COMMENTARY

Venturing into Qualitative Research:
A Practical Guide to Getting Started

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Abstract

In this commentary, we offer an introduction to qualitative research. Our goal is to provide guidance so that others can avoid common missteps and benefit from our lessons learned. We explain what qualitative data and research are, the value of qualitative research, and features that make qualitative research excellent, as well as how qualitative data can be collected and used to study undergraduate research. Our advice and recommendations are targeted at researchers who, like us, were first trained in fields with tendencies to overlook or underestimate qualitative research and its contributions. We share examples from our own and others' research related to undergraduate research settings. We provide a table of resources researchers may find useful as they continue to learn about and conduct qualitative studies.

Keywords: *faculty development, interdisciplinary/multidisciplinary, qualitative, scholarly engagement, STEM*

Introduction

We both started our scholarly journeys as biologists. As we trained, we both grew interested in researching undergraduate education and we transitioned to doing education research. We quickly came to realize that our training in experimental approaches and quantitative methods was woefully insufficient to study the diversity of ways students think, believe, value, feel, behave, and change in a variety of learning environments and educational systems.

For instance, there are established ways to quantify some educational variables, but not others. In addition, there may be phenomena at play that we haven't thought of or that might be counterintuitive, which could lead us to quantify things that end up being irrelevant or meaningless. Herein lies the power of qualitative research. Qualitative research generates new knowledge by enabling rich, multifaceted descriptions of phenomena of interest, known as constructs (i.e., latent, unobservable variables), and producing possible explanations of how phenomena are occurring (i.e., mechanisms or relationships between constructs in different contexts and situations with different individuals and groups).

In this essay, we aim to offer an approachable explanation of qualitative research, including the types of questions that qualitative research is suited to address, the characteristics of robust qualitative research, and guidance on how to get started. We use examples from our own and others' research to illustrate our explanations, and we cite references where readers can learn more. We expect *Scholarship and Practice of Undergraduate Research* (SPUR) readers from disciplines with a tradition of qualitative research might question why we would write this piece and what makes us qualified to do so. There are many scholars with much more qualitative research expertise than we have. Yet, we think we can offer a unique perspective to SPUR readers who are new to qualitative research or coming from disciplines where qualitative research is unfamiliar or undervalued. We have both designed, conducted, and published qualitative research in the context of undergraduate education and research experiences. We draw upon this experience in the recommendations we offer here.

Doing qualitative research involves acknowledging your "positionality," or how your own background, lived experiences, and philosophical understandings of research influence how you approach and interpret the work (e.g., Hampton, Reeping, and Ozkan 2021; Holmes and Darwin 2020). Our positionalities have influenced our approach to this article and qualitative research generally. I (MAP) first learned about qualitative research from my undergraduate academic adviser. She invited me to help her implement and evaluate a capstone course in which groups of microbiology undergraduates engaged in a semester-long research project to address problems faced by community organizations (Watson, Willford, and Pfeifer 2018). At the time, I wasn't aware of the long-standing history of qualitative research or its different forms and approaches. I just knew that reading quote data helped me understand human experiences in a way that survey numbers did not. Since my introduction to qualitative research, I've been fortunate to receive formal training. I consider my most valuable lessons about qualitative research to be through the practical experience of doing qualitative research and being mentored by qualitative researchers.

When I (ELD) first learned about qualitative research, I thought it meant words – perhaps collected through surveys, focus groups, interviews, or class recordings. I thought qualitative research would be easy – it was just words after all, and I had been using words almost my whole life. I assumed if I collected some words and summarized what I thought they meant (think word cloud), I would be doing qualitative research. As we will elaborate here, this is a limited view of what qualitative research is and what qualitative research can accomplish. When I began presenting qualitative research, I found it helpful to draw analogies to qualitative studies in natural science and medical disciplines. For instance, in the field of biology, the invention of technologies (e.g., lenses, microscopes) allowed for detailed observation and rich descriptions of cells (i.e., qualitative research) that led to the development of cell theory, the establishment of the field of cell biology, and quantitative research on cell structure, function, and dysfunction. In my own field of neuroscience, Henry Moliason, known as HM, was the focus of qualitative case study because he lost the ability to form new long-term memories due to a surgical treatment for severe epilepsy. Rich (i.e., comprehensive and detailed) description of Mr. Moliason's memory impairment was the basis for hippocampal function being proposed as the main mechanism through which memories are formed. These examples of "non-numbery" research that produce influential descriptions and testable mechanisms helped me recognize the potential value and impact of qualitative research.

