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Ciencia en *Nepantla*: the journey of *Nepantler@s* in science learning and teaching

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Abstract This paper presents a new approach to science education that takes a path through sociocultural theory and into the ideas of Gloria Anzaldúa. We apply Anzaldúan theory to science education by illustrating it in action through various examples which explore the multidimensionality of teaching science with Latin@ students in various contexts including dual language settings. We present what it is to journey through transformation using examples from educators at various levels of science within the world of teaching science with Latin@ students in the U.S. Our examples illustrate how Latin@ students cross many cultural borders in Spanish, English, Latin@ home culture, school culture, and the world of scientific dialogue and content, and in doing so, go through tensions and transformations between dominant and non-dominant worlds, which should be acknowledged and better understood through Anzaldúan theory. Fundamentally, we present a transformative notion of Latin@ science learning as "living on the bridges" of many dialogic and cultural practices, and having to negotiate these in-between spaces, or "*nepantla*" (Anzaldúa and Keating in Interviews, Psychology Press, London, 2000), where Latin@ students must contend with the fragmented and sometimes painful struggle of living in racialized reality amidst the demands of a dominant culture, and where transformation and healing are possible through the path of *conocimiento*. We advocate for

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teachers to become science teacher *nepantler@s*, who guide their students through *nepantla*, and into a *new mestiz@ consciousness* of science education.

Keywords Latin@ students · Reflective practice · Transformation · Anzaldúan theory

Este estudio brinda un conjunto de perspectivas, investigaciones y experiencias de un grupo de educadores que son multiculturales, multilingües, o latin@s. Esta variedad representa lo que significa enseñar ciencias a estudiantes latin@s en ambientes tanto formales como informales utilizando diversas técnicas educativas, como los programas de lenguaje dual, alternando idiomas o códigos, y el uso de las experiencias multiculturales y multilingües. Por medio de las conversaciones colectivas que sostuvimos logramos reflexionar sobre la complejidad, las diferencias, y los retos relacionados con nuestras identidades subalternas, así como la de nuestr@s estudiantes. Encontramos que, de una u otra manera, tod@s hemos caminado por senderos similares que nos han permitido lograr una transformación personal y colectiva en nuestras prácticas como educadores de ciencias con estudiantes latin@s. Abogamos para nosotr@s mism@s como para nuestr@s estudiantes las identidades que Gloria Anzaldúa (2007) llama "la conciencia de el/la *nuev@ mestiz@*" las cuales se basan en la habilidad de caminar por múltiples culturas, hablar distintos lenguajes y negociar nuevos significados que se relacionan a estas identidades múltiples, y que se unifican formando un todo resultante del continuo cruce de "fronteras" entre esas culturas y lenguas múltiples. A través de la unión de nuestros ejemplos narrativos y etnográficos discutimos que, tanto l@s estudiantes latin@s como nosotr@s como educador@s, nuestros biculturalismos o multiculturalismos son inseparables de nosotr@s mism@s debido a las distintas identidades que habitamos, ya sea en español, en inglés, en la cultura del hogar latino, en la cultura de la escuela, en el contenido y el diálogo del mundo científico, y en nuestro vivir como estudiantes, maestr@s, profesor@s, mentor@s, y miembr@s de una familia. Los ejemplos que se presentan ilustran a l@s maestr@s en un proceso investigativo y reflexivo con sus estudiantes que promueven ambientes estudiantiles edificantes que reflejan el idioma y cultura del hogar de sus estudiantes en conversaciones que les proveen con oportunidades para explorar por medio de representaciones, proyectos, y experimentos inquisitivos, conceptos científicos y asuntos relacionados a sus vidas como estudiantes que han cruzado y siguen cruzando fronteras. A través de nuestras reflexiones, investigaciones y observaciones examinamos los lazos entre idioma, cultura, raza, historia e identidad y proponemos que la coexistencia de estas dimensiones tienen un efecto significativo en la afiliación que l@s estudiantes latin@s muestran hacia las ciencias así como también la manera en que ell@s negocian las ciencias y la cultura mayoritaria y dominante. Hablamos de manera especial sobre el sentimiento que este ambiente de negociación conlleva con respecto a la perspectiva planteada por Anzaldúa. Presentamos una noción transformativa sobre el aprendizaje de las ciencias de l@s estudiantes latin@s como un proceso de "vivir en los puentes" de muchas prácticas dialógicas y culturales donde ell@s deben negociar el espacio liminal de "*nepantla*" (Anzaldúa and Keating 2000), en donde el estado de no estar ni aquí ni allá, y estar siempre entre espacios, causa tensiones y algunas veces el rechazo de y la resistencia a las demandas puestas por la cultura dominante. Pero también es allí en *nepantla*, donde la transformación y la curación son posibles a través del sendero del *conocimiento*. Nosotr@s abogamos por el poder que tienen l@s maestr@s de ciencias para actuar como *nepantler@s* y facilitar la curación de las tensiones y las luchas de est@s estudiantes. Al mismo

tiempo reflexionamos sobre el papel que jugamos como *nepantler*@s, comprometidos por nuestras identidades subalternas y experiencias en la vida de buscar mejores formas para orientar a nuestr@s estudiantes y a nosotr@s mism@s a través de *nepantla* en nuestro viaje de enseñanza-aprendizaje de ciencias. Continuamos el proceso, pero no sin antes contender los efectos dolorosos de normas dominantes y colonizantes que por lo general invaden el ambiente escolar y el proceso de enseñanza-aprendizaje de ciencias y tampoco sin resistir y destruir esas reglas y promover el acto de curación, para que así finalmente lleguemos a una educación de ciencias a un nivel armonioso integrando la conciencia de *nuev@s mestiz@s*.

> To survive the Borderlands
> You must live sin fronteras
> Be a crossroads (Anzaldúa 2007, pp. 216–217)

The world of science education

Science education researchers have disseminated a wealth of knowledge and information on best practice and perspectives that are conducive to children's science learning, yet the opportunity to apply these research findings is limited to a decreasing number of schools where teachers are actually allowed to teach science. Unfortunately, due to curriculum shifts resulting in more high-stakes standardized testing, many schools around the U.S. have restricted students' access to science instruction during the school day. This pattern is more frequent in schools with higher concentrations of students from culturally and linguistically diverse backgrounds. This is the real world of science education in our schools. Behind this deprived curriculum, there is a world of science education theory, which could play a role in determining where and when science is taught. We will first present this world and then present an approach that melds these theories with current realities for Latin@s in our science classrooms.

Current pedagogic perspectives in science education support an active, constructive, experiential, and collaborative learning process (Bereiteer and Scandamalia 2003). Learning and cognitive self-regulation are supported through meaning-rich contexts with challenging, realistic, and open inquiry processes (Warren and Rosebery 2008) in which demonstrations and continuous use of the discourse, by learners and teachers alike, are essential to understanding science practices (Roth and Lee 2002). The learning of science practices is deemed as multimodal, since it includes words, images, diagrams, mathematical/graphical signs, and oral communication (Lemke 1998). Simultaneously, these processes evolve in social, cultural, and emotional realms (Roth 2008) where students not only learn about content but also about the "kind of person one is recognized as being, at a given time and place" (Gee 2000, p. 99), in addition to a scientific identity construction (Greeno 1997) supported through participation (Lave and Wenger 1991).

Additionally, and related to the appropriation of science practices, is the development of a scientific discourse. Language and thinking are intricately connected (Vygotsky 1978); thus, in the development and application of science practices, the use of a scientific/academic discourse is implicit in the process of doing science (Snow 2008). Scientific inquiry should be linked to students' empirical activities in order to support their development of scientific discourse (Fang 2004). Reading and writing are essential in the context of learning and furthering science knowledge (Brown, Reveles, and Kelly 2005). This

language-based demand, however, often presents a challenge for culturally and linguistically diverse learners who are learning English as well as their home language. This is especially true for students who are learning the school's dominant language as their second language.

Considering this language-based process in science education, suggestions have emerged for teaching science and English language learners. For example, it has been suggested that by including a wider range of participants in the learning process, including participants from the students' families, friends, teachers and trusted professionals, students can build a richer science discourse from interactions in practical and objective contexts where they use non-specialized discourse that supports students' own science learning process (Warren and Rosebery 2008). This process should integrate linguistic and cultural aspects to make science relevant to all students (Lee 2002). We notice that although considered for all students, the emphasis or hierarchy of interests dwells in the learning and acquisition of a Western scientific discourse. Power issues of identity and knowledge seem secondary.

Recent science education research has pointed out that teachers from dominant backgrounds may have difficulty in understanding or being aware of what diverse learners bring to the classroom; a fact that makes them feel unprepared to meet the needs of students from non-dominant cultures (NRC 2007). This situation relates to the fact that teacher preparation programs often do not target teacher beliefs on multicultural issues (Bryan and Atwater 2002). These circumstances create the conditions where science education becomes an assimilative system that may either marginalize culturally and linguistically diverse students away from the science field or may abruptly force them to transition from their "otherized" views of science to the dominant, Westernized ways of doing, talking, and knowing science (NRC 2007). These hegemonic structures influence language discrimination of non-dominant languages (Barwell 2003) and place deficit perspectives on students' cultural, ethnic, class, and native identities that bestows upon them a racialized experience of learning science (Martin 2007).

In this paper, we center our reflective and analytical process on the teaching and learning experiences of Latin@, Hispanic, or Chican@ students in science education. We argue that current science education perspectives have not profoundly dealt with aspects specifically related to this population's situation in the United States. We recognize that analyzing the needs of Latin@ students is not a simple matter. Students that identify as Latin@ come from many backgrounds with identities that may or may not share similar values and beliefs. Yet, identity of Latin@s continues to be critical to academic success in science education (Gallard 2009). Although not all this population may be bilingual, the issue of language is commonly connected to them. In addition, the fact of being the result of the mixing of Native and European cultures, and at times of foreign and domestic origins, creates specific political, cultural, social, linguistic, and identity circumstances for this population. It is in this merging of worlds and identities where we think that Anzaldúan theories provide a useful set of lenses that may help us walk through a reconciliatory approach for science education. We use the term Latin@, nepantler@s, and nosotr@s throughout this paper, as is the preferred term among Latin@ Critical Race (LatCrit) Scholars (Cantú and Fránquiz 2010), instead of "Latino" or "Latina/o" to deemphasize the androcentric or cis-gendered "a/o" fragmented terminology regarding individuals of Latin-American heritage, and move towards more inclusive language, which incorporates the full diversity and unity of gender among our rich and diverse communities. Although we have translated most of the occurrences of Spanish throughout this paper into English, we purposefully have left many of Anzaldúa's concepts in their original

Spanish or Nahuatl without translation in order to honor Anzaldúa's truest meanings of the ideas, which cannot be translated perfectly into English without losing much of the original intent of her concepts as she presented them. In this paper, we attempt to bring the worlds of science as they are, and the Anzaldúan concept of the *new mestiz@* into convergence.

Troubling dominant notions of science education

We authors, as either Latin@, bicultural, or bilingual science educators are troubled by the narrowness with which science, and science content knowledge, is presented to our increasingly diverse student population, especially given that the largest percentage of minority students, and in some cases the majority population, in most school districts at this time are Latin@s. Yet little has been discussed in science education literature, regarding broader, more multicultural approaches that specifically include and take into account the specific issues and considerations of this Latin@ demographic.

