



Establishing Quality in Qualitative Research with Linguistically and Culturally Diverse Research Participants

Dr. Amy Wilson-Lopez, Utah State University - Engineering Education

Amy Wilson-Lopez is an associate professor at Utah State University who studies culturally responsive engineering and literacy-infused engineering with linguistically diverse students.

**Karen Hazel Washburn Washburn, Utah State University
Indhira María Hasbún, Virginia Tech**

Indhira Maria Hasbun is a PhD student and Graduate Research Assistant in Engineering Education at Virginia Tech. She received her BS in Civil Engineering and ME in Environmental Engineering from Utah State University.

Establishing Quality in Qualitative Research with Linguistically and Culturally Diverse Research Participants

Qualitative research is becoming increasingly prominent in the field of engineering education as practitioners and researchers seek diverse methods for understanding the human dimensions of engineering.^{[1],[2]} All research, whether qualitative or quantitative, must meet standards of rigor and quality in order to lead to reliable insights that advance research and practice.^[3] However, due to the diverse methods and theoretical stances embraced by qualitative researchers, standards for quality vary significantly among those who engage in qualitative research.^[4] In the engineering education community, the most widely accepted framework for quality in qualitative research was initially proposed by Walther, Sochacka, and Kellam in the *Journal of Engineering Education* in 2013,^[5] and has since been expanded in subsequent publications.^{[6],[7]}

With great respect for this framework, we offer this critique as a means to further expand the framework by making it more rigorously account for linguistic and cultural plurality. Indeed, the authors of this framework have suggested that addressing the persistent problem of underrepresentation is one core reason for conducting qualitative research.^[8] Given that researchers of engineering education, like engineers, remain overwhelmingly White and middle class,^[9] we argue that additional validation strategies are needed for these researchers when working with underrepresented groups. This theoretical paper draws from our own experiences in working with culturally diverse youth, as well as methodological literature on qualitative inquiry writ large, to expand Walther et al.'s framework by making it account more robustly for linguistic and culturalism pluralism, and specifically for linguistic and cultural differences among researchers and participants in engineering education.

In this paper, we use Walther, Sochacka, and Kellam's framework as a starting point for identifying strategies for ensuring quality in qualitative research throughout the data generation and analysis process. This article contributed significantly to the field of engineering educational research by establishing a typology of validation constructs and process reliability for interpretive engineering educational research. At the same time, this article did not include the word "culture," name the race of the research participants, or account for the ways in which quality might include cultural responsiveness to populations, such as Native Americans, which have historically been exploited and misrepresented by researchers and educators from dominant cultures.^[10] In this paper, we seek to identify additional strategies for establishing quality in qualitative research with historically marginalized populations. We argue that cultural responsiveness, as well as a commitment to research that actively benefits marginalized communities, are two core components of quality in qualitative research that were not originally identified by Walther et al.

In the remainder of this paper, we use their six validation types—theoretical validation, procedural validation, communicative validation, pragmatic validation, ethical validation, and process reliability—as an organizational framework. Under each validation type, we describe how researchers can maintain cultural responsiveness during three phases: the conceptualization phase, the data generation phase, and the data handling phase. To identify additional validation strategies beyond Walther et al.'s framework, we conducted a search using the terms "culturally

responsive” in peer-reviewed qualitative methodology journals such as *Qualitative Inquiry* and *International Journal of Qualitative Methods*. If a validation strategy related to cultural responsiveness appeared in two or more articles, we discussed its application to Walther et al.’s framework and to engineering educational research in general. We then included it in our review. However, this review is not intended to be an exhaustive search or comprehensive systematic review on validation strategies, and thus there may have been validation strategies that we missed due to our limited search methods.

Theoretical Validation

Walther et al. define theoretical validation as the fit between the social reality under investigation and the theory that is produced. Qualitative research aims to capture the lived experiences of people and communities.^[11] With globalization comes the opportunity for researchers to observe and engage with research participants from a variety of linguistic, social, cultural and historical backgrounds.^[12] In recognizing such heterogeneity, researchers must consider the positionality of both themselves and these participants.^[13] Investigators can revisit their stories and identities, their prior experiences, preconceptions and biases and examine how these may hinder their understanding of the people they study.^{[11],[14]} When working with diverse communities, researchers must question how concepts transfer across cultural contexts as well as how differences (i.e. language, culture and ethnicity) may influence methodological tools and data interpretation.^{[14],[15]} And as no one can have complete knowledge of another’s lived experiences, researchers must work to not only better understand themselves and their limitations, but to also find and implement culturally responsive techniques when engaging in qualitative research.^{[11], [15]}

Conceptualizing the Study

Much qualitative research is “interpretive”: that is, it does not assume a one-to-one correlation between reality and the final research report.^{[1],[16]} Instead, it recognizes that perception—including both the perception of the participants and the perception of the researchers—permeates all aspects the research. Rather than attempting to minimize this, researchers can capitalize on it by consciously and actively seeking to incorporate culturally-derived theories of the research participants in all aspects of the study design. Accordingly, when conceptualizing the study, scholars (including, but not limited to, scholars from a dominant culture) can partner with scholars and community members who are familiar with, or who stem from, similar communities as those of the research participants. This strategy can help to ensure that the final theoretically-informed research report does not conflict with the theories held by the research participants.