Types of Qualitative Research Questions

Qualitative research is useful for addressing two main types of questions: descriptive and mechanistic. Descriptive questions ask what is happening, for whom, and in what circumstances. Mechanistic questions ask how a phenomenon of interest happening. Here we explain each type of question and highlight some example studies conducted in the context of undergraduate research.

Descriptive Questions

Descriptive research seeks to elucidate details that enhance our overall understanding of a particular phenomenon—it answers questions about what a phenomenon is, including its defining features (i.e., dimensions) and what makes it distinct from other phenomena (Loeb et al. 2017). Descriptive research can also reveal who experiences the phenomenon, as well as when and where a phenomenon occurs (Loeb et al. 2017). Details like these serve as a starting point for future research, policy development, and enhanced practice. For instance, Hunter, Laursen, and Seymour (2007) carried out a qualitative study that identified and described the benefits of undergraduate research from the perspectives of both students and faculty. This work prompted calls for expansion of undergraduate research nationally and led to numerous quantitative studies (Gentile, Brenner, and Stephens 2017). Among these were quantitative studies from our group on the influences of research mentors on undergraduate researchers (Aikens et al. 2016, 2017; Joshi, Aikens, and Dolan 2019). Although these studies were framed to identify beneficial outcomes, we observed that undergraduates who had less favorable experiences with mentors were opting not to participate in our studies. Given this observation and the dearth of research on negative experiences in undergraduate research, we carried out a descriptive qualitative study of the dimensions (i.e., the what) of negative mentoring—that is, problematic or ineffective mentoring—in undergraduate life science research (Limeri et al. 2019). This study revealed that negative mentoring in undergraduate research included the absence of support from mentors and actively harmful mentor behaviors. These results served as the basis for practical guidance on how to curtail negative mentoring and its effects and for ongoing quantitative research. We use this study as the basis for the extended examples highlighted in Table 1.

Descriptive research is also suited to investigating the experiences of groups that are marginalized or minoritized in higher education. These studies offer insights into student experiences that may be otherwise overlooked or masked in larger quantitative studies (Vaccaro et al. 2015). For example, descriptive qualitative research shed light on how Black women in undergraduate and graduate STEM programs recognized and responded to structural racism, sexism, and race-gender bias. This research identified how high-achieving Black STEM students experienced racial battle fatigue and offered program-level suggestions for how to better support Black students (McGee and Bentley 2017). Descriptive qualitative research of

deaf students involved in undergraduate research revealed that lack of awareness of Deaf culture of research mentors as well as lack of communication hindered students' research experiences (Majocha et al. 2018). This research led to recommendations for research programs, research mentors, and students themselves. Another descriptive qualitative study showed how Latine students' science identity changed over time when involved in an undergraduate research program (Vasquez-Salgado et al. 2023). Specifically, Vasguez-Salgado and colleagues identified patterns in students' science identity through three waves of data collection spanning 18 months. Students' identities showed consistent or fast achievement of feeling like a scientist, gradual achievement of feeling like a scientist, achievement adjustment of feeling like a scientist at one point and less so later in the program, or never feeling like a scientist. Together, these and other studies have generated knowledge that raises questions for future research and informs our collective efforts to make undergraduate research more accessible and inclusive.

Mechanistic Questions

Mechanistic qualitative research aims to address questions of how or why a phenomenon occurs. In the context of undergraduate research, an investigator may seek to understand how or why a particular practice or program design affects students. Recently, we conducted a mechanistic qualitative study that aimed, in part, to understand how early career researchers (undergraduate, postbaccalaureate, and graduate students) conceptualized their science identity (Pfeifer et al. 2023). Previous research theorized that someone is more likely to identify as a scientist if they are interested in science, believe they are competent in and can perform science, and feel recognized by others for their scientific aptitude or accomplishments (Carlone and Johnson 2007; Hazari et al. 2010; Potvin and Hazari 2013). However, this theory is somewhat limited in that it does not fully explain how context affects science identity or how science identity evolves, especially as researchers advance in their scientific training (Hazari et al. 2020; Kim and Sinatra 2018). To address this, we integrated science identity theory with research on professional identity development to design our study (Pratt, Rockmann, and Kaufmann 2006). We analyzed data from two national samples, including open-ended survey responses from 548 undergraduates engaged in research training and interview data from 30 early career researchers in the natural sciences. We found that they conceptualized science identity as a continuum that encompassed being a science student, being a science researcher, and being a career researcher. How students saw their science identity depended on how they viewed the purpose of their daily research, the level of intellectual responsibility they have for their research, and the extent of their autonomy in their research. We consider these findings to be hypotheses that can be tested quantitatively to better understand science identity

dynamics in research training contexts. By asking this mechanistic question about science identity, we sought to add to and refine existing theory.