The hush surrounding the inclusion of Latin@s in science is deafening. Their exclusion from the conversation in science education research is mystifying, given the abundant possibility just beyond this wall of silence. The staggering underrepresentation of Latin@s in the field of science, currently at only 3 % of the entire workforce (Crisp and Nora 2006), accounts for only 1 percent of all graduate science degrees awarded each year (NSF 2006). The underrepresentation of Latin@s who declare a major in any science field, while they are only 10 % of the total science majors, does not account for very high amounts of student turnover (Crisp and Nora 2006). These dismal figures are indicators that the current methods of teaching science with Latin@s, and the materials used, are pushing Latin@s out of the field of science. Paradoxically, the Latin@ population in the U.S. is 50.5 million strong (United States Census Bureau 2010), with 1 in 5 students in public schools being Latin@, making Latin@s the largest minority group, and in New Mexico are the majority group in our public schools (Fry and Gonzales 2008). In New Mexico, Latin@ students outnumber Anglo students nearly two to one. With talk of the dire need to compete scientifically and technologically as a nation, with the assumption that our political and economic futures are in peril (Domestics Policy Council 2006), comes the reality of the lack of minority representation in the field of science (NSF 2006) in addition to the "leaky pipeline" where more and more students drop out of the trajectory of entering scientific fields with each successive year of schooling (Chapa and De La Rosa 2006). With all of this before us, we can only help but wonder why issues of science education with Latin@s have not been more of a priority among the science education community. Additionally, we are witnessing an increasingly hostile attitude towards ethnic studies programs and other programs that dare to introduce curriculum specifically for Latin@s and acknowledge the complexities of their struggles. We refer here to the Mexican–American Studies program that was shut down recently by the Tuscon, Arizona school board. We have seen similar pushes against curricula and pedagogies that accommodate bilingual and bicultural students in the decades-long push towards "English-Only" policies across the nation. Do silenced and delegitimized bilingual, bicultural pedagogies have a place in our country's curriculum, or are they also being pushed back across the border? We mention these events, because they highlight the current context of science education for Latin@ students. Both the dismantled Arizona ethnic studies program and the efforts towards bilingual, bicultural pedagogies have proven their worth for Latin@ students, but have faced derision and delegitimization by dominant forces. The Mexican–American Studies program had a proven track record of significantly increasing the achievement of the Latin@

students who are in those programs, even in the face of many of these programs being dismantled. Students in the Tucson ethnic studies program scored 45 points higher than their non-ethnic studies peers in standardized tests in reading, 59 points higher in writing, and 33 points higher in math, and 67 % of them enrolled in college, above the national average for Latin@s (Ginwright and Cammarota 2011). Additionally, students in bilingual education programs have been shown in numerous studies to outperform students schooled in English-only settings (Krashen 1996).

Yet, there remains an antipathy towards the curriculum and the staff who dare teach ethnic studies or bilingual education which, at its root, is based in desires to whitewash biculturality, bilingualism, and any sense of the "other" and force a monocultural, White, English-only standard on students who are deeply and historically bicultural and bilingual. In the case of the ethnic studies program, this has led to a wide-scale banning of books that discuss bicultural ideas, such as Gloria Anzaldúa's "Borderlands/La Frontera: The New Mestiza."

Looking at the results that ethnic studies and bilingual/bicultural education have on Latin@ student populations by acknowledging and working with Latin@ students' racial, ethnic, cultural and linguistic identities, it is puzzling that much literature continues to condone educational practices that treat all students in a "neutral" and colorblind fashion. Instead, curricular practices tend to focus on delivering content knowledge in an "objective" fashion, which ignores the realities of power and oppression that permeate the lives of Latin@s in the U.S. and, thus, takes the side of the oppressor (Freire 1970). This willful ignorance, under the guise of "colorblindness" toward the genuine concerns of Latin@s in our classrooms, has led to oppressive and inequitable outcomes for Latin@ students in our science classrooms, and for students of color as a whole (Parsons, Rhodes, and Brown 2011). Science educators cannot claim that they are providing science education for *all* children while continuing a "collective failure thus far to provide equitable science instruction along racial, cultural, and gender lines in our classrooms" (Walls, Buck, and Akerson 2013).

We highlight Anzaldúa's ideas and apply them to science education here, not only because we feel it profoundly applies to our life work as science educators, but also as a political act of protest against the banning of her book *Borderlands/la frontera: The New Mestiza* (Anzaldúa 2007) by the Tucson Unified School District in early 2012. As Anzaldúa profoundly asserts in ways that speak to each of the authors:

> In childhood we are told that our language is wrong. Repeated attacks on our native tongue diminish our sense of self. The attacks continue throughout our lives. […] So, if you really want to hurt me, talk badly about my language. Ethnic identity is twin skin to linguistic identity – I am my language. […A]s long as I have to accommodate the English speakers rather than having them accommodate me, my tongue will be illegitimate. I will no longer be made to feel ashamed of existing. I will have my voice: Indian, Spanish, white. […] I will overcome the tradition of silence. (pp. 80–81)

This shutting out of Latin@ history, culture, language, and identity in so many areas of education is part of a larger problem in our science educational world that considers "science" to be defined by very specific and regimented cultural aspects, such that a conflict emerges "between challenging established cultural beliefs in order to improve on them versus supporting established cultural beliefs because the establishment supports us" (Lemke 2011). This results in a population of science educators so deeply invested in the dominant, established culture of science, that students and educators who encompass broader, holistic, embodiments within the science classroom are often deemed as needing to "change" in order to become more "scientific," based on this narrow meaning of what is

legitimate in a science classroom. This dominant meaning of science is burdened with much fracturing and compartmentalization of knowledge, forcing students to have to break themselves into fragments in order to be considered "scientific" by this definition. In this article, we hold that this fragmentation is damaging to a more authentic and integral practice of science, as Lemke points out:

> One objection you might hear from some science educators, and many social conservatives, is that such issues are not ''science'', but belong to social and cultural studies. […A] narrow specialist definition of science […] which excludes all social and human factors and concerns, is itself anti-intellectual and anti-educational. The very compartmentalization of the curriculum, reflected in textbooks, is itself a key means for NOT raising issues which may be subversive of naive ideas and dominant ideologies. […] Narrow classification and framing of disciplines is in itself inherently conservative. It is rather precisely by means of its opposite—bringing together things that don't normally come together—that we find sources of new ideas, new practices, and social and cultural change. (pp. 290–291)

Not only is this damaging to an authentic practice of science, but we suggest that this kind of fragmentation is particularly destructive and painful to students from non-dominant backgrounds, and especially to Latin@s, who already straddle multiple cultures. Being forced to assimilate to the dominant culture of "science," as it is defined in the mainstream, breaks this Latin@ multicultural whole into hierarchical pieces. This kind of compartmentalization turns Latin@ identities against themselves and forces them to be torn between ways, in a state Anzaldúa terms *nepantla*, or the in-between state. This shattered, fragmented state leads further to a very painful choice——the "*Coatlicue state*"—where students must negotiate (through *conocimiento*) or disavow (*desconocimiento*) their own identity and their understanding of self. In the following section, we will delve deeper into these Anzaldúan concepts.

Walk with us into *Nepantla*

In this study, we will introduce you to Gloria Anzaldúa's application of a classic indigenous myth to a larger framework of identity that touches on the nature of bilingual, bicultural border-crossing, and to what Anzaldúa (2007) proposes as the *mestiz@* consciousness of Latin@s in the United States. This framework also introduces you to the struggle, wounds, and pain of traversing into dominant worlds and healing from such navigations. We will then apply these Anzaldúan ideas to the world of science education in ways that we can transform how one sees and practices science education for Latin@ students.

As science educators in a variety of settings with Latin@ science learners, we have witnessed the uncomfortable struggles in *nepantla* of our Latin@ students and have felt it also profoundly within ourselves. We have found ways to negotiate and emerge from such situations and have found ways to share these insights with our students. We utilize the theories, myths, and ideas within much of Gloria Anzaldúa's work with an authentic conviction in the idea of student biculturality as a marker of Latin@ culture and identity. Our study uses Anzaldúa's ideas of **border crossing**, ***nepantla***, ***metiz@ consciousness***, **and the path of *conocimiento***, as integral in our analysis of Latin@ culture and identity as necessarily bicultural and multidimensional.

Border crossing or negotiating the borderlands Anzaldúa (2007) considered multi-dimensionality of identity as being a crossing of "borderlands" as individuals traverse and negotiate social and cultural terrain. Anzaldúa considered that each of us is hybrid, inclusive, a mixture and many-voiced, and that we build our identities most noticeably at the "crossroads" between worlds, at the borders and intersections. Our trajectory is one of the integration of many selves. As a result of being in these "borderlands," an individual, especially a Latin@, can be stuck between these worlds, pulled in many directions, or can traverse them, finding a way to make them her/his own. Further, Anzaldúa (2007) argued that ethnicity and language are inextricably intertwined for Latin@ identity construction, and so biculturality and bilinguality are intermeshed into Latin@ identity.

Nepantla and mestiz@ consciousness We feel that in order to progress towards a more inclusive, multicultural science education that includes Latin@s' multiple cultural and linguistic identities without subtracting, delegitimizing, or whitewashing them, we must recognize that students are a sum of many (dynamic) parts, and that all these parts must be made visible and respected, not just those that convenience us as science educators in a Western/Anglocentric world. Anzaldúa draws parallels between being *mestiz@*, as most Latin@ are a mix of Native American, Spaniard, and African American, to the "consciousness of the borderlands" or *mestiz@ consciousness* where Latin@s "continually walk out of one culture and into another" and yet are "in all cultures at the same time" (Anzaldúa 2007, p. 99). The quality that Anzaldúa describes of being "between worlds" is that place of transition during border crossing, which she considers

> bridges [that] span liminal (threshold) spaces between worlds, spaces I call *nepantla*, a Náhuatl word meaning *tierra entre medio* [in between land]. Transformations occur in this in-between space […] living in this liminal zone means being in a constant state of displacement – an uncomfortable, even alarming feeling. Most of us [Latin@s] dwell in *nepantla* so much of the time it's become a sort of 'home.' (Anzaldúa and Keating 2009, p. 243)

Nepantla is part of a larger multi-stage path proposed by Anzaldúa, towards healing, which she calls the "path of *conocimiento*." This path, much like the term *nepantla* itself, is inspired by ancient indigenous ideas and words from Aztec and Nahuatl mythologies. Before venturing into the path of *conocimiento*, we would like to tell you about the indigenous myth that inspires it:

The myth of *Coatlicue* and *Coyolxauhqui*

According to ancient Aztec mythology, there was a mother of all Gods, *Coatlicue*, who gave birth to all celestial things. Goddess of the Earth, *Coatlicue* holds both the nurturing aspect of life, and the devouring aspect of death. *Coatlicue*'s oldest daughter, *Coyolxauhqui*, along with 400 of her children, felt dishonored when *Coatlicue* mysteriously became pregnant by falling enchanted hummingbird feathers, so they rallied together to attack her. At that very moment, *Coatlicue*'s new child, *Huitzilopochtli*, the god of war, sprang from her womb and attacked all the children. The 400 children were thrown into the sky, and each one became a star. He dismembered *Coyolxauhqui* into many pieces and cut off *Coyolxauhqui*'s head, throwing it into the sky where it became the moon, and she became revered as the moon goddess.

This myth has several elements of violence and calls deeply for the need to heal. Anzaldúa drew from this myth to elucidate the healing process for anyone from a non-dominant culture who experiences shock when contending with the dominant world—for anyone living in the borderlands in a profound state of *nepantla*. She called this healing process the path of *conocimiento*.

The path of *conocimiento*

This study considers both students and teachers as walking in what Anzaldúa calls the "path of *conocimiento*," (Anzaldúa and Keating 2009, pp. 540–578), of which *nepantla* is a part. Along this path, (which does not have to necessarily follow the same order detailed here, nor does a person's trajectory necessarily have to involve every stage) persons from non-dominant cultures go through seven stages when faced with demands from dominant cultures:

1. The *Arrebato- deep rupture; fragmentation*
2. *Nepantla*
3. The *Coatlicue* state—where *desconocimiento* is an option
4. *Compromiso*
5. Putting *Coyolxauhqui* back together
6. The clash of realities and
7. Shifting realities

This path presents ways that those from non-dominant cultures may "deal" with the painful reality of being broken into fragments by a dominant culture that wants to partition them and divide out their "acceptable" pieces disregarding them as a whole. Going through the stages, and choosing the path of *conocimiento* [knowing] versus *desconocimiento* [unknowing], can ultimately become an act of healing, and those that learn to walk through these stages of cultural division and redefinition are considered "nepantler@s" who can then help others transform through their journey within *nepantla* and find healing from the initial *arrebatos*, considered the initial pain brought on by dominant society, which leads into *nepantla* where one does not know whether to assimilate, separate, or isolate from the demands of the dominant culture. A *nepantler@* or *curander@* can help others through *nepantla* by offering the necessary tools for survival that they have themselves found through similar ordeals.

