak, how we speak the words and the knowledge represented by those words. Communicative acts are required for learning and this second circle represents those acts. The last circle represents the generation of congruent Third Space. This occurs when the physical spaces of home and school containing these Discourses are blended in a manner that creates a space that is congruent with the physical spaces and the specialized knowledge sets of the first space (home) and the second space (school).

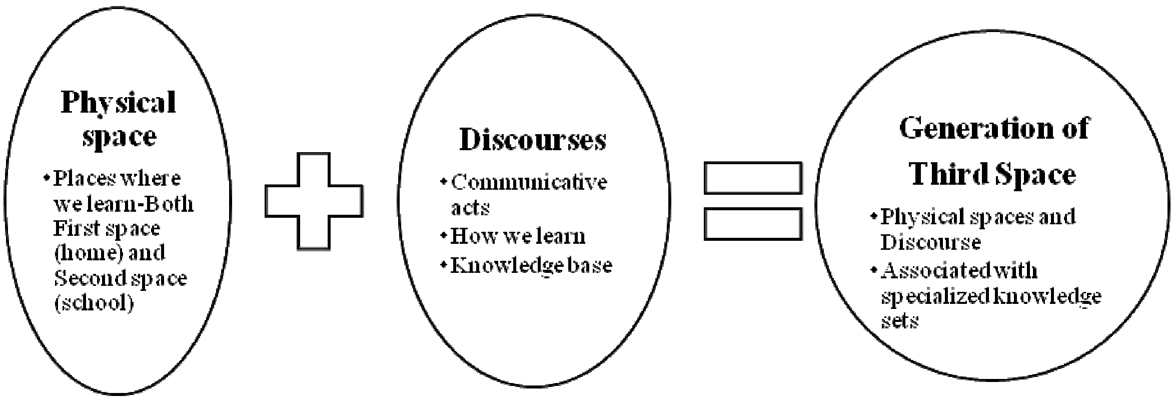

Figure 1. Generation of Third Space. Physical Space with Discourses generates Third Space.

Additionally, whereas these researchers focused on new language learners I am focusing on scientific discourse as both a discipline and a language to be learned, how the teacher constructs this congruent Third Space, the girls' connection to science and how the discourse is documented during these times.

In the past, the focus of NOS research has not been in marginalized areas. However, through the introduction of scientific literacy into educational research, the focus of urban education research has shifted to how learning science occurs in these areas. Educational research suggests marginalized students need strong links between home and school. This creates an environment for mainstream values and equal acknowledgement of the significance of home cultures that contribute to a learning environment.

Studies of discourse in science offer a range of views and provide examples of learning in science classrooms. These discourse studies of classroom interaction revealed how science is framed, who gets to speak in regard to science, and how issues of language use encourage or hinder science learning. Yet, even as science is made available to students through appropriate discourse techniques, many of the studies found limited participation of students talking science. This demonstrates a continual problem for science education and a call for discourse studies in science education with attention on congruence.

In addition, the majority of the science discourse research continues to be focused on one particular space: either scientific or instructional discourse. However, in order to understand how students integrate this knowledge in their daily lives and truly teach science to all, we must include the other aspects that contribute to authentic science learning through congruence. The paucity of research that includes attention to congruence demonstrates the complexity needed to address the needs in urban settings. Still, complexity is not a reason to avoid this important research. Future research is needed about how these models of congruence are applied in urban schools and to learn what it means to do science, be a part of the scientific community, and using the students' local knowledge to so.

In conclusion, I am encouraged by the work of Meyers and Crawford. It provides a strong outline of how to promote NOS understandings in diverse settings. Meyers and Crawford describe how NOS aspects lend themselves to connecting marginalized students to science through inquiry-based practices that integrate multicultural educational aspects. I ask that we extend this view to include explicit-reflective instruction as a part of inquiry instruction to encourage the instructional approaches Meyers and Crawford outline. Moreover, it is my hope that science educators will continue to access students' funds of knowledge while encouraging integrating discourse practices to encourage students' understandings of NOS. In this way, I imagine Bianca becoming an active participant in the science community, blending her knowledge from everyday experiences with the knowledge of science. I imagine her talking science but more importantly adding to the knowledge base of science. I imagine a science that is richer, more real, and truer because Bianca participated.

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