For example, Geertz Gonzalez and Morrison^[17] argued that much of previous research on Latinx persistence in college was conducted under implicitly assimilationist views, which did not honor the diverse cultures of Latinx students. They argued that applying a LatCrit framework to these persistence studies would more fully illuminate issues surrounding Latinx persistence in college (both inside and outside of engineering programs) in a more culturally responsive way.

In practical terms, this strategy means that researchers in engineering education can:

- Assemble a diverse research team, including people who are familiar with or people who are from the population that is being studied, and consult closely with this team during the design of the study.
- Read, understand, and use the work of scholars whose theories or research designs account for the specific beliefs and practices of the cultural groups to which the research participants belong.

In terms of theoretical validation, this strategy can help to ensure that there is a fit between the social reality under investigation, as experienced by a particular cultural group, and the theory that is produced or extended in the research report.

Generating Data

Unfortunately, historically, much educational research has oversimplified and generalized underrepresented groups. Studies have made claims about African Americans or Native Americans, without accounting for the incredibly diverse characteristics of the people to whom these terms might apply.^[17] Consequently, when generating data, researchers should carefully select participants whose characteristics enable an investigation of the target phenomenon. For example, in our own studies of the literacy practices of “English learners” who engaged in engineering design,^[18] we worked with Spanish-speaking high school students who were newcomers to the US and new to the English language, as well as Spanish-speaking high school students who had lived in the US for several years and who felt comfortable speaking English but not comfortable with writing in academic English.^[19 (see footnote 1)] Each group used written English and Spanish differently when seeking for information about an engineering-based problem.

As indicated by this example, the term “English learner” encompasses people who possess a vastly diverse array of linguistic proficiencies as well as linguistic backgrounds (e.g., Spanish versus Chinese), which may influence how they can be supported in understanding and approaching engineering in primarily English-speaking classroom contexts.^[20] Thus, study designs that target “English learners,” rather than consciously focusing on more specific groups (e.g., students who speak Spanish as a first language and who are newcomers to the US), may not result in findings that can be transferred to engineering educators who work with other sub-groups under the same umbrella. Accordingly, when designing studies, researchers should generate data with the population that has the potential to most fully illuminate the phenomenon

¹ We acknowledge that the term “English learner” may represent a dominant perspective by focusing on the acquisition of English (a dominant language), versus focusing on the possession of a home language as a major asset. Like other scholars, we in many ways prefer the term “emergent bilingual” as an assets-based term that connotes the importance of both the home language and the target language. However, we used the term “English learner” in this paper because it is still common in much of empirical literature and in official policies and school designations.

under investigation, thereby resulting in a “fit” between the social reality under investigation and the theory that is produced. In practice, engineering educational researchers can:

- Avoid oversimplifications and overgeneralizations by carefully selecting participants whose characteristics hold the potential to most fully illuminate the specific phenomenon that is under investigation.

Handling Data

Walther et al. assert that theoretical validation requires the purposeful and systematic exploration of coherence and complexity. Coherence is explored by inductively identifying commonalities across data points, whereas complexity is explored by explicitly identifying tensions and contradictions across data points. When researchers carefully attend to both coherence and complexity, they minimize the risk of oversimplifying particular groups (e.g., English learners) because they explicitly acknowledge differences among this group.

Like many other scholars of qualitative research,^{[21],[22]} we assert that all research is theoretically informed: that is, researchers do not enter a study with a blank slate and let the data “speak for themselves.” To ensure that the research results in theories that are responsive to specific populations, researchers can test and compare inductively-generated analytic codes or themes against the previous theories of scholars whose work accounts for the beliefs and practices of specific cultural groups.

For example, in seeking to adopt an assets-based view of Latinx immigrants engaged in engineering, we debated whether to draw from the theories of Pierre Bourdieu,^[23] who studied cultural capital among dominant groups in France, or from the theories of Tara Yosso,^[24] who studied community cultural wealth among Latinx students in the US. Both scholars engaged in theories of capital, but Yosso’s work resulted in the identification and theorization of new types of capital (e.g., resistant capital) held specifically by youth of color. Thus, when we analyzed our data to identify Latinx youths’ engineering assets as forms of capital, we consciously compared our emerging codes against both Yosso and Bourdieu’s theories to ensure that we did not exclusively theorize capital from a dominant perspective (Bourdieu’s) but also considered potential counter-perspectives (Yosso’s) that stemmed from critical race theories.^{[25],[26]} Other scholars^{[27],[28]} have likewise used Yosso’s work in theorizing the forms of capital that enhance engineering activity and persistence among youth of color.