The path to *conocimiento* is a path towards a deep and transformative "knowing," one that goes beyond mere content knowledge and into a deep understanding and a transforming perception of reality and one's place in it. To explain the seven stages of *conocimiento* more deeply, we must first start with the *arrebato*, or the deep rupture and fragmentation. It is a sudden and shocking disturbance to one's wholeness and peace. From this trauma, one is forced into a state of *nepantla*, where one is knocked into a limbo state, where one vacillates between many possibilities in a state of vulnerable and painful chaos. Anzaldúa holds that for many bicultural beings like Latin@s, this liminal space of *nepantla* is inhabited so regularly that it becomes a sort of "home" (Anzaldúa 2002). In this state of *nepantla*, one becomes split in their awareness, a kind of "double vision" where one can walk in more than one world at once. *Nepantla* can also bring on a level of fear, however, due to the ordeal of having been shattered by an *arrebato* that has disturbed one's wholeness. *Nepantla* hurts.

The *Coatlicue* state is named after the goddess *Coatlicue*, who has both the dark aspects of death and the light aspects of life. In the *Coatlicue* state, one must come to terms with this type of fragmentation. One can run from it and deny the fragmented state they have

been forced into, which could be a form of *desconocimiento*, or they can work to "own" their fragmentation, as in the state of *conocimiento*. This journey can be traversed in a way that can bring about the next stage of *compromiso*, where one accepts that fragmentation has occurred, and answers "the call" toward the potential self through crafting new *mestiz@* identities that incorporate the many fragments into a new conversion, incorporating the multicultural resources within oneself. In this state, one accepts that "identity, like a river, is always changing, always in transition, always in *nepantla*" and "like the river downstream, you're not the same person you were upstream" (Anzaldúa 2002, p. 556).

This transformation into a new *mestiz@* consciousness requires putting *Coyolxauhqui* back together, thereby creating new personal and collective stories of a new form of hybridity that resist assimilation. In putting *Coyolxauhqui* back together, the pieces may not be in the same order as they were before, but the new wholeness of the reconfigured *Coyolxauhqui* is one deeply aware of the nature of these fragmentations, and returns with a new *mestiz@* consciousness that can see through the demands for assimilation and "turn the established narrative on its head, seeing through, resisting, and subverting its assumptions" (Anzaldúa 2002, p. 560). In repairing *Coyolxauhqui*, one begins to heal from the oppressive *arrebatos* that painfully fragmented you.

The next step makes the shift from having worked on one's own fragmentations and reconfigurations, into the important work of then, acknowledging that we are constantly negotiating and renegotiating *nepantla* in a constant reconstruction of ever-shifting identities, and are therefore life-long "in-betweeners" or *nepantler@s*. As we look outside our own struggles with ongoing *arrebatos*, we experience a "blow-up" or "clash of realities" where others' challenges in *nepantla* intermesh with our own. In our own walk down the path of *conocimiento*, an important stage is to then assist others walking their paths of *conocimiento* as well. *Nepantler@s* live on the bridges and facilitate passage between worlds for those also experiencing *nepantla* in addition to the fear and shock of having to negotiate these new worlds after their own *arrebatos*.

The final stage on the path of *conocimiento* is shifting realities, by which one acknowledges that others have realities that differ from our own, and that we can look beyond our individual separateness into an interrelatedness with others called *la naguala*. By acknowledging *la naguala*, we shift our own perspectives into that of others' such that compassion for their struggles overtakes and transforms investment in ourselves.

In negotiating our own shifting identities with the perspectives of others in *la naguala*, we are constantly in many positions of insider/outsider. Anzaldúa posits this state through the concept of *nos/otras*, where "nosotras" is Spanish for "us," but by placing a slash between "nos" (meaning us) and "otras" (meaning others), the concept of *nos/otras* conveys the mainstream narratives of dividing "us" from "them" within the larger reality that we are all "us." By embracing this concept, as the path of *conocimiento* would have us do, a form of deep healing can occur regarding the many splinters that the subaltern face. "The future belongs to those who cultivate sensitivities to differences and who use these abilities to forge a hybrid consciousness that transcends the 'us' versus 'them' mentality and will carry us into a *nosotras* position bridging the extremes of our cultural realities" (Anzaldúa and Keating 2000, p. 254).

Anzaldúan theories in science education and the science teacher as a *nepantler@*

Anzaldúa's theories help us as science educators to better see the disconnect and tension that occur when we ask students from non-dominant cultures to appropriate rigid, Western/

Anglocentric conceptions and languages of science without doing any work towards *conocimiento* and healing. What occurs too often with Latin@ students from non-dominant cultures is *desconocimiento*, as an act of self-preservation. Unexamined Anglocentric science concepts, presented to students through a banking model approach, or even when presented through an inquiry approach, become an *arrebato* that sends many students from non-dominant cultures reeling into a state of *nepantla*. The question then becomes, as science educators, can we be *nepantler@s* to guide these students through *nepantla* toward *conocimiento*? Can we actively take our own past experiences negotiating our own walks through *nepantla* and see our students within *la naguala* and as fundamentally *nosotras*? We feel not only that we can, but that we *must*. In doing so, guiding students to put *Coyolxauhqui* back together and heal from the fragmentations and compartmentalizations of a narrow Western science, we science teachers become not only *nepantler@*s, but we also become *curander@s* or agents of healing. In this act of walking through our own paths of *conocimiento*, we help our students also achieve theirs by helping students find the resources to emerge stronger, transformed, and recreated as new *mestiz@* identities that can traverse the worlds of Western science with a new strength, without sacrificing their other identities, languages, and resources. The science teacher *nepantler@* remembers their own painful struggles within a dominant world, and "by redeeming your most painful experiences you transform them into something valuable, *algo para compartir*, or share with others so that they too may be empowered" (Anzaldúa 2002, p. 540).

As *nepantler@* science teachers, we "facilitate passage between worlds," because "nepantleras are threshold people" and develop "perspectives from the cracks" (Keating 2006). "Nepantleras use their views from these cracks-between-worlds to invent holistic, relational theories and tactics enabling them to reconceive or in other ways transform the various worlds in which they exist" (Keating 2006). Science teacher *nepantler@s* must use their own experiences walking through *nepantla* to inform their ability to help their students cross the borders they have become adept at traversing through their own transformations. In an interview, Anzaldúa said of *nepantler@*s:

> Nepantleras are the supreme border crossers. They act as intermediaries between cultures and their various versions of reality. […] They serve as agents of awakening, inspire and challenge others to deeper awareness, greater conocimiento, serve as reminders of each other's search for wholeness of being. (Anzaldúa 2003, p. 20)

Being a *nepantler@* in science education is not, however, without its consequences, as all the authors can each attest to. "Their inability or refusal to remain within a single group or worldview makes them vulnerable to rejection, ostracism, and other forms of isolation" (Keating 2006). A science teacher *nepantler@* breaks with the tradition of teaching science in traditional dominant ways using the dominant language and methods. In doing so, a science teacher *nepantler@* is in some ways a radical, laying bare her/his own existence and pain to help others across the typically heavily-guarded "gate" of science in ways that heal and recreate in strength, instead of strip away and subtract. A science teacher *nepantler@* holds back nothing to help her/his students in *nepantla*. In walking between the dominant worlds of science and the worlds of Latin@ students and becoming a bridge and calling that bridge "home," a science teacher learns to live with the *arrebatos* of colleagues and the dominant structure and negotiate those into *conocimientos*. It is our hope that in opening up our practices as *nepantler@* science educators, we welcome those new to these ideas into *la naguala* of our reality with our students, in hopes that we can

broaden our *curanderism* to acknowledge the broader community of science educators from a place depicted as *nos/otras*, to a place where we can all take on science education as *nosotras*.

How we came to study our teaching through *Nepantla*

This study is the result of a collaborative effort of a team of teachers, researchers, or both, who work in the science and/or mathematics education fields in formal and/or out-of-school education programs. Our experiences span across elementary, middle, and high School grade levels in the Southern, Southwestern, Eastern, and Midwestern regions of the United States. In all of these educational settings there was either a predominant or significant student population of Latin@s. Through online social networks with visual information and face-to-face meetings, the team met several times to discuss issues of science education of Latin@ students in relation to Anzaldúa's sociocultural theory and to each author's own experiences. Based on these discussions, the team selected foundational themes from this theoretical perspective and explored them in each author's own data. Selected examples were collectively discussed and analyzed in the light of the theoretical argument. All of these examples are representative of the different bodies of data included in this study.

Context of the studies

Among the various studies included as examples to the overarching theoretical discussion, we present Carlos' study of *Los Rayos* (Khisty 2004), an afterschool program in a large urban area in the Midwest designed to better understand the language and cultural resources Latin@s use as they engage in tasks including mathematics and science. *Los Rayos* is an adaptation of other after-school projects, such as *La Clase Mágica* (Vásquez 2003). The 25 students in the program worked with undergraduate facilitators on problem-solving situations in small groups twice a week for 90 minutes each time. Every time the program met, students were to select the tasks they wanted to work on. The units included various areas that integrated science and mathematics through exploring time, community, and games. Students also selected the facilitators and peers to work with. During every session, students would write e-messages in either Spanish or English to *El Maga* describing what they had learned. All participants were bilingual Latin@s, and conversations around meaning-making tasks were encouraged to happen in either language. Students were attending a dual-language school in a neighborhood with a population predominantly from Mexican or Mexican–American backgrounds. The program started when students were in 3rd–6th grades. The *Los Rayos* example included in this paper was selected from the first year of the program. Throughout the program, the research team explored results and progress of the program. Carlos participated in this program and the selection of this example was done based on his knowledge and experience of the program as a participant observant and an extra analysis process of video data and facilitators' field notes gathered during the implementation of the program. This example shows the open structure of the program and the kind of tasks and environment that students commonly developed at *Los Rayos*.

Next, we present Deborah's self-study of practice through reflection, where the setting for this example was a first grade classroom in a Title 1 school located in a large

metropolitan area in the Mid-Atlantic region. Deborah reflects in first person: I was a first grade teacher, and happened to be fluent in Spanish. Because of this I was afforded the opportunity to work with the students who were native Spanish speakers, recent immigrants to the country, for math and science instruction. In choosing this example for this study, I wish to show that my goal as a teacher was for all of my students to learn science and math as it applied to their lives and made sense to them. It was my intention to find ways to connect the learning to the students who were in the classroom and to embrace and build upon the knowledge they already had.

The *PRISMS* (*Pupils Reflecting in Scientific and Mathematical Studies*) study presents how Diane, Gilberto, and Carol collaborated on an in-depth qualitative study in a dual language classroom. Gilberto Lobo is the 6th grade dual-language science teacher, Carol served as a consultant, and Diane conducted the research for this project. Student participants were selected somewhat strategically from the entire class of Gilberto's 4th–5th–6th period block of mathematics–science–Spanish class. In this dual language program, class content was integrated across school periods. Students learned that science and mathematics can be used to represent their class, family, community, and social context (Torres-Velásquez and Lobo 2005.) Gilberto is part of a dual language teaching team. During the year of the study, the school day was divided into two blocks. One block was taught in English, the other in Spanish. All of Gilberto's teaching was and continues to be in Spanish. At the time of our study, teachers kept the same students for three periods of the day. Their instruction was not broken down by subject area, but rather subjects were integrated across the 3 hours of instruction.

All students were observed as they participated in all class activities and lessons. Gilberto was also interviewed once before and once during the teaching of the unit, and then once after teaching the unit on the reproductive system. All lessons were videotaped and transcribed for the purposes of observing interaction patterns. We looked for patterns of interaction and dialog between students, from student to teacher, and from teacher to students. There were 24 students in the class.

In finding the classroom and teacher for this research project, Diane conducted phone interviews with numerous district and professional organization experts on bilingual and dual language education in New Mexico, as well as church clergy in bilingual communities. Gilberto had been identified as an excellent teacher by the principal, by parents and students at the school, by the bilingual resource teachers of the district, and by the leaders of a dual language professional organization in New Mexico. Indeed, Gilberto has won six awards in his 16 years of teaching for his excellence as a dual language bilingual teacher. He had recently been featured by the PBS program, *American Graduate*, as models for other bilingual teachers and students.

