



# **Conocimientos and the borderlands of identity from Mexican American women in Engineering and Computer Science (Work in Progress)**

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## ***Conocimientos* and the borderlands of identity from Mexican American women in Engineering and Computer Science (Work in Progress)**

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### **Abstract**

The purpose of this study was to examine how Mexican American women in engineering and computer science utilized Anzaldúa's borderlands of identity and *Conocimientos* to successfully navigate between Mexican American cultures and engineering and computer science cultures. Understanding how they navigate their journeys through engineering and computer science will encourage scholars to create education spaces and structures to heal students and communities within higher education. Using secondary analysis, preliminary findings show that Mexican American women students experienced different stages of *Conocimientos* during their engineering and computer science journeys, as well as borderlands of identity. Several of the participants experienced *el arretrato* and *Nepantla* as they experienced life-changing events in their educational pursuits and at times felt split between their obligations as a "good Mexican American daughter" and their duties as a student. Finally, many of the Mexican American students experienced later stages (*el compromiso and blow-up*) when discussing their future goals, with many of them wanting to utilize their *Conocimientos* and their engineering and computer science technical skills to give back to their communities.

## ***Conocimientos* and the borderlands of identity from Mexican American women in Engineering and Computer Science (Work in Progress)**

Out of close to 2 million students enrolled in 2018, only around 2.8% of Latina students earned a bachelor's degree in science and engineering [1]. In engineering, Latino men earned 3.5 times the number of bachelor's degrees in engineering as Latina women did [2] while Latina women make up only 2% of all computing bachelor's degrees [3]. Previous literature on Latina students in engineering and computing within higher education has shown the importance of identity formation and community cultural wealth [4] [5], having a strong network of support from peers, advisors, and faculty, particularly those from the same race/ethnicity [6] - [8], and interventions that used collectivism and increased self-efficacy to improve department climate [9].

However, such research rarely engages writer and philosopher Anzaldúa's writings as a possible way to understand clashing of cultures that Mexican American women may face as they enter their engineering and computer science disciplines. Prior research has demonstrated that Latina youth in the K-12 population are *Nepantleras* in a constant state of *Nepantla*, or existence in the space between two separate cultures [10]. At the higher education level, Latina students, particularly those who have grown up in predominantly Latinx or diverse contexts, may similarly experience culture shock and differing values upon arriving at a predominantly white institution.

The purpose of this study was to examine how Mexican American women in engineering and computer science utilized Anzaldúa's borderlands of identity and *Conocimientos* to successfully navigate between Mexican American cultures and engineering and computer science cultures. This research project was guided by this research question:

- How do Mexican American women in engineering and computer science experience borderlands of identity and *Conocimientos* between Mexican American cultures and engineering and computer science cultures?

Understanding how they navigate their journeys through engineering and computer science will encourage scholars to create education spaces and structures to heal students and communities within higher education. In addition, as a work in progress, this study is meant to push new theoretical boundaries on utilizing Anzaldúa's writings to research the experiences of Latina students and encourage other engineering education scholars to delve more deeply into her work.

### **Conceptual framework**

We primarily used Gloria Anzaldúa's *Borderlands* [11] and *This Bridge Called My Back* [12] writings as the conceptual framing for this study. In *Borderlands* [11], Anzaldúa first discusses her experience as a Mexican American woman being split between two cultures, or *Nepantla*. *Borderlands* theory explores the concept of living life at the intersections of various identities and cultures, focusing on issues of ambiguity, power, and oppression around those experiences. We, and others (e.g. [13]) posit that engineering is a borderlands space in which Latina students navigate their existence within an in-between state – in between their cultural origins and home communities and the often exclusionary spaces of engineering. As such Mexican American women students may experience conflict moving back and forth between these spaces, however,

Anzaldúa states that a transformation must happen in which an individual grows into a new self. In *This Bridge Called My Back* [12], Anzaldúa introduced the concept of *Conocimientos* as the healing process of shifting realities within the self. She explains that the seven stages of *Conocimientos* consist of *el arrebato*, *Nepantla*, the Coatlicue State, *el Compromiso*, putting Coyolxuahqui back together, the blow-up, and finally, shifting realities (explained in Table 1). For the purposes of our paper, the concepts of *Borderlands* and *Conocimientos* work together to explore how Mexican American women in engineering and computer science experience borderlands of identity and *Conocimientos* between Mexican American cultures and engineering and computer science cultures.

**Table 1. Stages of *Conocimientos***

Stage	Description
<i>El arrebato</i>	A rupture or fragmentations. An ending or beginning where you are forced to look inward to your identity and change it (major life changes).
<i>Nepantla</i>	Feeling of being torn between identities (in-between space).
<i>Coatlicue</i>	It allows us to make meaning out of our painful experiences and disappointments. It's a paralyzed psychological state that can lead us to become more of who we are. A rebirth of the new sense of self.
<i>El Compromiso</i>	Letting go of stagnant parts of their selves. Give up the parts that are too comfortable and out modeled.
<i>Putting Coyolxuahqui together</i>	From the destruction, reinventing the self and putting the pieces back together.
<i>Blow-up</i>	Using spiritual techniques along with activist tactics to help sooth frustrating thoughts and feelings.
Shifting realities	Final move through and away from pain, healing wounds, and forgiveness where needed.