By using multiple theories, including theories generated specifically in relation to people of color, we hoped to ensure that the fit between the social reality investigated and our produced theories did not simply reproduce a dominant perspective. In summary, to ensure theoretical validation when working with linguistically and culturally diverse populations, qualitative researchers in engineering education can:

- Compare inductively-generated codes and theories against the theories of scholars whose work stems from the cultural group with whom you are researching.

Procedural Validation

Walther et al.^[5] defined procedural validation as procedures that can be incorporated into the research design to mitigate threats to overall validation. Walther and colleagues emphasized transparency in defining the procedures, in following them, and in reporting them explicitly in research reports. They identified triangulation, constant comparative analytic methods, and interpretive awareness as core methods for establishing procedural validation. Below we specify additional methods of procedural validation for researchers who work with underrepresented populations.

Conceptualizing the Study

Because many educational researchers have historically communicated a deficit view of students of color,^[29] it is imperative for researchers to avoid methods that perpetuate myths that underrepresented students' "lack" in skill, motivation, or practices related to engineering. Many studies which communicated a "lack" in students of color were designed in such a way that they did not ascertain or showcase the assets and skills of linguistically and culturally diverse people. There are several steps that researchers can take to increase the likelihood that their procedures capture the practices and perspectives of research participants from an assets-based perspective.

We agree with Walther and colleagues that triangulation, which includes collecting data from multiple sources, is one method for avoiding deficit portrayals of underrepresented groups. In our work with English learners, for example, we found that participants verbally explained concepts that they may not have explained as clearly through writing. In this case, then, collecting oral data (e.g., transcripts of group discussions) in addition to written data (e.g., their writing) was one form of data triangulation that arguably provided a more accurate view of their facility with engineering design.

Other scholars^[15] have noted that subtle linguistic, cultural, and contextual differences affect study design and data generation processes. For example, an interview question may be worded in such a way that it reflects the experiences and worldview of somebody who speaks Appalachian English versus African American English. To offset this possibility, the research team should consult with people who are familiar with the language and culture of the research participants and ask them to evaluate data generation protocols as well as early collected data. In summary, researchers can enact several validation procedures to increase the likelihood that their data generation methods are culturally responsive and result in a fit between a social reality and the research report, rather than a deficit view. These steps include:

- Recognize subtle (or non-subtle) linguistic, cultural, and contextual differences between research participants and the research team.
- Consult with researchers who are familiar with the language and culture of the research participants before and throughout the data generation and analysis process. Ask them to evaluate all aspects of the research design and data generation instruments.

Generating Data

Researchers^{[30],[31]} have identified the importance of establishing cultural congruence between STEM pedagogies and students' cultural backgrounds. Certainly, when engineering educators conduct a study in which they test the effectiveness of a new pedagogy, they should design culturally responsive pedagogies (a topic for another paper), but we assert that the concept of cultural congruence applies to data generation processes as well. That is, qualitative researchers should ascertain participants' preferred modes of communication and seek to collect data using that mode.

For example, we are aware of qualitative work with tribal elders from a particular Native American group (anonymized to protect confidentiality), in which the researchers initially sought to collect data primarily via written instruments (e.g., surveys in English), even though the elders preferred oral methods of communication in English or their native language. We would argue that audio-recording interviews in the participants' language of choice might have been a better way to ascertain their bodies of knowledge. Moreover, K-16 schools have been a site of oppression or a tool of colonization for many Native groups, and as such, researchers might consider generating data from sites in which their participants feel more comfortable. In summary, procedural validation throughout the data generation process includes the following:

- Collect multiple forms of data that are culturally congruent with the participants' preferred mode of communication. A culturally congruent approach allows participants to use home languages, multiple modes of communication (e.g., visual, oral, or written), digital communication if preferred over pencil-and-paper communication or vice versa, and so forth.
- Collect data at sites in which the participants feel comfortable.

Handling Data

Similarly, previous data analysis methods must also take an assets-based approach by capturing a range of the participants' perceptions, practices, and abilities. For example, Shanahan and colleagues^[32] worked with elementary English learners who engaged in engineering in order to solve design challenges. Although the students did not know many words in English, they communicated largely through gestures and pointing to objects while constructing devices to solve various problems. Consequently, Shanahan and colleagues argued for the need for multimodal analysis—or analysis of images, gestures, *and* words—versus an analysis of written transcripts. The latter would have resulted in an inaccurate or deficit view of the event by portraying the participants as limited in English, whereas the multimodal analysis demonstrated the participants' rich communication around the design and more accurately captured what the elementary students were thinking and doing. In summary, procedural validation in the data analysis stage can include the following:

- Use analytic methods that take an “assets” approach to participants' multiple skills, such as forms of multimodal analysis. Procedures that only capture verbal speech may not account for the participants' ability to communicate gesturally and visually.