This classroom is located in an area of town where many immigrant families choose to live when they first arrive in the city where we conducted our study. Latin@ students comprise 56.7 % of the total student population of the state and 66 % of the district in which this school resides. Typically, 20 % of the Latin@ population receives bilingual education. In this school, 20 % of the students are enrolled in dual language programs. In this classroom, in the year of this research project, about 98 % of the families spoke only Spanish or mostly Spanish in the home, even if the students were speaking mostly English to their parents. This is a classroom where the students were either born in another country or are first-generation U.S.-born citizens. These families are dealing daily with the issues of moving across borders and living in multiple realities and multiple worlds. The examples provided from this classroom demonstrate the ways Gilberto researches the context of his

students' lives with his students to inform his teaching, shape the culture of the class, and determine the ways our research found that he valued student language and culture.

Finally, we will each present ourselves in a reflection as a final example of what it means deeply and personally for each of us to contend with *nepantla* and try to be *nepantler*@s. Though we each come from different biographical and professional paths, we have found common bonds among each other in how deeply we can relate to "living on the bridges" of many cultures while finding ways to heal from *arrebatos* and move towards *conocimiento* for ourselves and for our students.

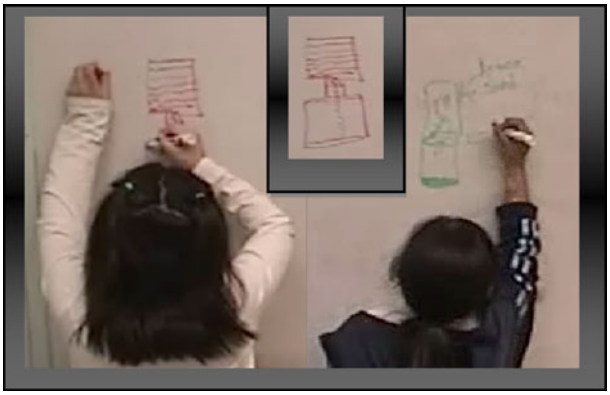
Examples of what we found on our journeys as *nepantler*@s

The authors bring various examples of educational ecologies from their paths as science educators and science education researchers to illustrate the many intermeshed aspects of Anzaldúan theory enacted within science education. Although the contexts of these examples vary by grade level, geography, formal/informal settings, etc., they hold some commonalities. What ties them together is the intentional inhabiting of the bridges of *nepantla* with bilingual, bicultural Latin@ students in ways that facilitate passages between worlds for these students into more wholistic approaches that respect both familiar cultures and dominant cultures of science, in manners that are multiple, interconnected, transformative, and healing.

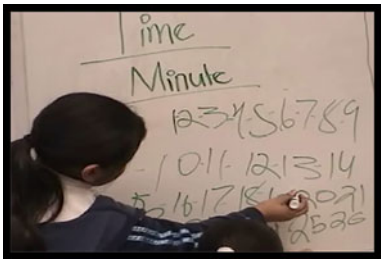
Example from *Los Rayos*

This example, from *Los Rayos* afterschool program (Khisty 2004), presents a group of three girls in 3rd grade (Betty, Candy, and Yolanda) working with two facilitators (Vicky—a research fellow—and Sandra—a Latina pre-service teacher) on a task that invited students to create their own hourglass and explore, describe, and measure time. This example is analyzed through the path to *conocimiento*. From the start, this group seemed excited with the materials (i.e., sand, jars, tape, plates, and straws, among other things). Yolanda changed the process by suggesting an experiment (finding buried nails in the sand) to the other girls. They played this game several times. All girls engaged in an inquiry process by using several objects as metal detectors.

Designing an hourglass The group eventually started creating the hourglass. They first brainstormed about how to construct the hourglass. For this, they drew possible designs on the board. These designs included ideas about how construct an hourglass considering the flow of sand and the use of time units. The facilitator asked the group to justify the amount of time they had agreed upon. They explained that 10-minute intervals would ease the process of keeping track of time. Betty said: "If it was 9 minutes and then it was done, and we need to turn it, it would be more difficult to do. So with 10 we can see quicker who does it the fastest, the other project." The group decided to use a base-ten-like system to measure time. This system was conceived to fairly measure the time in the game that Yolanda had suggested. The hourglass design not only served the purpose of measuring time, but also included the group's own goals. Additionally, the group organized a collaborative process of working in pairs to play and judge the game. The designs purposefully aligned with the girls' genuine goals and interests and those of the original task. This system turned into a more evident inquiry process that included the terms and demands of standardized scientific concepts and conventional teaching goals. Students posed the question: "How are we going to make the sand measure time? How do we know how much a minute of sand is?"



Measuring time in students' own terms. Several routes were suggested to measure the sand in relation to time; for example, Betty and Candy suggested writing on the board as many numbers as needed while the sand transferred down from one jar into the other. The goal was to find out a total of time (numbers) and then divide it into equal intervals—hopefully ten. The group had two students (Yolanda and Betty) write numbers on board and one (Candy) watch the sand flow. As the picture on the left portrays, students had identified these numbers as "time minutes." The final count between students was different and made them wonder about other ways of measuring. Moreover, as Betty affirmed that it had taken her 48 "minutes" to write on the board, Yolanda replied: "*No! If it was 48 minutes, you would've been here all day!* [It's] *48 SECONDS*!!" This input had the group switch units from "minutes" to "seconds." The units of time at this point seemed very arbitrary in contrast to standardized scientific or mathematical forms of measuring time. Here, we see an example of *arrebatos* as conventional science terms mixed in with the students' time-developed units and made *nepantla* evident. The facilitator (Vicky), concerned about the group straying from a valid scientific inquiry approach and being mostly engaged in a game, suggested switching the activity to pose math problems to each other and *El Maga*. The facilitator attempted to step away for the *nepantla* stage and maintain a *Coatlicue* state by negating this group the chance to face *nepantla*. The girls, however, so deeply engaged in the task, and since the program provided the option, took up the *compromiso* and continued the activity of measuring time.



The group, taking the *compromiso* and following their own ideas, decided to measure time in a new way and instead of numbers used tally marks. Their decision was based on the fact that when writing numbers on the board, within the same period of time, number size affected the amount of written numbers. Tally marks, then, represented a more

consistent format. In this new way, Betty's count equaled 208 "seconds." This count was based on the facilitator's prompt, and the group collaboratively converted into 3 minutes and 28 seconds. The group of 3rd graders, not fluent at multiplying and dividing, struggled through the process but figured this conversion out. When a facilitator asked them: "…*how come we used the same hourglass but the two times we measured it* [with numbers and with tally marks], *the numbers were so different*?", students recalled the ways they had measured time and concluded that their ways of measuring time (numbers and tally marks) were inconsistent; however, the flow sand between jars took the same length of time during both trials. Through this conversation, the group started working on putting their *Coyolxauhqui* back together by exploring both standardized measures of time (how clocks measure time) and their own. The group posed the question, "*What do real seconds feel like*?"

Conocimiento of standardized definitions of units of time. In the process of putting their *Coyolxauhqui* back together to understand/feel standardized time units the group, assisted by Sandra, looked at her watch and differentiated this kind of time unit from the ones they previously used. They watched the time from 3:56:00 PM to 3:58:00 PM. As the time passed, the group commented on what seconds felt like and anxiously they waited for the minute number to change. The group also inquired about larger time units, such as hours. This was done by thinking about real-life events. This could include, for example, the school schedule and TV programs. The group then wrote massages to *El Maga*. Even though students did not get a chance to go back to their original game idea, they had advanced a step forward on the process of organizing their *Coyolxauhqui* of the concept of time.

Although this situation could point out students' "limited" knowledge about time, the fact is that students utilized what they actually knew. They knew about and used the conventional terminology of standardized time, even of relations and conversions of time units, but this knowing did not guarantee their understanding of time conventions. In a way, these students *sabían* (knew) the terminology, but they did not *conocer* (understand deeply) the time-related concepts associated to these terms. Though students had their own hypotheses and conjectures about what seconds were or felt like, knew that seconds were smaller than minutes, and that seconds and minutes relate to each other in ratio of 60:1, they still had not made connections between these conventional time units and their usage of their everyday lives. The task of measuring and thinking about time and applying it to their own experiment, goals, and ideas allowed them to create their own ways to measure time and connect them to conventional scientific terms. Thus, their *compromiso* in the *nepantla* space mediated the *clash of realities* to emerge and have students developed meta-awareness about these two ways of using and knowing time. There were no wrong or right forms of measuring time, just different understandings. This open process supported students' opportunity to *conocer* the use of conventional, standardized units of time from their own terms. This process presents a group of students moving from a *Coatlicue* state in *nepantla* to a *Coyolxauhqui* state, an integration of multiple ways of knowing and understanding time; a process away from the *desconocimiento* of superficially using conventional concepts without understanding. The acknowledgment of the alternative ways of knowing time without reprimands allowed students to shift realities from *saber* (e.g., knowing a person's name) to *conocer* (e.g., meeting or knowing a person). When lack of connections between knowledges become the norm at schools, they create cumulative gaps leaving many students behind, not only in their knowledge and grades on standardized

scientific concepts, but also on a separate state of their ways of understanding and knowing science. In this situation, however, students became agentive beings, creators, planners, and developers of their own science activities wherein their ideas were valued and supported. This agentive process furthered their learning when various ways of doing and learning science intersected; together, participants shared their goals with an authentic learning experience.

Complex process of facilitating *conocimiento*

Although this process may seemingly appear effortless for the facilitators, they declared having experienced a very challenging situation by dealing with this unorthodox way of interacting with children. Facilitators mentioned in their field notes that the process was not obvious to them and often they felt unsure about the next step and often felt that things moved on too quickly to be able to respond appropriately. Vicky said: "*They* [students] *were all over the place and I felt incapable of orchestrating them.*" Sandra mentioned: "I didn't see any math in the experiment. They wanted to do their own experiment and I let them, hoping there was some math involved or that at least I could make some connections with math, but I wonder if that was the case?" Contrastingly, students seemed to have had a much clearer understanding of why and what they were doing. In their messages to *El Maga* students wrote:

> Betty: *Yo hice un* [I did a] project *con* [with] Yolanda, Sandra *y* [and] Candy. I put sand in a bottle and then we were writing on the board and we checked the paper so we could know what we were doing.
> Yolanda: I had a best day with Sandra, Betty, and Candy, because we were like doing projects and I like doing projects.
> Candy: Sandra showed me how to do time tables and they were kind of hard….our seconds were different from the clock's.

Students' comments portray agency, assertiveness, ownership, and enjoyment in their work about understanding and enacting scientific concepts and practices. Additionally, these comments also show that students knew what they were doing and they acknowledged having learned new concepts with the facilitators. Apparently, adults experienced *nepantla* when supporting kids' unconventional ways of doing and of understanding science and mathematics. Perhaps, this process seemed more genuine and meaningful to students, as they were the actors and creators of this approach of putting their *Coyolxauhqui* back together. For adults, this process provided an *arrebato* caused by the need to support conventional scientific/mathematical knowledge. It seems that the pressure of promoting conventional science or mathematics concepts interfered in facilitators' judgment of students' activity. It not only made *nepantla* evident, but it became evident efforts were made to avoid it. With this, we are not arguing that scientific concepts or teaching goals are

wrong, but we assert that the acknowledgement and support of what students know, the facing of a genuine *Coatlicue* state, promotes an integrative process of *conocimiento,* a learning process of multiple understandings and applications of the same concept.

