# WIP: Integrating Querencia into Engineering and Computer Science Courses

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## Abstract

In this work-in-progress research paper, we examine two LEES Program Themes—Colonialisms and Decolonization in Engineering and Sociotechnical Integration in Engineering Education—in the context of faculty-proposed teaching innovations in engineering and computer science. Specifically, we consider the ways faculty-proposed innovations incorporated decolonial and sociotechnical approaches after we began a focus on *querencia*. Querencia is a form of place-based or land-based education that emphasizes home-as-safety and belonging to, reciprocity with, and responsibility to place. We called for teaching innovation proposals from faculty and provided opportunities for them to learn about querencia. Seven faculty implemented teaching innovations. Using regression modeling of pre/post course surveys measuring engineering identity, design self-efficacy, cultural compatibility beliefs, persistence intentions, demographics, and instructionally-sensitive measures (relevance, learner agency), we found benefits from this approach.


## Introduction and Research Purpose

Beginning in spring 2024, we solicited proposals from faculty in engineering and computer science for teaching innovations. Initially, the call was broad and resulting proposals were varied. Of the awarded innovations that faculty implemented, we found better outcomes for the students of those who integrated a design challenge, compared to other approaches that focused on various forms of competition, scaffolding, and technology use [1]. In addition to the design challenges providing opportunities for students to use their agency in consequential ways, such learning experiences present engineering and computer science as sociotechnical fields, providing increased opportunities for students to make connections between their lived experiences and what they are learning [2, 3]. In our next call for proposals, we specifically invited ideas that incorporated a particular type of place-based learning, *querencia*.

In this ongoing project, we sought to investigate the impact that engaging faculty in teaching innovations on querencia might have on their students. In particular, we investigated students' persistence intentions, self-efficacy, and engineering identity, considering the degree to which students' demographics and instructionally-sensitive measures of relevance and agency might relate. We were guided by a research question: To what extent do the constructs of identity, self-efficacy, cultural compatibility, agency and relevance explain predict persistence intentions after students have completed a course that includes a teaching innovation?

## Theoretical Framework

Engineering persistence intentions (and related actions) are strengthened by the development of engineering identity and design self-efficacy [4]. Given the culture of engineering as "pale" and "male" [5], we also consider the role of perceptions of cultural compatibility. While these psychosocial factors are commonly associated with students' persistence and success, we are interested in instructional mechanisms that contribute to identity and self-efficacy. We argue that learner agency and relevance can be fostered through a place-based approach called querencia.

### *Models of Persistence Intentions*

Persistence intentions in STEM fields are commonly treated as positively related to identity and self-efficacy in the particular STEM field [4]. Self-efficacy, rather than being a general characteristic, refers to the confidence one feels related to specific disciplinary tasks [6]. In engineering, for instance, we can trace the development of a students' design self-efficacy as they take courses. In such studies of persistence, identity is typically treated as a doubled-sided sense of belonging, in which one identifies as a member of a field, and is also recognized by others belonging to that field [7]. In our work, undertaken at a Hispanic-serving institution, we have complemented identity with a related construct: cultural compatibility, defined as the degree to which one perceives compatibility or conflict between their own cultures and the cultures they experience in STEM.

### *Querencia*

Querencia is a specific type of place-based learning that focuses on emphasizes belonging to, having relationality with, or feeling safe in the land you inhabit [8, 9]. Querencia extends notions from place-based learning that argue humans ascribe meaning to specific places, particularly beautiful ones or those that hold particular histories [10, 11]. While commonly used in the geosciences and sustainability, place has received comparatively little attention in engineering.

Some researchers draw attention to the notion of safety, defining querencia as a place where one feels safe [12]. We ground our work in the use of the term found in Northern New Mexico [13]. As such, querencia calls upon us to grapple with complex histories of colonization, violence, and belonging. This complicates how people relate to the land itself, as well as their responsibilities to be stewards of the land. Querencia emphasizes relationality with place that aligns with many Indigenous cultures' understanding of nature that cannot be separated from humans. Querencia is thus a post-humanist approach [14], contending that land itself has agency and roles, such as collaborator or teacher [9].