Communicative Validation

Although Walther et al.^[5] mention multiple forms of communicative validation, here we focus on internal communicative validation, or communicative validation among the research participants and the research team. Communicative validation includes procedures increase the likelihood that a shared community of interpretation has been established with research participants. Establishing communicative validation begins with the recognition that many researchers, presumably who have an advanced degree from a university, may speak in particular academic registers that hold a position of power or prestige in society. Indeed, all language use is imbued with power, and researchers must be aware of how differences in language—between themselves and research participants, for example—may influence what participants share.^{[13],[33]}

Conceptualizing the Study

Although researchers might never completely eliminate all power differentials between themselves and their research participants, there are steps the researcher can take to ensure that the participants feel more comfortable communicating in languages and forms that showcase their practices and thoughts. Multiple studies, for example, have demonstrated that participants speak differently, or code-switch, when they are at different places or among different people, and thus one form of communicative validation includes allowing participants to choose the places and mediums through which they are interviewed/observed.

Validation procedures may also include procedures that simply ensure that data generation runs smoothly (e.g., that everybody knows when the next focus group is). In our own work with Latinx immigrant youth, we found that the participants preferred to communicate with the research team through texts, but they often switched cell phones and cell phone numbers, which made consistent communication difficult. In consideration of these factors, in order to improve internal communicative validation, researchers can:

- Collect data in places that are preferred by research participants at consistent times (e.g., interview every Thursday at 4:00 and send texts as reminders).
- Ask research participants how they prefer to communicate with the research team, and identify back-up methods of communication in case the initially preferred methods do not work.

Generating Data

When working with linguistically diverse participants, researchers must recognize that some words simply do not have linguistic equivalents to English, and they must take steps to ensure they understand their participants.^{[12],[34]} Moreover, a growing body of research on identity formation among underrepresented students has asserted that students' cultural identities should be supported (rather than discouraged) in engineering programs.^[35] Given the close relationship between language and identity,^[36] it is vital that educational researchers demonstrate respect for students' home cultures by communicating with them in their languages. Accordingly, when generating data, to maintain communicative validation, researchers can:

- Find experienced translators or interpreters, who are fluent in the participants' home language, to ask questions in the participants' language of preference.
- Transcriptions should be written in participants' home languages as well as the researchers' language. Where possible, when results are communicated to a larger academic community, quotations from both languages (e.g., the home language and the English translation) should be used to accurately represent what the participants said.

Handling Data

Difficulties in translation also have implications for how researchers analyze data. In order to be culturally responsive and to maintain internal communicative validation throughout this process, qualitative researchers can:

- Enlist native language speakers to conduct member checks with participants. These member checks should be honest and linguistically and conceptually accessible to the participants. To give the participants time to process what has been shared, researchers might provide them with advanced information in writing (if this form of communication is congruent with the participant's preferences) and allow the participant to annotate or ask questions about the findings.
- Invite participants to be involved in data analysis, or explicitly ask them to challenge or identify additional categories or insights during member checking.

Pragmatic Validation

Walther et al.^[5] define pragmatic validation as occurring when the concepts and knowledge claims withstand exposure to the reality investigated. Following Gutiérrez and Penuel,^[37] we wish to extend this definition of “pragmatic,” to mean that the study should be designed with “relevance to practice as a criterion for rigor” (p. 19). In explaining this criterion for demonstrating whether a study has “quality,” Gutiérrez and Penuel asserted that researchers must ask themselves whether the study has the potential to make a difference in practice somehow. When applied to an engineering education context, researchers might consider whether or not their study will improve learning contexts for underrepresented students (for example). In the context of cultural relevance, a defining consideration, which determines whether or not a study should even be conducted, is whether or not the study is likely to result in specific benefits that are geared toward the community that is being researched.^[38]

Conceptualizing the Study

To meet this type of validation, when conceptualizing the study, researchers should consider whether it serves a purpose in the community in which they are researching. If the study advances the researcher, but does not advance the goals of the community, then the researcher may reconsider whether the study should be conducted. To maintain pragmatic validation, qualitative researchers can:

- Anticipate possible effects on communities served, including benefits or risks of harm to those communities.
- Amplify possible benefits to the community being studied, and consider issues of sustainability in advance. For example, if the study will result in better pedagogies for engineering education, the researcher might consider specific ways in which the pedagogies will be shared with a particular community and how it might be sustained after the study is officially over.