What we think this example means in terms of being a *nepantler@* science teacher

We recognize that our perspective supports a paradigm shift about who needs to adapt or face *nepantla*. In this case it was for both—for students, as they developed new understandings about time, and for the teachers, as they needed to take the role as *curander@s* supporting students through the gaps between their sciences and identities and the conventional science. They all faced *nepantla* and engaged in a hybrid teaching/learning process that integrated and enacted the being and becoming a doer of sciences or mathematics in a dialogic pathway of ways of knowing that supported *conocimiento.* We question very structured, formal ways of teaching and learning science that overshadow or ignore students' agency and knowledge and theories about life and scientific concepts, because these approaches generate gaps between students' knowledge and scientific concepts, barriers that contribute to marginalize those students who need the most support. It is pivotal to be mindful of assumptions on students' usage of standardized terminology because it will often be infused with the students' own constructions of those terms. These alternative understandings of science or mathematics concepts are not wrong, but they represent the true lenses that children use when trying to understand formalized scientific and mathematical discourses. This disruption corresponds to Andalzúa's idea of *nos/otras* as different ways of knowing science often take separate pathways. Gutiérrez (2012) urges us (teachers and researchers) about the need to expand our current definitions and practices of academic discourses that demand students to adapt to these restrictive limitations to a *nosotras* approach of doing science where science opens up, and adapts to students' understandings and their cultures, to other sciences, and to other ways of knowing and doing science in order to promote deeper personal connections to understand and practice science, or *nuestra ciencia* [*our science*].

Example from La Luna

Change over time

All year we had been looking at different instances of change over time, especially through nature. We had already done monthly nature walks around the schoolyard, noticing that the plants and trees changed as the weather changed. Often, students would comment about how the vegetation on the East coast was different than where they had come from. Sometimes, we would discover things that students said were common to their countries. "Nosotros tenemos hormigas también, pero son más grandes que esos. ¡Y qué dolor cuando te pican!" [We have ants too, but they are much larger than those. And how it hurts when they bite you!] We were all learning together, because I did not have all the answers for the questions they were asking about the environment around us, nor did I pretend to.

Moon change over time

As another opportunity to look at change, I decided to do a unit on the moon, in order to show another way that things in nature, which are common to us all, change over time. The students each made their own moon journals, complete with covers that they painted

themselves. The task was for them to observe the moon every day, and record the following things: What did I see? What do I think? What do I wonder? The students were asked to draw a picture of what they saw in the sky and describe it in words. As a matter of safety, the students were asked not to observe the moon alone, but to actually go outside with a responsible member of the family. I sent a note home to the parents requesting that they make sure the students were not unaccompanied when they went out. We conducted our moon-watching activities for about 5 weeks (Roberts 1999). As was my practice for all classwork and homework in my classroom, I encouraged the students to write in their native language. When I sent out the weekly homework assignments, I wrote them in both Spanish and English. I wanted the students and their caregivers/parents to feel included and capable when doing schoolwork.

First moon sharing

On the first day of sharing the moon journals, I was amazed by the results. The first few students who shared each had a different picture of the moon. Some had full moons, some had waning moons, and some had waxing moons. As a teacher, I was somewhat in a panic, because this was certainly not what I had expected to happen. Then, I noticed Antonio sliding his moon journal under his legs looking very upset. I asked him if he would share his moon journal. He was very reluctant. He was doing everything he could not to let the tears spill out of his eyes. Finally he shared his picture and writing. "Se me cayó la noche, pero sin luna. Esperé un buen rato, pero mi mama me hizo ir a dormir." [Night fell, but without moon. I waited a long time, but my mom made me go to bed]. In my naiveté, I had not consulted any resources ahead of time, to see what phase of the moon we would be in when we started. And Antonio was exactly right—there had not been a moon the night before. The other students then started admitting that they had not actually seen a moon, but felt they were supposed to have seen one, so they drew a moon picture.

Deconstructing the observations

This began a conversation among the students about why their pictures were different. Some had misunderstood that they needed to draw what they saw. Others had understood perfectly, but wanted to have a moon picture anyway. I asked what difference it made if they drew things differently than what they saw. One student shared, "¿Cómo vamos a saber cuáles son los cambios, si no notamos bien lo que vimos?" [How are we going to know what the changes are, if we don't note well what we see?]. Another student wanted to know if they were all seeing the same moon—maybe it was different in different places. Other students then realized in order to find out if the moon looked the same, it would be necessary for all of the students to make accurate observations of what they saw. María Elena requested that the students write down the time that they saw the moon, in case they were not all looking at the same time, in case the moon changed with time—"porque, así, podemos ver la verdad!" [Because, this way, we can see the truth!]. Without a lot of intervention from the teacher, the students were able to set up criteria for making accurate observations, and even testing some theories (Is the moon the same at each of their houses? Is it different at different times of day?).

Constructing and reconstructing *conocimiento en comunidad*

Each day, the moon journal sharing discussions were rich and interesting. The student observations were shared in both Spanish and English. The English only students were asking their peers how to say sky, night and moon and yellow, etc., in Spanish. The students who spoke Spanish were sharing their writing and ideas in Spanish, and sometimes in English, other times in both. "Can he hear me, the moon? asked one student. "Me escucha, ¿o no?" [Can it hear me, or not?]. Quickly, the students noticed the changes in the moon and the patterns that emerged. If one child drew a picture of a waxing moon and another the waning moon, the students questioned each other. What side of your house were you on? Are you sure it was pointing that way? Look at your picture from yesterday—it wasn't pointing that way? How come it is going backwards today? Did you draw it when you were outside, and you just forgot when you went in? The task of moon journaling and learning had become a cooperative task. Each student was eager to hear about another's observations. They shared the responsibility of learning, and the responsibility of supporting each other *en comunidad*.

After the first week of moon journaling, several of the parents came to talk to me when they picked up their children from school. They were excited about the project and loved being able to assist their children with their homework. One parent shared, "In the United States, the way you do teach things is different from my country. It's been a long time since I went to school, so looking at the moon, and writing about it is a way for me to feel good about helping my son." Other parents enjoyed being able to help their children *write in their own language*. They felt valued and appreciated the opportunity not to feel left out because of their lack of experience with the English language. One mom told me that the homework had enhanced their time together as a family. "Todos los niños me ayudan limpiar la cocina después de la cena, porque todos quieren ir a ver la luna. ¡Mi esposo también!" [All of my children help me to clear the kitchen up after dinner because all of them want to go out to see the moon. My husband too!] Some parents had questions about the moon as well. One student had asked if his mom could come to our moon talks, "Pero tiene que venir mi hermanita con ella." [But my little sister needs to come with her]. I encouraged him to invite them both.

Más comunidad, cultura y conocimiento

As the moon investigations continued, science and family, and culture and community were shared. Students began telling stories that their families shared with them. One young woman shared that her grandmother warned her never to marry a man that you meet under a full moon. Those marriages always have problems. The students all weighed in on this issue. "I just won't go on dates on full moons," said one girl, looking over at her mom, "I'll just stay in with my mom." Another child shared what his father had told him about werewolves coming out on the full moon. Some children were in disbelief. "That's just a cartoon," they said. "Your dad is teasing you… right?" (Roberts 1999).

Parents and students brought in books from the library that were about the moon, or were stories that talked about the moon. The school librarian had a hard time keeping up with student requests for moon books and was encouraging students and their families to visit public libraries as well. The study of the moon, the "science" part of the curriculum was spilling into reading and even into writing. The ELL teacher shared with me some of the creative writing the students were doing in her class in both languages. "Yo nunca había visto una luna tan linda, como en mi país." [I have never seen a moon as pretty as in

my country]. It seemed moon mania was influencing all areas of learning, even in my classroom, one student wrote:

> I went to outer space last night with my family and we were walking around. Did you see us?

The benefits to learning in this unit were many; the students were able to construct knowledge about the changing of the moon, test their ideas, question each other, and share ideas and languages. But the best part of the learning was the learning about sharing community and culture. The children did it seamlessly and without hesitation. The parents came and went during our discussions, sharing and listening. We became one community, one group of learners, one group of scientists, making critical observations not only of the moon, but opening ourselves and our ideas to each other, leaving our old ways of identifying ourselves behind, and engaging in a new way—accepting and trusting each other openly and without reservation. Moon magic? Or, has the spirit of the moon goddess *Coyolxauhqui* blessed our walk on the path to *conocimiento*, as we worked to put her, and ourselves, back together?

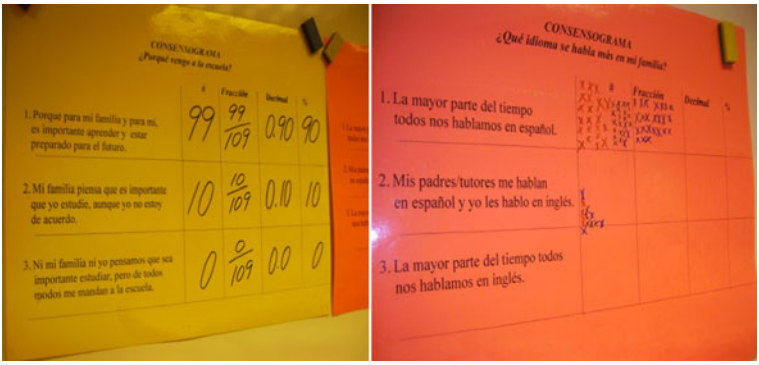
Example from PRISMS

Gilberto and the students relayed the importance of trust and confidence in interviews before, during, and after our research project. They talked about Consensograms, a social graphing activity that Gilberto conducted after the first week of class, once he has established their trust. Although the title implies consensus, it is actually an anonymous survey used as a tool to better comprehend the home, historical, and present context of the student and his or her family.

Gilberto and his students also talked about the many ways Gilberto teaches community cultural wealth (Yosso 2005) and uses the resources students bring, as identified in the Consensogram, in terms of cultural information. Questions included asking where students and parents were born, their current situation in terms of language use in the home, employment and education of the parents, and expectations of both student and student's family on why the student motivation comes to school. Gilberto uses all this information to bridge students to their potential future lives.

The Consensogram Gilberto prepares a set of posters and strategically places them in the room for students so that students cannot see each other post their answers. Each student writes an x in the box best representing their answer to his question. He then tallies all the marks and students provide the total for each answer, the fraction, decimal and percentage. He uses the data from the Consensogram to inform and guide almost all of his instructional decisions and his communication between home and school. In the process, students also learn mathematics (percentages and graphing) and geography. Among the questions Gilberto asks are the following:

- What language do you speak at home?
- Why do you come to school?
- Where were your parents born?
- Do you have a computer and internet access at home?
- What elementary school did you attend?
- Were you in a dual language bilingual education program at that school?



Becoming vulnerable to the rest of class and confiding in their teacher By the time the students provide data to the Consensogram, they know Gilberto's history as an immigrant himself. They know that he was a university professor of veterinary science in Mexico and worked menial jobs when he first moved to the United States in order to provide for his family. They know he is an award winning teacher, and many of their older brothers and sisters or neighbors have talked very highly of his teaching and his care for all students. They know that he struggled with many of the same battles his parents are currently enduring and that he crossed the border a different man than the man he is now, and yet they also know he is a highly esteemed professional in our community. Although they have not been taught the term *nepantler@*, they recognize him as someone who can help them through to their own *conocimiento*. He has dissolved the usual teacher/student barrier of nos/otras, and they now recognize him as one of *nosotr@s*. For this reason, he is allowed to ask the questions he asks of them, questions for which he has already provided the same information about himself to his students. Students answer anonymously and know that they are contributing to data about their class.

Conocimiento of who we are as a class and as individuals Information from the Consensogram supports Gilberto's teaching and curricular decisions in setting up a safe classroom environment with stimulating lessons and high expectations. By learning about the language use in the home, Gilberto is able to estimate the type of support that has been provided to students.

> **Gilberto**: We find that students who just moved from Mexico that have a strong educational foundation and use Spanish at home tend to succeed. The other dual-language students help them keep up and transition if they don't understand directions in the English classes. They keep writing in Spanish, and pretty soon they are writing in English in their English classes. Their self-esteem drops so bad if they are only learning in English. They even test better on the Standardized testing in both languages when they are in dual-language classes.

There is a notion that Latin@ students do not achieve, because they need special instruction or something extra added to the curriculum (Bartolome 1994). While one school of thought would provide culturally sensitive instruction, some have argued that use of this terminology may lead to a perception that some students need something extra in order to learn and that this might imply something is lacking or deficient in Latin@ students. The concept of culturally relevant pedagogy (Ladson-Billings, 1995) was very helpful in recent years as we looked at sociocultural theories and their application to

teaching practice. We suggest that the framework provided by Anzaldúa builds on these sociocultural theories and leads us in a new direction. How students are represented affects the space we give to the different ways of knowing and student voice or oppression of that voice. Gilberto sees his students as being in transition or in transformation, not as students needing to be fixed. He demonstrates in discussions how much he values what students bring to the science classroom and he often refers back to the data they provided on the Consensogram.