### *Relating Querencia to Agency and Relevance*

Place-based approaches commonly enhance relevance, helping learners build understanding of situated understandings of academic content [15] and often through a sociotechnical approach, weaving together the technical aspects of place with its social and historical contexts [2].

We argue that for any type of place-based approach to tackle decolonial aims, learner agency should be foregrounded. In contrast with approaches that treat autonomy and agency as synonymous, we argue for a distributed and shared view of agency [16], as this aligns with querencia's notions of land as collaborator or teacher [9].

## Methods

To answer the research question, we used survey methods with a pre/post design.

We solicited proposals from faculty in engineering and computer science for teaching innovations in a Hispanic-serving R1 university in the southwestern United States. Seven faculty members participated in the program. Four faculty proposed projects related to querencia, while the others focused on AI. However, all faculty attended sessions to discuss querencia and facilitators encouraged faculty to explore ways to incorporate aspects of querencia. The teaching innovation faculty were from electrical & computer engineering, computer science, and mechanical engineering, and included first-year, core, and capstone courses. The proposed

querencia-related teaching innovations included a community-engaged design project with a high school on a tribal reservation (the professor had previously worked with the community and school) and replacing anatopic examples (e.g., skyscrapers) in a computer modeling/simulation course to include local architecture and designs (e.g., escaleras, acequias).

The survey, which included items previously subjected to validity studies, measured persistence intentions in engineering, engineering identity, design self-efficacy, cultural compatibility, demographics, and four instructionally-sensitive measures:

- Relevance of the learning experiences to engineering/computer science;
- Opportunities to make decisions;
- Sense of responsibility for making decisions; and
- Decision consequentiality.

Students completed the survey as a pre/post, required assignment for course/program improvement purposes. Only those who provided written consent (N = 553) are included in our analysis. Of these, 331 completed the post survey and 263 completed both surveys fully (Table 1).

Table 1. Participants who responded to the demographics questions on the survey

| | Number | Percent |
|---|---|---|
| Men | 553 | 80.30% |
| Women/Non-binary | 106 | 19% |
| Privileged race/ethnicity | 347 | 62.30% |
| Minoritized race/ethnicity | 208 | 37.30% |
| First generation | 114 | 20.50% |

We calculated descriptive statistics and conducted a sequence of regression models to explain variance in persistence intentions. Because we wanted to relate these to the teaching innovations, we specifically chose to develop a set of regression models that linked outcomes to the instructionally sensitive measures (relevance, opportunities, responsibility, and consequentiality).

**Results**

First, we report descriptive statistics related to the instructionally-sensitive measures (Table 2). Students reported, on average, somewhat high levels of relevance, opportunities, responsibility, and consequentiality, with the latter two higher than the former. As this is a post-only measure, it suggests that students tended to feel responsible and that their decisions were consequential, with slightly fewer reporting that what they were learning was relevant.

Table 2. On a seven-point scale, students reported somewhat high levels

| | **Average** | **SD** |
|---|---|---|
| Relevance | 5.4548 | 1.60119 |
| Opportunity | 5.0283 | 1.18731 |

| | | |
|---|---|---|
| Responsibility | 5.913 | 0.85018 |
| Consequentiality | 5.9382 | 0.86206 |

We used sequential, stepwise regression modeling, guided by theory, to investigate whether study constructs and demographics explained variance in end-of-course persistence intentions. Specifically, we tested likely direct predictors—engineering identity, design self-efficacy, cultural compatibility, and demographics—of persistence intentions. We then investigated the role of instructionally sensitive measures—relevance, opportunities, responsibility, and consequentiality.

Unexpectedly, design self-efficacy did not significantly predict persistence intentions. None of the instructionally-sensitive subconstructs were significant, nor was race/ethnicity. We share a parsimonious model (Table 3). We found that pre-course persistence intentions, end-of-course engineering identity and cultural compatibility, and gender explained significant variance in end-of-course persistence intentions, $F(4, 259) = 66.10$, $p < .001$, $r^2 = 0.51$). For gender, being a man was significantly related to lower persistence intentions, compared to women.