## Methods

We used a semi-structured multi-interview phenomenological approach to investigate the trajectories of 6 undergraduate Mexican American women majoring in engineering and computer science fields at a tier-one predominantly white university (see Table 2 for participant information). Students completed two interviews (each approximately 1 hour), with the second interview consisting of an artifact discussion in which students were asked to bring in five items that represented their identities and connect those items to their engineering or computer science identities. This study is part of a much larger study on the STEM identity experiences of Latina undergraduate students (e.g. [4], [14] - [15]). We focused on Mexican American women and the areas of engineering and computer science because we saw the greatest challenges present for students who possessed these identities and were situated in these fields. Using secondary analysis, we analyzed interview data utilizing concepts from Anzaldúa's *Borderlands* [11] and Moraga and Anzaldúa's *This Bridge Called My Back* [12]. Trustworthiness activities included prolonged engagement with participants and transcription member-checking.

**Table 2. Participant Information**

Pseudonym	Major	Classification	SES	First-Gen Student?	Parent Education Level	Primary Language Used at Home
Ana	Engineering	Senior	High	No	Mother: Bachelors Father: Masters	Spanish
Ashley	Computer Science	Junior	Low	Yes	Mother & Father: Middle School	Spanish & English
Cindy	Computer Science	Senior	Middle	Yes	Mother: Junior High Father: Elementary	Spanish
Lydia	Engineering	Senior	Middle	No	Mother: High School Father: Bachelors	Spanish
Sofia	Engineering	Senior	High	No	Mother & Father: Some College	English
Victoria	Engineering	Senior	High	No	Mother: Masters Father: Associates	English

### **Preliminary findings**

Preliminary findings show that Mexican American women students experienced borderlands of identity as well as different stages of *Conocimientos* during their engineering and computer science journeys. Several of the participants experienced *el arrebató* and *Nepantla* as they experienced life-changing events in their educational pursuits. Finally, many of the Mexican American students experienced later stages (*el compromiso and blow-up*) when discussing their future goals, with many of them wanting to utilize their *Conocimientos* and their engineering and computer science technical skills to give back to their communities. In regard to the artifact analysis and due to the WIP nature of this study, we have not had the chance to fully analyze and engage with the wide range of artifacts that our participants brought to their interviews. However, we look forward to doing such analysis in the future.

### ***El Arrebató & Nepantla upon entering engineering and computing contexts***

Cindy, a computer science major, described the feeling of going to a predominantly white institution. Anzaldúa conceptualized this feeling as *el arrebató*, which she describes as a major life change that makes the individual take a major look inward to your identity. This is how Cindy describes it:

It was a cultural shock. The valley is 92%...it was awesome but at the same time it was scary like oh my God I didn't know how to deal with people... it was just scary for me at first.

Cindy mentioned that she came in her first semester with an undeclared major because she was not sure she wanted to do computer science for the rest of her life until she joined a group of women in computer science that made her feel more welcomed. She declared her computer science major on the second semester of freshman year.

Lydia, an architecture engineering major, experienced what Anzaldúa describes as *Nepantla*, or being torn between the two cultures. She describes that it was hard to relate to other women in the Latinx community:

...not a lot of girls want to go to engineering. So you're kind of just on your own...

These two examples are a good way to show that having a community within computer science and engineering and outside greatly benefits the student's successes.

### ***El Compromiso* and *The Blow-up* during coursework**

Many of the Mexican American women students interviewed wanted to use their degree to give back to the community. This feeling of wanting to improve Latinx communities, is described by Anzaldúa as the Blow-Up within the *Conocimientos* theory. It is essentially using specialized techniques along with activist tactics to help soothe frustrating thoughts and feelings, which in this case are toward geared toward our community.

Ashley, another computer science major described her feelings of wanting to give back to the community as the following:

...for education and for developing countries facilitate the internet access in remote areas maybe fix mobile application to learn algebra for teachers to use or make an educational game for students or something.... there was this mobile app that the students... did where during the... earthquake hit and the transportation infrastructure was all destroyed they made some app where the people who were going around collecting information and... it would send to the large database or wherever the central office was and... a lot more people were able to receive more help. That is what I mean by real world solutions.

### **Are shifting realities in the future?**

One of the stages of *Conocimientos* that was not represented with the Mexican American women students interviewed was the last stage, which is shifting realities. This could be due to the fact that all of the Mexican American women were still in the process of completing their undergraduate education and did not need to move on from their learning experience at the time of the interviews. Even though they were thinking of future plans of what to do with their newfound skills, they could not take complete action until they graduated. The Mexican American women were still experiencing some of the pain that is felt while getting a degree in computer science and engineering, which meant they could not heal or forgive as a means to shift their reality yet.