Key Attributes of Qualitative Research

For any type of research to be meaningful, it must possess some degree of rigor—what qualitative researchers call trustworthiness (Morse et al. 2002; Yilmaz 2013). Qualitative research is more trustworthy if it is characterized by credibility, transferability, dependability, and confirmability (Creswell and Poth 2016; Lincoln and Guba 1985). For instance, like accuracy and precision in quantitative research, do qualitative findings reflect what is being studied and are the interpretations true to the data (credibility)? Similar to reproducibility in quantitative research, how can qualitative research findings be applied to similar contexts (transferability)? Like validity in quantitative research, to what degree are the framing, methods, and findings of qualitative research appropriate given the aims (dependability)? Similar to the idea of replicability in quantitative research, if the same analytic tools were applied to the same data set could similar findings be reached by someone outside the original research team (confirmability)? The exact dimensions of trustworthiness, how trustworthiness manifests in the research process, the best ways to achieve trustworthiness, and how to talk about trustworthiness in research products are the subject of ongoing and often-spirited debate (e.g., Gioia et al. 2022; Mays and Pope 2020; Morse et al. 2002; Ritchie et al. 2013; Tracy 2010; Welch 2018; Yadav 2022). Central to these dialogues is the fact that qualitative research is composed of different philosophical approaches that emerged and evolved from diverse social science fields (Creswell and Poth 2016; Ritchie et al. 2013). Identifying universally agreed-upon criteria and the means to achieve these criteria is complex.

In our own work, we have found Tracy's (2010) eight criteria for excellent qualitative research particularly useful. These criteria have helped us design studies, make decisions during the course of research, and articulate in our papers how our research seeks to achieve trustworthiness (e.g., Pfeifer, Cordero, and Stanton 2023). The full list of criteria is: worthy topic, rich rigor, sincerity, credibility, resonance, significant contribution, ethical conduct, and meaningful coherence (Tracy 2010). These criteria borrow from and build on the presented concepts of credibility, transferability, dependability, and confirmability. In our view, these criteria are presented and described in a way that makes sense to us and fits our approach to research. Here we highlight two criteria that may be particularly relevant if you are new to qualitative research.

Worthy Topics

As scholars familiar with undergraduate research and scholarly inquiry, *SPUR* readers are well-positioned to

design studies that address research questions that are significant and timely in the context of undergraduate research. The first step in doing qualitative research (or any research) is to figure out what you want to study. You'll want to select a topic that you find interesting, relevant, or otherwise compelling so you are motivated to spend time and effort investigating it. One way to find a topic is to notice what is happening in your environment and your work. What are you observing about undergraduate research? Something about students who participate (or not)? Something about colleagues who work with undergraduate researchers (or not)? Something about the design, implementation, or outcomes of the research experience? Something about the programmatic or institutional context? For a topic to be worthy of research, it should be interesting to you *and* to others. Consider sharing your observations with a few critical friends (i.e., trusted colleagues who will give you honest feedback) about whether they find your observations interesting or worth your time and energy to explore.

Ethics

Like other human research, qualitative studies must adhere to basic ethical principles of respect for persons, beneficence, and justice (National Commission for the Protection of Human Subjects 1978). Respect for persons means treating all people as autonomous and protecting individuals with diminished autonomy (e.g., students whom we teach and assess). Beneficence involves treating people in an ethical manner, including respecting their decisions, protecting them from harm, and securing their well-being. Justice refers to the balance between benefiting from research and bearing its burdens; in other words, people should be able to benefit from research and should not be expected to bear the burden of research if they cannot benefit. Although it is beyond the scope of this essay to provide guidance on how to adhere to these principles, it is important to recognize that qualitative methods like interviewing can be highly personal and sometimes powerful experiences for both participants (and researchers). Investigators should carefully consider how their participants may be affected by data collection. For example, you may interview or survey participants about a personally difficult or painful experience. Do you then bear responsibility for helping them find support to navigate these difficulties? What if a participant reveals to you a serious mental health issue or physical safety concern? These situations occurred during our negative mentoring studies. We provided information to participants about where they could seek counseling or support for specific issues that can occur with mentors, such as harassment and discrimination.