Table 3: Model 1: Parsimonious model explaining variance in post course persistence intentions

| | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | | | Tolerance | VIF |
| (Constant) | 0.76 | 0.50 | | 1.52 | 0.13 | | |
| Persistence Intentions, Pre | 0.27 | 0.06 | 0.20 | 4.26 | <.001 | 0.91 | 1.09 |
| Identity, Post | 0.48 | 0.07 | 0.43 | 7.00 | <.001 | 0.51 | 1.95 |
| Cultural Compatibility, Post | 0.28 | 0.06 | 0.28 | 4.71 | <.001 | 0.54 | 1.85 |
| Gender | -0.27 | 0.13 | -0.09 | -2.04 | 0.04 | 0.10 | 1.00 |

Next, we conducted stepwise regression modeling of the significant end-of-course predictors from model 1. First, we investigated whether demographics and instructionally-sensitive subconstructs explained variance in end-of-course engineering identity. We share a parsimonious model in Table 4. We found that relevance, opportunities to make decisions, and the consequentiality of those decisions positively and significantly predicted stronger post-course engineering identity, $F(3, 328) = 24.82$, $p < .001$, $r^2 = 0.18$).

Table 4. Model 2: Parsimonious model explaining variance in post-course engineering identity.

| | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | | | Tolerance | VIF |
| (Constant) | 2.53 | 0.49 | | 5.18 | <.001 | | |
| Relevance | 0.29 | 0.04 | 0.37 | 7.34 | <.001 | 0.99 | 1.01 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Opportunities to make decisions | 0.15 | 0.05 | 0.15 | 2.79 | 0.01 | 0.92 | 1.08 |
| Decision Consequentiality | 0.13 | 0.07 | 0.09 | 1.81 | 0.07 | 0.93 | 1.08 |

Second, we investigated whether demographics and instructionally-sensitive subconstructs explained variance in end-of-course cultural compatibility. We share a parsimonious model in Table 5. We found that relevance, responsibility, and belonging to a racial/ethnic group that is privileged in engineering positively and significantly predicted sense of cultural compatibility, $F(3, 328) = 33.74$, $p < .001$, $r^2 = 0.23$).

Table M=5. Model 3: Parsimonious model explaining variance in post-course cultural compatibility.

| | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | | | Tolerance | VIF |
| (Constant) | 1.93 | 0.50 | | 3.87 | <.001 | | |
| Relevance | 0.33 | 0.04 | 0.41 | 8.39 | <.001 | 0.98 | 1.03 |
| Responsibility | 0.27 | 0.07 | 0.18 | 3.62 | <.001 | 0.98 | 1.02 |
| Privileged Race/Ethnicity | 0.28 | 0.13 | 0.11 | 2.20 | 0.03 | 1.00 | 1.00 |

**Discussion**

In contrast to commonplace models [4], we did not find a predictive relationship between self-efficacy and persistence intentions. We instead found support for identity and cultural compatibility, two indicators that might reasonably be linked to querencia. In follow-up modeling, we linked these indicators to all four instructionally sensitive measures. These findings reaffirm the value of instruction that is relevant and offers learner agency, as these constructs contributed to students' sense of belonging in and cultural compatibility with engineering.

However, these findings come with limitations due to the preliminary nature of this analysis. Our analysis has not yet accounted for differences by level (first year, middle years, seniors). It is highly likely that more nuanced modeling will detect different patterns by level. Likewise, we lacked an adequate indicator of the degree to which instructors integrated querencia into their courses.

Importantly, our survey did not include a measure of querencia and its subconstructs. While measures exist for some related constructs, like place attachment, querencia is a more nuanced notion that requires significant attention, both to how it is used in New Mexico and how it functions as a fund of knowledge in learning settings. In our ongoing work, we are laying the foundation for instrument development by reviewing community artifacts, newspapers, grey literature, and peer reviewed literature, as well as conducting qualitative research to ground querencia in the learning process. This scale will provide an additional indicator that can be used

for tuning learning designs. Future studies will incorporate data from more semesters, allowing for more sophisticated analysis techniques, such as structural equation modeling.