Conocimiento of some difficult challenges students may bring from home From data on the Consensograms, Gilberto can determine percentage of students whose parents are unemployed and their level of educational attainment. Some years, this rate goes up to 27 %, as many fathers are employed in construction. As a *nepantlero*, he knows that with unemployment, the parents are going through chaos, and that this brings a different form of *nepantla* to the home. The student will be struggling not only with the content of the class and culture of the school, but also with the instability of the loss of income in the home environment. Gilberto has also learned that most years, his students have more mothers with a higher level of education than fathers. This information helps Gilberto reach out to the families and informs him of what he needs to keep in mind as he communicates with the home. Having and utilizing this information helps the teachers in the dual-language team increase family engagement. They tend to get 97–100 % participation during parent–teacher conferences, a mark of a good *nepantlero* who is able to unite beyond the classroom and bring together family and community for a larger interpretation of the teacher/student/family/community enactment of *nosotras*.

The complexities of oppression, resistance and transformation Anzaldúa describes the feelings of suffering that come from oppression, resistance, and transformation. We need to remember that it is not only the student who is going through *nepantla* and crossing back and forth between borders, it is every member of the family. If the parents are going through changes of employment, or issues related to citizenship whether at the school or in the community, chances are the student will pick up on these feelings. One added benefit of the Consensogram is that the dual-language team has some information early in the school year that gives insight as to possible struggles occurring at home. Anzaldúa (2007) explains that during self-change, "[t]he struggle is inner:… our psyches resemble the border towns and are populated by the same people…" (p. 87) As *nepantler@s*, part of our work is to keep from mirroring the social inequities our immigrant students often see outside the classroom.

Gilberto gives students room to grow as they travel in and between worlds, all in the safety of the dual language classroom. The Consensograms provide a frame of reference for students to relate to their peers with mutual respect and shared affiliations. As Anzaldúa (2007) explains:

> Living in a multicultural society, we cross into each other's worlds all the time. We live in each other's pockets, occupy each other's territories, live in close proximity and in intimacy with each other at home, in school, at work. We are mutually complicitous–us and them… (p. 153)

Holding nothing back to activate spirit For many students in 6th grade, the topic of the reproductive system could be embarrassing or a matter of teasing and being silly. Students are well into their body changes, and the boys and girls are starting to demonstrate interest in the opposite sex or in relationships that go beyond friendship. Keating (2006) notes that Anzaldúa's use of spiritual activism demonstrates how this theory allows for the personal and structural to interjoin. In the first lesson of this science unit, Gilberto inspired his students with what Anzaldúa (2002) entitled *the call…el compromiso… the crossing and conversion:*

> With awe and wonder you look around, recognizing the preciousness of the earth, the sanctity of every human being on the planet, the ultimate unity and interdependence of all beings –*somos todos un país* [ibid] [we are all one country]. Love wells in your chest and shoots out of your heart chakra, linking you to everyone/everything…(p. 558)

By pointing out the awe and wonder of the reproductive system, Gilberto taught students the deep common connections we all have as human beings, and invited his students to study how we are connected to our environment and nature.

> **Gilberto**: Today we will begin studying something wonderful and miraculous! Have you ever wondered what would happen if we did not have the reproduction system? (long pause) Patricia, Do you like eating tortillas with your tacos?
> **Class**: Yes.
> **Gilberto**: Ah! The wonder of the reproductive system! Mario, you got to take home a gerbil a month ago to keep as a pet. How is he doing?
> **Mario**: He's gotten bigger. He likes to play in the round ball you sent home for him.
> **Gilberto**: Ah, the wonder of the reproductive system! YOU would not be here without the reproductive system! Your pets, the flowers, our food: none would be here without the reproductive system!

Cultural wealth: whose culture has capital?

Latin@ students' ability to use both languages is seen as an asset and as a tool for cognitive development in this dual-language classroom. While 90 % of Gilberto's students or their parents were born in Mexico, he does not see his class of Latin@ students as a homogenous group that can be stereotyped with typical narratives. They are not all mechanics working on their broken down cars in the driveway; they are not academic failures without any future. He learns from his students what jobs are held by their parents. Gilberto is fully aware of the stereotypes, the narratives, and the reality of crossing borders. His experience as a professor of veterinary science at a university in Mexico provides him with experiences to connect with his students. His classroom is filled with a large variety of living animals and living examples of the life cycle. Gilberto shares his participation by demonstrating his own capital across professions, countries, and languages, and shares with his students how this influences his teaching and the advice he gives them. He demonstrates an important aspect of his values and his ability to move across labels, jobs, professional communities and stay true to his core being.

Gilberto teaches the social and cultural capital of the Latin American culture, North American culture, and the Latin@ culture. He advises students on the expectations of the real world as they work independently or in collaborative teams. In observations and interviews of his teaching, Gilberto provided examples of the ways he teaches community cultural wealth (Yosso 2005) and cultural capital.

- Aspirational Capital—students demonstrated their knowledge of vocabulary and the human body parts associated with the reproductive system by simulating being a gynecologist. They had the opportunity to simulate a role that many would aspire to become as adults. They were required to speak and provide medical and scientific information at the level of a professional in consultation with a patient.

- Familial Capital—Gilberto took on the role of husband and took his wife (the class skeleton dressed up and with a wig) to see the doctor because they had now been married for a year and she had stopped having her period. He took her to the doctor so that they could both learn how babies are conceived, how to test for pregnancy and how to care for his wife and baby if she was pregnant.
- Social Capital—He interacted with the Dr. in the simulation before and after the Dr.'s visit, thanking the Dr. for the excellent information, and then asking the Dr., where she had received her outstanding preparation. (What school did you graduate from?)
- Navigational Capital—Gilberto made sure to get clear directions upon entering the Dr.'s office on where to sit, when to come in, etc.
- Resistant Capital—In discussing the reproduction of butterflies, Gilberto explained that animals migrate freely—birds and butterflies do not have to worry about fences or borders when they look for a healthy, safe habitat that will provide the food they need for themselves or their offspring to sustain themselves.
- Linguistic Capital—Gilberto provided multiple opportunities for students to learn the scientific language associated with the reproductive system. Students learned vocabulary in class; they practiced it in games and at home. They applied vocabulary in explanations in group setting and then in the role play and simulation activities.

What we think this means in terms of being a *nepantler@* science teacher

Gilberto embodies the *nepantler@* teacher by learning all he can about his students' demographics and family expectations, so as to better inform his teaching. He acts as an intermediary "between cultures and their various versions of reality" (Anzaldúa 2003, p. 20.).

He does not teach as if students are static linear objects to be shaped and molded, he does not believe that only by showing them that which relates to their culture can they understand. Instead, he sees his students as dynamic individuals who are fully participating members of a larger family at home, members of a community, members of a society that crosses borders, and now a significant member of this classroom. He holds back nothing to help his students into *nepantla*, including the data he collects from his Consensograms, stories of his life, and his passion for science. In fact, in his classroom he has about 50 varieties of animals. His students see the wonder and awe of science and share responsibility for the care of the animals as they watch them go through the cycle of life.

Yvette Lapayese (2008) states that "Latina/o children's identities are constituted by a complex mosaic of cultural fragments" (p. 168). In this science class, the students know that no matter the unit, their teacher is fully aware of where they come from, their languages and their values. They also know all aspects of their identities are honored at a time that they are going through their own *nepantla*, during a transformational period in which they find their lives and identities fragmented, conflicted, and changing. Thus, Gilberto is a true *nepantlero,* as described by Analouise Keating (2006): he facilitates passage between worlds. Gilberto uses a variety of teaching strategies to encourage students to see their full potential. By addressing the many forms of capital in this classroom, he helps his students "reconceive or otherwise transform the various worlds in which they exist." (Keating 2006, p. 9). In so doing, he does not disparage any of the fragments of his students' lives. Instead, he makes it safe for students to put their fragments back together,

and invites them on a journey of working toward a shared *conocimiento* that involves students, family, the community, society, and their teacher.

A reflexive example: our stories as science educator *nepantler*@s

As an additional example of what Anzaldúan theory looks like in practice in science education, we present ourselves as Latin@, bilingual, and/or bicultural science educators, as we have ourselves "lived on the bridges" of *nepantla*, constantly negotiating between many worlds and finding new ways to reinvent ourselves, putting ourselves back together, to function in the dynamic worlds we must traverse. As we walk in our own path of conocimiento and become more adept at living with *nepantla*, we reach the point of becoming *nepantler*@s for our students and communities. As *nepantler@s* science educators, we serve as agents to help others along their paths to renegotiate themselves with science, with education, with academia. But necessarily, as *nepantler*@s, we've also had to face the consequences of walking between worlds, and being misunderstood on all sides. Here are our stories:

Jean: I grew up as a half Cuban, half Panamanian in Miami, in a working class family with traditional Latin@ values. Entering into the world of academic science was, for me, like stepping onto another planet—a total culture shock. This was my deepest science-related *arrebato*: being the only Latin@ and one of only a handful of women in a deeply white, Anglo, male, middle-to-upper class dominanted field such as physics. I could have easily run away from such a situation into *desconocimiento*, but I didn't. In learning how to speak not only the language of science, but the language of this Anglo and male dominated world, I found new ways to exist within them, slowly going through the path of *conocimiento* into a place where I learned how to cross those bridges and persevere. Later, I found myself teaching science to many all-Latin@ classes in a middle school in East Los Angeles—I felt the calling of the last stages in the path of *conocimiento*, where I felt that others' struggles in *nepantla* could be informed and comforted by what I had learned from my own struggles—from my "perspective from the cracks." As a *nepantlera* science teacher, I walked alongside students who, much like me, had only known science as content to be learned *about* in a traditional school-like manner.

As a science teacher *nepantlera*, I found that the actual *doing* of science—the curiosity, problem-solving, inquiry, and the real messiness of science—became an act of healing for my students, who before this had been struggling in a *nepantla* of traditional content-knowledge of science as constant *arrebatos*, to the point of *desconocimiento* from science altogether. My students told me at the beginning of the year how much they hated science, because it was all difficult words and memorization. But by openly walking this path of *doing* science with my students in a way that acknowledged and spoke in their language(s), honored their culture, and developed family and community along the way, we forged new ways of being Latin@ scientists, and overcame science-phobia. By intentionally living on the bridges, and letting students be themselves as *una familia*, while still engaging in a more comfortable and real science. They put their own science *Coyolxauhquis* back together, but the pieces are still very much theirs. Many of my former students are now entering their first few years of college, and many are majoring in science. I spoke to one of my former students recently about how he's holding up, as he is now

an environmental science major at a predominantly white university, and he quoted a Francisco Alarcon poem, saying: "Mis raíces las cargo siempre conmigo, enrolladas me sirven de almohada." ["I carry my roots with me all the time, rolled up I use them as my pillow."]

Carlos: The experience of *nepantla* became evident to me when I arrived in the US. Back in Guatemala I had a privileged position by being a Mestizo. Indigenous people are greatly marginalized, this issue among others, represented one of the reasons for the civil war that lasted for over 30 years. When I arrived to the US this situation shifted and I started experiencing the circumstances that some of my indigenous students and friends had lived in Guatemala. Although I was empathetic with their struggle, I had no real understanding of it until I lived it through my own skin. As a teacher and a researcher in Chicago, I also witnessed how some bilingual Latin@ students were objects of discriminatory practices that often forced them into assimilative and subtractive processes in order to "fit" into US society. I believe that the *new mestiz@s* concept represents a hopeful construct supporting us in the process of healing our often fractured identities by trying to connect to the different worlds that we as bilingual Latin@s need to live in the US. This concept asks Latin@s, Hispanics or Chicanos to see the beauty, the power, and the peace of stopping the search for external links to the dual or multiple, inner nature of our languages, cultures, and identities, into an integrated one that comprises this compound way of being, living, and in the case of science and mathematics education, that we can see ourselves as Latin@s, Hispanics or Chicanos *conocedores* (knowers and doers) of *nuestras* (our) sciences.