### **Discussion & implications**

This study builds upon previous works that posit that a borderland exists between the communities that these women are coming from and the worlds of engineering and computer science that they are seeking to become a part of during college (e.g. [13]). Preliminary findings reveal that as Mexican American women move through their engineering and computer science journeys, they may have a series of identity experiences that may begin with Anzaldúa's concepts of *el arrebató* and *Nepantla*, which look like a rupture, fragmentation, and feeling of being torn between two spaces, respectively. Then, later in their experience, they may be able to move from *el compromise* and *putting Coyolxuahqui together* through the *blow-up* stage in which they reconstruct their identities, using spiritual and activist techniques to heal from these

experiences and move away from the pain. Unlike previous studies on Latinas in STEM (e.g. [16]), which centered identity frameworks from outside of the Latinx community, this study utilizes a uniquely culturally-relevant Mexican American framework to more fully understand these experiences and contextualize the needs of Mexican American women in engineering and computing.

Implications for future research include:

- Investigating engineering and computer science (or computing) separately using Anzaldúa's writings, which could help researchers to delve more deeply into these two different contexts.
- Further investigating the differences between the first- and later generations of Mexican American women in engineering and computing, which could lead to a greater understanding of how those borderlands and stages of *Conocimiento* look differently for students of different generational statuses and connectivity levels with their country of origin.
- Gathering additional perspectives from Mexican American women in engineering and computing until data saturation has been reached.

Implications for practice include:

- Thinking of engineering and computer science curriculum as a journey of identity and creating supports that aid in identity development.
- Creating spaces for exploring identity development over the course of the engineering and computer degrees, particularly working with student-led Latinx organizations.
- Redesigning engineering and computer science spaces to be more culturally relevant and inclusive, rather than exclusionary and white.

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## References

- [1] National Center for Science and Engineering Statistics. 2021. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2021*. Special Report NSF 21-321. Alexandria, VA: National Science Foundation. Available at <https://nces.nsf.gov/wmpd>.
- [2] E. L. Anderson, K. L. Williams, L. Ponjuan, & H. Frierson, “The 2018 Status Report on Engineering Education: A Snapshot of Diversity in Degrees Conferred in Engineering”, Association of Public & Land-grant Universities: Washington, D.C., 2018.
- [3] F. McAlear, A. Scott, K. Scott, & S. Weiss, “Women and girls of color in computing.” Data brief. Kapor Center, 2018. Available: <https://www.wocincomputing.org/#data-brief>.
- [4] S. L. Rodriguez, R. Estes, M. Sissel, & E. Doran, “Becoming La Ingeniera: Examining the Engineering Identity Development of Undergraduate Latinas.” *Journal of Latinos in Education*, 2019.
- [5] B. E. Rincón & S. L. Rodriguez, “Latinx students charting their own STEM pathways: How community cultural wealth informs their STEM identities.” *Journal of Hispanic Higher Education*, 20 (2), 149-163, 2021.
- [6] R. M. Banda, and A. M. Flowers, III, “Birds of a feather do not always flock together: A critical analysis of Latina engineers and their involvement in student organizations.” *Journal of Hispanic Higher Education*, 16, 359–374, 2017. Available: <http://dx.doi.org/10.1177/1538192716662966>
- [7] T. Coronella, “Validation Theory Into Practice: Asset-Based Academic Advising With First-Generation Latina Engineering College Students.” Unpublished Dissertation. Arizona State University, 2018.
- [8] J. P. Martin, D. R. Simmons, & S. L. Yu, “The role of social capital in the experiences of Hispanic women engineering majors.” *Journal of Engineering Education*, 102(2), 227–243, 2013.
- [9] B. E. Rincón and C. E. George-Jackson, “Examining department climate for women in engineering: The role of STEM interventions. *Journal of College Student Development*, 57(6), 742-747, 2016.
- [10] J. A. Mejia, A. Wilson-Lopez, A. L. Robledo, & R. A. Revelo, *Nepantleros and Nepantleras: How Latinx Adolescents Participate in Social Change in Engineering* Paper presented at 2017 ASEE Annual Conference & Exposition, Columbus, Ohio. 10.18260/1-2—28701, June, 2017.
- [11] G. Anzaldúa, *Borderlands/La frontera: The new mestiza*, 1987.
- [12] T. C. Bambara, G. Anzaldúa, & C. Moraga, *This Bridge Called My Back*, 2015.



- [13] M. M. Camacho and S. M. Lord, "Latinos and the exclusionary space of engineering education." *Latino Studies*, 11(1), 103-112, 2013.
- [14] S. L. Rodriguez & J. M. Blaney, "We're the Unicorns in STEM": Understanding How Academic and Social Experiences Influence Sense of Belonging for Latina Undergraduate Students. *Journal of Diversity in Higher Education*, 2020.
- [15] S. L. Rodriguez, A. Pilcher, & N. Garcia-Tellez, "The influence of familismo on Latina student STEM identity development." *Journal of Latinos and Education* 20 (2), 177-189, 2021.
- [16] Author, 2018. S. L. Rodriguez, C. Lu, & M. Bartlett, "Engineering identity development: A review of the higher education literature." *International journal of education in mathematics, science and technology*, 6(3), 254-265, 2018.