Generating Data

In order to withstand exposure to the reality being investigated, many qualitative studies must maintain ecological validity.^[39] Ecological validity ensures that the findings from a study can be transferred to another comparable real-life context. For example, an engineering education study that is conducted in a lab setting might not result in findings that are transferrable to a classroom context. Thus, data generation must consider the messiness of real-life contexts, including multiple factors (e.g., district policies, time constraints, power differentials, school or neighborhood cultures) that influence how engineering or engineering education is enacted. To maintain pragmatic validation when working with diverse populations, qualitative researchers can:

- Generate data in naturalistic settings that are chosen or intentionally designed to affirm the participants.

Handling Data

Relatedly, deficit views are often perpetuated when people exclusively focus on individuals rather than focusing on the ecologies in which they are embedded. For example, NAEP has found that African Americans performed worse than White students on measures of engineering and technology literacy.^[40] Rather than blaming individuals for this finding (e.g., by saying that the individual students were less motivated to study engineering) researchers can look at systems factors, such as the characteristics of the schools that African Americans attend, whether or not the tasks on the engineering assessment were culturally congruent, whether or not engineering teachers enacted subtle forms of racism (e.g., lower expectations), and more.

By considering factors in an ecological system, versus simply looking at the individual, researchers can produce reports that result in more culturally responsive and ecologically valid outcomes. To this end, Riley and colleagues have asserted that engineering educational researchers should explicitly identify and question inequitable structural conditions, including those conditions through which researchers themselves gain credence and privilege.^[41]

In summary, to maintain culturally responsive pragmatic validation when analyzing data, qualitative researchers can:

- Analyze data by looking for systemic factors that influence research results, versus focusing exclusively on individual characteristics.

- Be self-reflexive about researcher positionality in the coding process, for example, through memos that explicitly delineate between researcher interpretation and raw data excerpts.

Process Reliability

According to Walther et al.^[51], process reliability in qualitative research occurs when the process is transparently documented. The processes (not necessarily the results) should be replicable by others in the research community. Culturally responsive research requires that researchers work “*with* people and not *on* them” (p. 902).^[42] Consequently, qualitative researchers can develop processes that rigorously incorporate the voices of their research participants. Processual steps that researchers can take are outlined below.

Conceptualizing the Study

When conceptualizing the study, researchers can consult with participants and incorporate their insights into processes related to data storage, generation, and analysis. For example, in one study we conducted, we established a data folder on a secure digital platform that was easy for the participants to use, and we gave them access to all data, including the right to delete transcripts or other products if they felt that these data might have harmed their reputations.

We also argue that culturally responsive qualitative research often takes time: time to build relationships with participants; time to reflect on biases in one’s own data generation and analysis processes; and time to evaluate, revise, and re-implement engineering programs and pedagogies (if applicable) to ensure they are more culturally responsive. In summary, fast research is not often reflective research, and responsive research requires self-reflection.^[43] In order to ensure culturally responsive research designs, qualitative researchers can:

- In consultation with participants (where possible), develop and communicate a plan for managing data.
- Develop materials for providing professional development to the research team and other relevant stakeholders, with explicit attention to culturally responsive research.
- Develop a realistic plan for data collection and analysis with built-in time for evaluation and reflection.

Generating Data

Like quantitative research, qualitative research is a human endeavor and thus is prone to a variety of errors that result in threats to validity.^[44] In the context of culturally responsive research, these threats may include cultural misunderstandings or power differentials that result in the researcher misinterpreting or misrepresenting research participants. Moreover, researchers may inadvertently engage in actions that make their participants feel uncomfortable. For example, Hartman⁴⁵ recently conducted a study on Diné (Navajo) students’ persistence in higher education; this study included several engineering undergraduates. Unbeknownst to her at the beginning of the study, she found that several of the research participants felt an emotional aversion to a university campus because it had a graveyard on it, and graveyards were believed

to attract evil spirits. Although Hartman had initially conducted interviews on a university campus near a graveyard, upon learning this information, she sought to collect data at sites at which the participants felt more comfortable.

This example underscores how researchers can reflect on their data collection methods and adjust their procedures (e.g., place of the meeting, phrasing of the questions) to make their methods more responsive to the cultures of their participants. This example also underscores the importance of self-reflection and the explicit acknowledgement of mistakes or failures, including failures in engineering educational pedagogical strategies, failures in communicating effectively with participants, or failures in providing participants with safe and affirming research spaces. After consciously looking for mistakes, failures, or areas for improvement in their research processes, researchers can explicitly reflect on these failures and develop new procedures or protocols intended to prevent them from happening again.

- Document processes clearly, including explicit and detailed descriptions of how programs are implemented and how data are collected, with explicit and purposeful acknowledgment and reflection on failures/mistakes, and explicit documentation of how the research team established new procedures to prevent future similar failures/mistakes.