Finally, we are redesigning the teaching innovations program to include greater support for faculty to learn about querencia. Rather than asking them to propose their ideas, they will instead join a community of practice during Spring that will support them to develop their teaching innovation, which will be implemented in Fall. The community will include faculty mentors as well as experts from anthropology and sociocultural studies to engage faculty in discussions of querencia.

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**References**

[1] V. Svihla, R. D. Lopez-Parra, D. Riley, E. Chi, and M. Moses, "WIP: QuantCrit analysis of the impacts of teaching innovations on student development," *Proceedings of the American Society for Engineering Education Annual Conference & Exposition,* pp. 1-14, 2025, doi: 10.18260/1-2--57439.

[2] V. C. McGowan and P. Bell, "Engineering education as the development of critical sociotechnical literacy," *Science & Education,* vol. 29, no. 4, pp. 981-1005, 2020, doi: 10.1007/s11191-020-00151-5

[3] E. A. Reddy, M. S. Kleine, M. Parsons, and D. Nieusma, "Sociotechnical integration: what is it? Why do We need it? How do We do it?," *Proceedings of the American Society for Engineering Education Annual Conference & Exposition,* pp. 1-15, 2023, doi: 10.18260/1-2--44239.

[4] M. M. Chemers, E. L. Zurbriggen, M. Syed, B. K. Goza, and S. Bearman, "The role of efficacy and identity in science career commitment among underrepresented minority students," *Journal of Social Issues,* vol. 67, no. 3, pp. 469-491, 2011, doi: 10.1111/j.1540-4560.2011.01710.x.

[5] A. L. Pawley, "Shifting the “default”: The case for making diversity the expected condition for engineering education and making whiteness and maleness visible," *Journal of Engineering Education,* vol. 106, no. 4, pp. 531-533, 2017, doi: 10.1002/jee.20181.

[6] A. Bandura, "Self-efficacy: Toward a unifying theory of behavioral change," *Psychological Review,* vol. 84, no. 2, pp. 191-215, 1977, doi: 0.1037/0033-295X.84.2.191.

[7] D. Holland, W. Lachicotte, D. Skinner, and C. Cain, *Identity and agency in cultural worlds*. Cambridge, MA: Harvard University Press, 1998.

[8] J. E. Arellano, "La querencia: La raza bioregionalism," *New Mexico Historical Review,* vol. 72, no. 1, p. 6, 1997. [Online]. Available: https://digitalrepository.unm.edu/cgi/viewcontent.cgi?article=3255&context=nmhr.

[9] C. R. Ault Jr, "Achieving querencia: Integrating a sense of place with disciplined thinking," *Curriculum Inquiry,* vol. 38, no. 5, pp. 605-637, 2008, doi: 10.1111/j.1467-873X.2008.00438.x.

[10] D. A. Greenwood, "A critical theory of place-conscious education," in *International handbook of research on environmental education*: Routledge, 2013, pp. 93-100.
[11] L. Scannell and R. Gifford, "Place attachment enhances psychological need satisfaction," *Environment and Behavior,* vol. 49, no. 4, pp. 359-389, 2017, doi: 10.1177/0013916516637648
[12] J. M. Causadias and E. W. Neblett Jr, "PARQUES: Dreaming a future for our Latinx children, youth, and families," vol. 53, ed: Taylor & Francis, 2024, pp. 129-140.
[13] V. Fonseca-Chávez, L. Romero, and S. R. Herrera, *Querencia: Reflections on the New Mexico homeland*. University of New Mexico Press, 2020.
[14] L. Forlano, "Posthumanism and design," *She Ji: The Journal of Design, Economics, and Innovation,* vol. 3, no. 1, pp. 16-29, 2017, doi: 10.1016/j.sheji.2017.08.001
[15] G. A. Smith and D. Sobel, *Place-and community-based education in schools*. Routledge, 2014.
[16] W. Rammert, "Where the action is. Distributed agency between humans, machines, and programs," in *Paradoxes of interactivity* U. Seifert, J. H. Kim, and A. Moore Eds. Bielefeld, Germany: Deutsche Nationalbibliothek, 2008, pp. 62-91.