Deborah: I cannot say with certainty when I reached the point of no return—no return to a space where mediocrity and blindness were acceptable. No return to a lack of awareness, pretending all is good, and fear of confronting. Through a complex process of experiences, and mentors along the way, pushing me to see what I had not seen before, I began to have a *connectionist* view. I took a humanizing pedagogical perspective to teaching and to living (Price and Osborne 2000) Recognizing that visibly the color of my skin provides a shield of protection and privilege that others do not have, but simultaneously, and not so visibly, other marginalizing life circumstances exist for me as well, makes it apparent that we are all *nos/otras*, and need to continue to reach with and for each other. We need to see all students as scientists and science capable, so that they can see themselves included rather than excluded. As *nepantler@s*, we need to start teaching in the way that each child learns, helping them to see themselves as an integral being, an integral part of schooling and society, *nuestras*, rather than forcing them to choose identities or ways of being, this is an *arrebato*, and then possibly – *desconocimiento*—in order to conform to the racist constructs that persist.

Gilberto: I think I've been fortunate to live in *nepantla* for a long time. While studying veterinary science in the UNAM, I had colleagues from different parts of Mexico as well as from different parts of Central America and South America. They came from different cultures, and they also had different socioeconomic backgrounds. This enhanced my way of seeing the world. When I was a professor at UNAM and as veterinary consultant in several pig farms in Mexico, I was once again fortunate to be surrounded by people from varying cultures and socioeconomic backgrounds that enriched my way of seeing the reality of the world in which we

live. Now, I am in the USA, living again in the world of *neplantla*. The past 16 years I have had the privilege of teaching science classes to 6th grade students in a dual language program. This has allowed me to learn more and more about the community I work with and to use my understanding of the *nepantla* way of life experienced by my students, their families and myself.

Diane: I started school early. By the time I entered my first day of school, my mother and father had provided lots of stimulation at home. By the age of four, I knew I wanted to be a teacher. I grew up living in a Mexican–American "barrio" during the summers in the city where I was born, San Antonio, and during the school year, I lived in the city where my parents had moved us for better opportunity. I place barrio in quotes, because only in graduate school was I formally taught that barrio meant poor and dangerous. This was one big *arrebato* for me; I always thought "barrio" meant a particular neighborhood. My first memorable *arrebato* came at the age of six, when my parents announced they were taking us from the extended family, neighborhood, language and culture that were our life force – our food, air and water and moving us far away. When I entered my new school in a new state, I was shocked to learn that I was not an English-speaker and that the people around me could not speak Spanish. Entering this *nepantla*, I remember the ridicule for the color of my skin and for the accent that I could not hear. Once I became a teacher, it was endearing to hear children on the playground using Spanish very naturally and hearing their accents as they were learning English. Hearing my native language, even to this day, strikes me to the core and feeds my DNA. Personally, I can identify with learners of English who can read every word out loud perfectly, but don't understand what they just read. As I watched my students force themselves to comprehend English, I remembered having done the same. When I began teaching, I went through a phase that was informed by formal Eurocentric teaching models and found they helped a little, but did not really help me connect with my students in ways that improved their learning. I found I was more successful as a teacher when I worked to help students understand and comprehend context and content in their native language and in English. As an elementary school teacher, I found that science was a magical space where only curiosity and inquiry mattered. Doing inquiry with hands-on science leveled the playing field for all students, including bilingual students and students with disabilities. Not only was this a space for greater social, language, and cognitive development, this was also a place where students could demonstrate their leadership and negotiate their identity without being labeled or prejudged. Given the tools of inquiry, I found my students' potential had no boundaries.

Carol: The authors of this article have applied the *nepantla* concept to Latin@ students in the United States educational system; however, the concept can be applied to any person whose experiences differ from those of a mainstream system. I was raised by my mother in the home of my grandparents who were immigrants from southeastern Europe. My mother and grandparents were multilingual in a number of eastern European languages. I am monolingual. My mother made it clear that I was to speak only English. She had a third grade education (as the oldest of five children, she was put out to work early). She felt that not knowing English as a child had made it difficult for her, so she did not want me to have the same experience. As an adult, when I read Richard Rodriguez's (1982) book, *Hunger of Memory*, I recognized a part of me had been lost because of my mainstream educational experiences and not

having access to the language of my family. In my life, several persons have served as *nepantler@s*. As a young child, I admired and sought to emulate Fran, a neighbor of immigrant parents. She convinced her parents to let her go to college (something not typically done at that time with girls in our neighborhood). She majored in biology and wrote to me. Because of Fran, I read extensively, especially science books. My high school science teacher encouraged my interest in science and had me apply for a summer science camp sponsored by a college in the region. I was one of 14 students from across the United States who gained a place in the program. When I graduated from high school, I was given a scholarship from that college and a job as secretary to the chemistry and biology departments. Faculty at the college encouraged my applications to graduate schools.

Because of the events that made it possible for me attend and be successful in higher education, as an adult professional, I wanted to make access to higher education possible for others. For 20 years I had personnel preparation grants that provided funding and academic supports for undergraduate and graduate students and training for these students to work with children and families from culturally/linguistically diverse backgrounds. Despite the fact that nearly 70 % of students in New Mexican public schools are from Hispanic and Native American heritage, these groups are markedly underrepresented in the university, especially at the graduate level. I am glad to now have the word, "*nepantler@s*." I realize that myself and my staff on these projects were *nepantler@s* for many first generation university students—we enabled students to value who they are, negotiate and be successful in the university system, and develop their own skills to become *nepantler@*s for others.

Interweaving Anzaldúa's theory into the previous examples

Our examples found that students made meaning and a sense of learning using their native languages, and with an acknowledgement of shared cultures and community. Science learning experiences made authentic connections to students' lives, and were open to their culturally diverse ideas. Because the students were variously exposed to open environments that allowed/encouraged participating in learning that was multilingual, multicultural, multi-affirming of the many varied pieces of Latin@ students' non-dominant cultures, they felt accepted and valued. According to the students and their families, they felt more comfortable in their transition from being mono-lingual (Spanish only) to bilingual as a result of the trust and respect they felt in the classroom. And as they did so, their abilities to feel safe to cross multiple cultural borders thrived, as well. Parents also felt that students' identities as Latin@s flourished because they were not coerced to give up their language, their cultural beliefs or backgrounds. A space that was not about us becoming them, *nos/otr@s*, but instead it is about us already being united with them, *nosotr@s*, and feeling safe to do so in solidarity with others walking together on the path of *conocimiento*. We found throughout the many studies that the Latin@ students' progress and growth was truly transformative, as was the progress and growth of the researchers and teachers involved.

In the formal and informal classroom examples we present, in a multifaceted and intermeshed way, the concepts of *nepantla*, *conocimiento*, and the work of science teacher *nepantler@*s in various science education contexts. *Los Rayos* showed how students negotiate ideas of time, a concept from the dominant world, into a new consciousness which then can become "theirs" as new *mestiz@*s, only through a path of negotiating and accepting these ideas through their own struggle, *compromiso*, and ultimately putting the pieces of *Coyolxauqui* back together in their own unique ways laced with their own cultural ways of doing, feeling, and understanding. The difficulties that the facilitators in the *Los Rayos* example had with allowing students to go through this complex process of having these dominant ideas become "theirs" through the process of *conocimiento*, illustrates the current problems that are dominant, Western approaches to education, from a teacher education perspective. The patterns of dominant science teaching still focus heavily on quick surface-level assimilation of content knowledge and getting the "right" answer as effortlessly as possible, which is an *arrebato* to many students, and should not surprise us that many students proceed into *desconocimiento*, under such an approach. Teachers should not be afraid of the messiness involved in the multidimensional path of learning through *conocimiento*, they must learn how to guide their students through the path, as science teacher *nepantler@*s.

In *La Luna*, we see how the initial *arrebato* of the fear of getting the moon picture "wrong" leads to deeper investigations that construct and reconstruct rigorous scientific observation, but in a recreated, deeply fulfilling process that interweaves the students, their families, their language, and their life stories and *consejos* in such a way that the doing of science moves past that initial *arrebato* and the possibility of *desconocimiento* that could have occurred, and into a unified whole that acknowledges culture, language, and family into a new *mestiz@* consciousness of science where students can deeply feel accepted and whole in the doing of science, rather than forced to assimilate to Western models of science appropriation. All this because a savvy science teacher *nepantlera* was there to acknowledge students struggles and pain, but not allow them to push the transformation away, and instead, to see them beyond it through a reintegration of their many fragments, putting *Coyolxauhqui* back together to create deeply healed and joyous journeys into science.

In our PRISMS example, we see the unifying and healing power of a nepantler@ teacher who deeply understands the fragmentation that his Latin@ students endure when trying to negotiate the demands of a dominant world and dominant concepts in science, and he does not try to hide it from them through *deconocimiento* of their realities, nor does he push dominant expectations on them through *arrebatos* that are insensitive to the *nepantla* states they are dealing with. Instead, from his own understanding of what it is to struggle between worlds, we find a *nepantler@* teacher who uses the commonalities of his students and the shared bonds of home, language, family, stories, and shared life struggles as a place of solidarity to undergo the path of *conocimiento* together, towards a communal healing and growing together into the dominant spaces of schooling and science, making them part of their multidimensional, *new mestiz@* selves.

In our own reflections, we, the authors, found that we walked through our own paths of *conocimiento*, informed by the many journeys we ourselves have had through *nepantla* in our own histories. Our conversations together as science educators and researchers led us to see ourselves as *nepantler@*s, who walk across the in-between spaces of various Latin@ cultures and the cultures of science, and negotiate the tensions there for ourselves as well as aid in negotiating these tensions for our students, which becomes an act of healing for students otherwise wounded by the imposition of harsh cultural barriers, who would

otherwise not have anyone to acknowledge this *arrebato* and ease them through it. In affect, each of us sees our role as a *curander@*, or healer, as we help students cross through the confusion and tension of being in *nepantla* on the way to learning concepts in school science, and through the path of *conocimiento* blend it with our sciences to result in *nuestra* science. We also come to realize and discuss that in doing so, we, as educators, also cross through *nepantla*, finding new and unexpected ways to transform science teaching for Latin@s, and find ways to also heal our multicultural, *new mestiz@* selves, as we create spaces for others' healing.

Encouraging transformative science: an act of healing from painful *arrebatos*

Being exposed to a rigid interpretation of dominant science, for students, is painful—it is culture shock and an *arrebato* that pushes students into *nepantla*. These dominant notions of what science education should propone in the classroom, with what Stanley and Brickhouse (2001) would term a universalist approach, informed by "Western Modern Science," or WMS, are Eurocentrically ingrained, individualistic, and knowledge and skills-driven. These *arrebatos* establish an exclusive and culturally subtractive monoculture. Western society often uncritically advocates and pushes these traditional models of science in schools where science is taught. Dominated by a positivistic "Universalist" (Stanley and Brickhouse, 2001) paradigm, this model is informed by Anglocentric and rigid views of the nature of science and what counts as scientific knowledge. As a result, a gatekeeping practice emerges and continues to exist between students that do assimilate into this culture of power (Delpit 1995) and students whose identities include other cultures and languages not aligned with the dominant culture. What results within science education is a cultural subtraction of Latin@'s broader interplay of multiple cultural expressions and values (Valenzuela 1999) for the sake of the singular accepted notion of what it means to be a "legitimate" and "promising" student in the science classroom, and in what it means to have a future in science. This, in turn, leads to a perpetuation of the hierarchy of Western/Anglocentric models of science, and a perpetuation in our science classrooms of student's expected complete assimilation, or else their disaffiliation (*desconocimiento*) with models of science that do not resemble the broader cultural diversity of students from non-dominant cultures, specifically here, with Latin@s, in our increasingly diverse classrooms.