Handling Data

In addition to establishing processes for ensuring quality and cultural responsiveness in the data generation phase, the research team should also seek to ensure cultural responsiveness in the data analysis phase. Interpretive research is generally based on the assumption that the researcher characteristics—including class, race, gender, geographic origin, educational background, language, and more—influence the research process in many ways, including in the types of questions that are asked and in the lenses through which the questions are interpreted.^[46] To explicitly account for the researcher’s bias in data analysis, researchers can clearly distinguish between data excerpts and researcher interpretations, a process known as bracketing, in order to be clear that researcher interpretations may not be “reality.”^[47] This process can help researchers (and the readers of their research) conceptually distinguish between a phenomenon versus their interpretation of the phenomenon, and may open doors for other researchers and participants to generate their own culturally-derived interpretations.

Other strategies for promoting quality and cultural responsiveness at this stage include the following procedures:

- Discuss bracketed interpretations with research participants or other scholars who have worked with this community.
- Develop mutually agreed-upon procedures for co-analyzing data with participants (if they would like to) in ways that are considerate of their time. For example, participants may help develop codes to assign to the data, but then the research team might use the participant-generated codes to analyze the data set.
- Clearly explaining data “chunking” processes and data reduction processes (why did you share this data excerpt and not that data excerpt in your final report?). Researchers

should not cherry pick data that presents a particular view of a group of people, but instead should select data that is somehow representative of the larger data set. They should explicitly document and explain why particular data excerpts were chosen to share with the larger research community.

Ethical Validation

Walther et al. consider ethical validation as a key component that must be present in all aspects of their framework. Engineering education researchers use ethical validation when they appropriately represent the social realities of those they set out to observe. They engage ethically when they question their motivations about why they intend to study a particular social reality, as well as when they recognize how their biases, preconceptions and world views may influence their research questions, methods of research, data interpretation and impacts of study. Investigators must work in “communication communities” where they continually confront their assumptions and interpretations as they discuss and disseminate findings with fellow researchers, research participants, and members of the community. Ultimately, this component requires engineering education researchers to work to portray the participants’ lived experiences as a means to impact purposeful change.

Although we report on this aspect of validation as a separate section, it should be a core consideration throughout the research design as researchers continually seek to ensure that their research meets standards of ethical research (as affirmed by an Institutional Review Board) and that it benefits the communities being researched as much as possible. In addition to the strategies mentioned previously, strategies to ensure ethical validation include the following:

Conceptualizing the Study

- Through reflective work, researchers can identify their positionality in advance, including their positions in relation to the specific topic of the study and in relation to the specific research participants.
- Researchers should consider potential negative effects on the research participants and on the community being studied, and they should reconsider conducting research that does not benefit both of them.

Generating Data

- Researchers can employ strategies for foregrounding participant voices, concerns, and ideas, including strategies for eliciting participant ideas that the researcher may not have previously considered (e.g., asking open-ended questions, such as “is there anything else you would like to say?”).

Handling Data

- Researchers can share raw data and bracketed analyses with auditors and/or research participants to increase the likelihood that the analyses match the data, and that they do not reflect a harmful cultural bias.

Limitations

As noted previously, we do not presume to offer an exhaustive list of strategies that promote culturally responsive engineering educational research; rather, we intend this paper as a springboard for additional conversations among engineering educational researchers who seek to conduct research with diverse populations in ethical and culturally responsive ways.

Our own positionality affects our identification and presentation of these strategies. Two authors are White women who have been K-12 educators; the third author is a Latina woman and former engineer; all three of us specialize in culturally responsive educational research. As middle class women who have excelled in the US educational system, we recognize that we benefit from class and educational privilege. We approach this paper from an interpretivist paradigm, meaning that we assume that one purpose of research is to understand and describe lived realities. Scholars who approach qualitative research from a more critical paradigm, whose purpose is to emancipate, or a post-structuralist paradigm, whose purpose is to deconstruct,^[46] might offer different strategies for conducting empowering research with culturally diverse participants in accordance with those paradigms.

Summary

In this paper, we took a popular framework for establishing quality in qualitative research in engineering education, and we expanded it by adding strategies that more explicitly account for cultural differences between engineering educational researchers and the people with whom they work. Given that many engineering educational researchers are White and middle class, and given that broadening participation remains a major goal of engineering educational research, the purpose of this paper was to outline ways that researchers can be more responsive when conducting research with diverse populations. It is imperative that engineering educational researchers avoid deficit views by conducting research whose methods and results are affirming to, and beneficial for, underrepresented groups. This paper outlined specific methodological steps that researchers can take to ensure different dimensions of quality when they work with linguistically and culturally diverse populations.

References

- ¹ J. Case, & G. Light, "Emerging methodologies in engineering education research," *Journal of Engineering Education*, 100, 186-210, 2011.
- ² E. P. Douglas, M. Koro-Ljungberg, & M. Borrego, "Challenges and promises of overcoming epistemological partiality: Advancing engineering education through acceptance of diverse ways of knowing," *European Journal of Engineering Education*, 35, 247-257, 2010.
- ³ S. A. Southerland, V. L Gadsden, C. D. Herrington, "What should count as quality education research? Continuing the discussion," *Educational Researcher*, 43(1), 7-8, 2014.
- ⁴ M. Freeman, K. deMarrias, J. Preissle, K. Roulston, & E. St. Pierre, "Standards of evidence in qualitative research: An incitement to discourse," *Educational Researcher*, 36(1), 25-32, 2007.

- ⁵ J. Walther, N. W. Sochacka, & N. N. Kellam, "Quality in interpretive engineering education research: Reflections on an example study," *Journal of Engineering Education*, 102, 626–659, 2013.
- ⁶ J. Walther, A. L. Pawley, & N. W. Sochacka, *Exploring ethical validation as a key consideration in interpretative research quality*. Paper presented at 2015 ASEE Annual Conference & Exposition, Seattle, Washington. 10.18260/p.24063, 2015.
- ⁷ J. Walther, & N. W. Sochacka, *Qualifying qualitative research quality (the Q3 project): An interactive discourse around research quality in interpretive approaches to engineering education research*. Frontiers in Engineering Education Conference, Madrid, Spain, 2014.
- ⁸ J. Walther, N. W. Sochacka, L. C. Benson, A. E. Bumbaco, N. Kellam, A. L. Pawley, & C. M. L. Phillips, "Qualitative research quality: A collaborative inquiry across multiple methodological perspectives," *Journal of Engineering Education*, 106, 398-430, 2017.
- ⁹ National Science Board, (*Science and engineering indicators*. Arlington, VA: Author, 2016. Available: <https://nsf.gov/statistics/2016/nsb20161/#/>
- ¹⁰ Jr. V. Deloria, *Custer died for your sins: An Indian manifesto*. Norman, OK: University of Oklahoma Press, 1969.
- ¹¹ R. Hole, "Working between languages and cultures: Issues of representation, voice, and authority intensified," *Qualitative Inquiry*, 13, 696-710, 2007.
- ¹² A. Squires, "Methodological challenges in cross-language qualitative research: A research review," *International Journal of Nursing Studies*, 46, 277-287, 2009.
- ¹³ B. Subedi, & J. Rhee, "Negotiating collaboration across differences," *Qualitative Inquiry*, 14, 1070-1092, 2008.
- ¹⁴ K. Rodham, F. Fox, & N. Doran, "Exploring analytical trustworthiness and the process of reaching consensus in interpretative phenomenological analysis: Lost in transcription," *International Journal of Social Research Methodology*, 18(1), 59-71, 2015.
- ¹⁵ A. Shordike, C. Hocking, W. Bunrayong, S. Vittayakorn, P. Rattakorn, D. Pierce, & V. A. W.-S. Clair, "Research as relationship: engaging with ethical intent," *International Journal of Social Research Methodology*, 20, 285–298, 2017.
- ¹⁶ M. J. Crotty, *The foundations of social research: Meaning and perspective in the research process*. Thousand Oaks, CA: SAGE, 1998.
- ¹⁷ R. Geertz Gonzalez, & J. Morrison, "Culture or no culture? A Latino critical research analysis of Latino persistence," *Journal of Hispanic Higher Education*, 15, 87-108, 2016.
- ¹⁸ A. Wilson-Lopez, M. D. Boatright, & G. Rose, *Native Spanish-speaking adolescents' information gathering processes while solving problems through engineering*. Conference Proceedings of the American Society for Engineering Education, 2017, Columbus, OH.
- ¹⁹ J. Cummins, BICS and CALP: "Empirical and theoretical status of the distinction. In B. Street & N. H. Hornberger (Eds.)," *Encyclopedia of language and education* (2nd ed., pp. 71-83). New York, NY: Springer Science + Business Media LLC, 2008.
- ²⁰ M. D. Brooks, "Pushing past myths: Designing instruction for long-term English learners," *TESOL Quarterly*, 52, 221-233, 2018.
- ²¹ K. Charmaz, "Shifting the grounds: Constructivist grounded theory methods," In J. M. Morse (Ed), *Developing grounded theory: The second generation* (pp. 127-154). Walnut Creek, CA: Left Coast Press, 2009.