Further, science education research often culls from studies with White middle class children and ascribes these data as "normal" and "neutral," ignoring the very biased racial and cultural standards that are hidden in this research that create a decidedly monocultural "white and privileged" science standard in the science education literature. Indeed, "we will continue to be limited in our understandings as long as we persist in ignoring race, culture, or gender" (Walls et al. 2013) but also we must be sure to acknowledge the intermeshed multidimensionalities of identities inherent in "that students are not simply of *a* race, *a* culture, or *a* gender, but are human beings affected by the interaction of all these systems" (Walls et al. 2013). With this study's intentional focus on Latin@ students, we are strongly entreating the science education community that "Remaining ignorant of the understandings of any group of children affects negatively the understanding of the educational community as a whole" (Walls et al. 2013) and these understandings are necessarily framed within a social structure of linguistic, political, cultural, racial, and historic power that mean specific things and has specific repercussions for Latin@s.

For these reasons our study is important not only because it shows results when it comes to bi/multilingual, bi/multicultural, critically conscious education in science in various settings for Latin@ students, but also, this study is of deep sociopolitical relevance. This study establishes firmly that Latin@ students are bi/multicultural, bi/multilingual beings (In fact, they are "*new mestiz@s*" of many intermeshed cultures) and that these aspects of their identity cannot be ignored by educators. In not ignoring these racialized facets of our Latin@ students, this study forwards necessary acts of resistance against dominant ethnocentric, English-only and Dominant-culture-only narratives, for the sake of what has been proven effective for Latin@s time and again. Further, this study takes a particular stand in embracing the ideas of Gloria Anzaldúa, much celebrated in the now-dismantled Mexican–American Studies program in Tucson, Arizona, precisely because her theories celebrate the bicultural/multicultural nature of Latin@s, demand that it be honored, and her book speaks out against dominant demands for monocultural assimilation, embracing the historic multitude of Latin@ identities and culture.

In our study, we put forth the ideas of a new Anzaldúan approach to science education that deeply acknowledges the racialized realities of Latin@ students, (and indeed, all students from non-dominant cultures). In not ignoring these historic racial, nativist, linguistic, and cultural realities, science educators can create a space for healing from the White, Western, Anglo-centric models of science that pervade perceptions in traditional science education that assimilation to these ideals is the only way to be "legitimate" within science. We advocate for a science teacher that can be a healer, a *curander@*, to these wounds *through* a science education that guides students through the *nepantla* between their own cultures and the culture and expectations of Western science. In short, we are asking for science teachers to become *nepantler@s*—critically conscious of their students' struggles and guiding them back to a place of wholeness after Western science had previously fragmented them; hence, creating a *new mestiz@* science that incorporates their cultures with the cultures of Western science in an integrative and holistic way.

Now "let us shift" from sociocultural to Anzaldúan paradigms: finding the *nepantler@* science teacher within us

The increasing diversity of students in schools calls for a shift in understanding how science education is understood and practiced. Relying on Western, Anglocentric models will not suffice, and to exclusively push those models onto diverse populations and disparage students who do not take to it readily is an act of symbolic violence. Anzaldúa's ideas demand that the *new mestiz@*, a mix of non-dominant and dominant cultures, dynamic and alive inside each of us be honored. We work in this study through sociocultural theories in science education to emerge into Anzaldúan theory. Much has been said in sociocultural applications to science education on Vygotsky's notions of appropriation of learning and the process of becoming and taking many socially constructed steps. Much has been said of these kinds of learning occurring within Lave and Wenger's (1991) ideas of a community of practice, and there has been much discussion about the need for "student culture" or "funds of knowledge" and "school culture/science culture" to come together to make a "hybrid" or "third space" (e.g., Calabrese Barton and Tan 2009). Ultimately, hybridity does need to occur. But greater attention needs to be paid to power differentials and the affective issues that play out when we push concepts from dominant culture onto students from non-dominant cultures. We fear there is a limited

perspective in science education research on the racialized experiences of Latin@ students in the U.S., and how this plays into the dynamics of science education with Latin@ students. This is where Anzaldúa's framework adds profoundly to the sociocultural discourse.

We understand that in any classroom necessarily dealing with Western science education, as well as in any school where students from non-dominant cultures are present, there are many cultures intersecting. Student non-dominant cultures are up against the dominant culture's school and science. This dual nature between student and school culture emerges as a perception of "us and them" or *nos/otras*. As we believe that the constraints of *nepantla* are heightened by society's emphasis on a dual nature of identity or scientific knowledge, we believe that they can be deconstructed. Gutiérrez (2012) asserts for mathematics education that a focus on *nepantla* helps us to move

> away from the idea that a unity umbrella (e.g., "mathematics for all") is the key to preparing teachers for a diverse society. *Conocimiento*, as a part of a larger cycle, is never complete or "fixed." So, it allows us to name the process and fragility/frustration that many teacher candidates (and students) will go through as they attempt to better understand their own views and uses of mathematics. (p. 46)

The intention then is to move away from colorblindness and to acknowledge diversity and include it in an integrated way that will prevent the marginalization of ways of knowing, doing, and being a scientist and being a person. We need, as teachers, students, and researchers to openly and critically point at, deconstruct, and challenge (take the square limiting box away from) colorblind perspectives in a humanizing and healing process of learning, accepting, loving, and being oneself as is, and with the potential of learning and expanding one's knowledges of sciences as a process of negotiating oneself into the dominant world.

How students are perceived deeply affects the space we give to students' ways of knowing and student voice, or to the oppression of that voice. We have noted a disturbing trend of Westernization, or Western appropriation of sociocultural approaches to serve privileged perspectives of education. Students' funds of knowledge are not merely data to be "used" to ease students' assimilation to expectations of traditional science learning. Students funds of knowledge are not the "other" kind of knowledge to inform what students "should be learning in school" and "should be" becoming. These misperceptions of sociocultural theories are dangerous, because they often lead to perspectives of fixing "what's broken" with the students in order so that they can "achieve" or become, something else. "Achievement" or "becoming" which usually entails students' looking, speaking, and acting like the Western interpretation of what a "good science student" should look, speak, and act like; thus, subtly but pervasively fading away who they intrinsically are. Anzaldúa proposes that people from non-dominant cultures are not broken, and they do not need fixing. However, demands from the dominant cultures will always come. What Anzaldúa proposes, is a way of dealing with those demands without fleeing in *desconocimiento*. And what we propose, are science teacher *nepantler@s* who deeply understand this *arrebato*, acknowledge it, and work alongside students caught in these in-between places, in *nepantla*.

Ultimately, students who cross borders between dominant and non-dominant cultures will become hybrid as sociocultural approaches to science education have discussed. However, this is the last step of the path of *conocimiento*—when a *new mestiz@* emerges. There is much more to consider beyond this "dual nature" perception between students and dominant science and culture, and the final desired step of a hybrid, or *new mestiz@*,

student in science. What still needs to be understood is everything that happens between one and the other: there is a path of culture shock, pain, and possible rejection (*desconocimiento*) or negotiation (*conocimiento*) of these tensions, which is a slow and messy path towards hybridity, or *new mestiz@ consciousness* in science. This path cannot be ignored: hybridity does not happen just by willing it so. We feel that a good teacher *nepantler@* has a profound role to play in this slow and messy path towards *conocimiento*.

It is important to admit to ourselves that *nepantla* is ever-present in our lives and in our classrooms and is not going away. We as teachers, students, and researchers will unavoidably encounter this ambiguous state of *nepantla* as a necessary consequence of power dynamics in a classroom. Thus, we believe that the only process of dealing with *nepantla* is by acknowledging it, becoming conscious of it in order to support equitable and transformative pedagogies. We have argued that this transformative process will take place neither by ignoring the differences nor by rejecting or privileging one side of the dilemma. These dismissive pathways will only lead to more *arrebatos* and to *desconomiento* and will fracture and marginalize the scientific and personal trajectories of many students. Instead, the pathway of *conocimiento* leads to a healing process that integrates and complements these rejected areas with the dominant, privileged, and conventional side, uncovering through *conocimento* that the barriers and constraints bestowed on each side are constructions of divisions, that although pervasive, are still just constructions. And so, with this deep realization, a *new mestiz@* can emerge that is at once made of many cultural dimensions, and yet is newly whole: an integrated creature that walks through many worlds, and embodies all of them simultaneously in a new, reconstructed self.

The *new mestiz@* state of mind, or inner situation, brought into consciousness, if embraced and encouraged, will correspond to a healing and reconstructive process (i.e., being hybrid, dynamic, of many worlds and of no one particular world, but to "live sin fronteras"—live without borders). We propose a new inclusive, Anzaldúan, *new mestiz@ science education* which is neither entirely Western, nor entirely Indigenous, nor entirely based in Funds of Knowledge, third space, etc.—but is an integrated approach that acknowledges the gravity of the intergration with respect to power differentials and the ever-presence of *nepantla*. We propose that we come out of the box of a dual nature, either/or, *nos/otras* mentality, emerging into a wholeness that lives without frontiers, unites *nosotras*, and in emerging as a *new mestiz@,* acknowledges the painful *nepantla* from which she was born and returns to it as a *nepantler@*, ready to integrate new cultural clashes yet again. We envision teachers, then, as *nepantler@*s for their students—to understand that they *are* going through *nepantla*, and to embrace their students' many selves and be the bridges in their border crossings towards more integrated wholes. As students are guided by an understanding *nepantler@* towards *conocimiento* instead of *desconocimiento*, they can be taken on the multi-step journey on the path of *conocimiento*, together with teachers that understand that we are *nosotr@s*, and not a separated *nos/otr@s*.

Nepantler@ teachers must acknowledge that their job is not to try to subtract their students' non-dominant cultural aspects so that they can just "become" the dominant (which is another giant *arrebato*), but rather, a *nepantler@* teacher takes the last steps of *conocimiento* and embraces *la naguala*, where one is able to shift their own realities and in shifting, acknowledges that others have realities that differ from our own. This requires a disavowal of liberal ideologies of "colorblindness" and the idea that all students are the same, and should be treated the same irregardless of race, ethnicity, language, culture, etc. To embrace *la naguala* entails the necessity to deeply *conocer* the other, and in so doing, one must acknowledge their many multidimensional selves, including their non-dominant

selves and the struggles those selves entail within a dominant world. As Anzaldúa (2002) explains of *la naguala*:

> When you include the complexity of feeling two or more ways about a person/issue, when you empathize and try to see her circumstances from her position, you accommodate the other's perspective, achieving *un concocimiento* that allows you to shift towards a less defensive, more inclusive identity. When you relate to others, not as parts, problems, or useful commodities, but from a connectionist view, compassion triggers transformation. (p. 569)

Science teacher *nepantler@s* embrace *la naguala*, and in so doing, negotiate shifting identities with their students which are constantly in many positions of insider/outsider, but acknowledge the shifting interplays of power and privilege, and the many racial, linguistic, and cultural dynamics in an open way that does not deny the struggles and tension of the ever-present *nepantla*, but does their best to work together in community with one's students, acknowledging their many different realities, towards the collective co-construction of *new mestiz@* consciousness. A *nepantler@* science teacher is not interested in students as parts to be divided, problems to be fixed, or commodities towards some other ends, but as deeply multifaceted wholes with real struggles as they negotiate between many worlds, and where "la nepantlera proposes individual and group rituals to contain volatile feelings and channel them into acts of *conocimiento*" (p. 568). It is important to recognize the nature of the in-between state of *nepantla* is not meant only for Latin@s. It is not meant to be placed in a parentheses for only "those students, over there." We propose this shift in consciousness, this shift towards an Anzaldúan paradigm, so that we all can stop fragmenting ourselves, our students, our science, and our education. What this shift means is no longer being broken into pieces, but putting forth an assertion of a way of being, that is not new, but is newly acknowledged. We are calling for a broader understanding of the students we teach and the struggles they endure, and in these openings of the heart, for all teachers, to "live sin *fronteras*: Be a crossroads" (Anzaldúa 2007). We call for a shift to a *new mestiz@* science.

> We are ready for change.
> Let us link hands and hearts.
> Together find a path through the dark woods
> Step through the doorways between worlds
> Leaving huellas for others to follow,
> Build bridges, cross them with grace, and claim these puentes our "home"
> Si se puede, que asi sea, so be it, estamos listas, vámonos.
> Now let us shift. -Anzaldúa (2002, p. 576)

Dual Language teaching can be viewed at the following URL (New Mexico PBS) http://www.youtube.com/watch?v=w6p1ojsZydg#t=45.

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