- ²² P. Smagorinsky, "The method section as conceptual epicenter in constructing social science research reports," *Written Communication*, 25, 198-226, 2008.
- ²³ P. Bourdieu, "The forms of capital. In J. G. Richardson (Ed.)," *Handbook of theory and research for the sociology of education* (pp. 241-258). (R. Nice, Trans.). New York: Greenwood Press, 1986. (Original work published 1983)
- ²⁴ T. J. Yosso, "Whose culture has capital? A critical race theory discussion of community cultural wealth," *Race, Ethnicity, and Education*, 8, 69-91, 2005.
- ²⁵ A. Wilson-Lopez, & I. Hasbún, *Cultural capital and community cultural wealth activated by Latina adolescents engaged in engineering*. Paper presented at the annual meeting of the American Educational Research Association, San Antonio, TX, May, 2017.
- ²⁶ A. Wilson-Lopez, C. Sias, A. Smithee, & I. M. Hasbún, "Forms of science capital mobilized in adolescents' engineering projects," *Journal of Research in Science Teaching*, 55(2), 246-270, 2018.
- ²⁷ R. A. Revelo, & L. D. Baber, "Engineering resisters: Engineering Latina/o students and emerging resistant capital," *Journal of Hispanic Higher Education*, Advanced online publication, 2017. Available: <https://doi.org/10.1177/1538192717719132>
- ²⁸ C. C. Samuelson, & E. Litzler, "Community cultural wealth: An assets-based approach to persistence of engineering students of color," *Journal of Engineering Education*, 105, 93-117, 2016.
- ²⁹ D. Paris, "Culturally sustaining pedagogy: A needed change in stance, terminology, and practice," *Educational Researcher*, 41, 93-97, 2012.
- ³⁰ G. S. Aikenhead, & O. J. Jegede, "Cross-cultural science education: A cognitive explanation of a cultural phenomenon," *Journal of Research in Science Teaching*, 36, 269-287, 1999.
- ³¹ B. I. Grimberg, & E. Gummer, "Teaching science from cultural points of intersection," *Journal of Research in Science Teaching*, 50, 12-32, 2013.
- ³² L. E. Shanahan, M.B. McVee, K. Silvestri, & K. Haq, "Disciplinary literacies in an engineering club: Exploring literacy and the engineering design process," *Literacy Research: Theory, Method, and Practice*, 65, 404-420, 2016.
- ³³ M. M. Hennink, "Language and communication in cross-cultural qualitative research. In P. Liamputtong (Ed.)," *Doing cross-cultural research: Ethical and methodological perspectives* (pp. 21-33). Dordrecht, Netherlands: Springer, 2008.
- ³⁴ B. Littig, & F. Pöchlner, "Socio-translational collaboration in qualitative inquiry: The case of expert interviews," *Qualitative Inquiry*, 20, 1085-1095, 2014.
- ³⁵ A. D. Patrick, & M. Borrego, *A review of the literature relevant to engineering identity*. Conference Proceedings of the American Society of Engineering Education, 2016, New Orleans, LA. Available: <https://peer.asee.org/a-review-of-the-literature-relevant-to-engineering-identity.pdf>
- ³⁶ B. Norton, "Language, identity, and the ownership of English," *TESOL Quarterly*, 31, 409-429, 1997.
- ³⁷ K. D. Gutiérrez, & W. R. Peniel, "Relevance to practice as a criterion for rigor," *Educational Researcher*, 43(1), 19-23, 2014.
- ³⁸ N. Beeman-Cadwallader, C. Quigley, & T. Yazzie-Mintz, "Enacting decolonized methodologies: The doing of research in educational communities," *Qualitative Inquiry*, 18, 3-15, 2011.

- ³⁹ K. Gravemeijer, & P. Cobb, "Design research from a learning design perspective," In J. van den Akker, K. Gravemeijer, S. McKenney, & N. Nieveen (Eds.), *Educational design research* (pp. 17-51). New York, NY: Routledge, 2006.
- ⁴⁰ National Center for Educational Statistics, *The nation's report card in technology & engineering literacy*, 2014. Available: https://www.nationsreportcard.gov/tel_2014/#results/overall
- ⁴¹ D. Riley, A. E. Slaton, & A. L. Pawley, Social justice and inclusion. In A. Johri & B. M. Olds (Eds.), *Cambridge handbook of engineering education research* (pp. 335-356). 2014, Cambridge, UK: Cambridge University Press.
- ⁴² G. Kamberelis, & G. Dimitriadis, Focus groups: Strategic articulations of pedagogy, politics and inquiry. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (3rd ed., pp. 887-908). 2005, Thousand Oaks, CA: Sage.
- ⁴³ K. L. Rodriguez, , J. L. Schwartz, M. K. E. Lahman, M. R. & Geist, "Culturally responsive focus groups: Reframing the research experience to focus on participants," *International Journal of Qualitative Methods*, 10(4), 400–417, 2011.
- ⁴⁴ N. Norris, "Error, bias, and validity in qualitative research," *Educational Action Research*, 5, 172-176, 1997.
- ⁴⁵ C. M. Hartman, *Facilitators of Diné (Navajo) student access, enrollment, and persistence in post-secondary education: An ecological systems perspective* (Unpublished doctoral dissertation). Utah State University, Logan, Utah, 2018.
- ⁴⁶ P. Lather, *Getting lost: Feminist efforts toward a double(d) science*. Albany, NY: State University of New York Press, 2007.
- ⁴⁷ M. B. Baxter Magolda, "A constructivist revision of the measure of epistemological reflection," *Journal of College Student Development*, 42, 520-534, 2001.