Certainly not all qualitative data collection brings up these issues, but it can and does happen more frequently than you might expect. Your institutional review board (IRB), collaborators, and critical friends can be helpful resources when planning for and navigating tough scenarios like this. If working with an IRB is new to you, we recommend finding colleagues at your institution who have conducted IRB-reviewed research and asking them for guidance and examples. Some IRBs offer training for individuals new to developing human research protocols, and there are likely to be templates for everything from recruitment letters to consent forms to study information. We have found the process of developing IRB protocols helps refine research questions and study plans. Furthermore, IRB review is needed *before* you collect data that will be used for your study; IRBs rarely if ever allow for retrospective review and approval. In our experience, these studies are likely to be determined as exempt from IRB review because they involve minimal risk and use standard educational research procedures. However, the IRB is still responsible for making this determination and is a valuable partner for helping investigators navigate sensitive or complex situations that occur in human research.

Getting Started with Qualitative Research

Now that you have a sense of the purposes of qualitative research and what features help to ensure its quality, you are probably wondering how to do it. We want to emphasize that there are entire programs of study, whole courses, and lengthy texts that aim to teach qualitative research. We cannot come close to describing what can be learned from these more substantial resources. With this is mind, we share our own process of carrying out qualitative research as an example that others might find helpful to follow. We outline this "how to" as a series of steps, but qualitative research (like all research) is iterative and dynamic (University of California Museum of Paleontology 2022). Feel free to read through the steps in a linear fashion but then move in non-linear ways through the various steps. Extended discussion of each of these steps with examples from our research on negative mentoring is provided in Table 1 along with an abridged list of our go-to references.

Observe, Search, and Read

For a topic to be worthy of qualitative research (or any research), it should also have the potential to address a knowledge gap. After we identify a "worthy topic," we try to find as much information about that topic as possible (Dolan 2013). We read, then we keep reading, and then we read some more. This may seem obvious, but we find that investing time reading literature can save us a lot of time designing, conducting, and writing up a study on a phenomenon that is already well known or understood by others and just not (yet) by us. To help us in our searching, we will sometimes reach out to colleagues in related fields to describe the phenomenon we are interested in studying and see if they have terms that they use to describe the phenomenon or theories they think are related. Theory informs our research questions, study designs, analytic approaches, and interpretation and reporting of findings, and enables

alignment among all of these elements of research (e.g., Grant and Osanloo 2014; Luft et al. 2022; Spangler and Williams 2019). Theory also serves as a touchstone for connecting our findings to larger bodies of knowledge and communicating these connections in a way that promotes collective understanding of whatever we are investigating.

TABLE 1. Qualitative Research and Negative Mentoring

Step	Example	References
Observe, search, and read	Before deciding to formally investigate negative mentoring, we heard from undergraduates that their research experiences had not been positive because of their interactions with their supervisors. We suspected that negative experiences with supervisors were not unique to undergraduate research, so we contacted a colleague in industrial and organizational psychology to tell her about what we were hearing. She confirmed that the idea of negative mentoring had been observed in workplace settings along with the ideas of abusive supervision and workplace incivility. We then used these terms to search for related literature with the aim of understanding the knowledge gap and informing our study design.	Note: These references are useful for learning about the entire qualitative research process. They may be useful to consult as you work to identify a "worthy topic." • Charmaz, Kathy. 2006. *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. Sage. • Kvale, Steinar, and Svend Brinkmann. 2009. *InterViews: Learning the Craft of Qualitative Research Interviewing*. Sage. • Kyngäs, Helvi, Kristina Mikkonen, and Maria Kääriäinen, eds. 2002. *The Application of Content Analysis in Nursing Science Research*. Springer International. • Ritchie, Jane, Jane Lewis, Carol McNaughton Nicholls, and Rachel Ormston. 2013. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. Sage. • Saldaña, Johnny. 2016. *The Coding Manual for Qualitative Researchers*. 3rd ed. London: Sage. Note: These are two references that introduce theoretical frameworks and how to reflect on and craft a positionality statement. • Grant, Cynthia, and Azadeh Osanloo. 2014. "Understanding, Selecting, and Integrating a Theoretical Framework in Dissertation Research: Creating the Blueprint for Your 'House.'" *Administrative Issues Journal* 4(2): 4. https://dc.swosu.edu/aij/vol4/iss2/4 • Holmes, Andrew, and Gary Darwin. 2020. "Researcher Positionality: A Consideration of Its Influence and Place in Qualitative Research; A New Researcher Guide." *Shanlax International Journal of Education* 8(4): 1–10. https://doi.org/10.34293/education.v8i4.3232
Formulate a question	After developing a solid understanding of negative mentoring in workplace settings, we posed the research question: What forms of negative mentoring do undergraduate life science researchers experience? Our aim was to identify and characterize the various problematic experiences undergraduate researchers had with their research mentors.	• Agee, Jane. 2009. "Developing Qualitative Research Questions: A Reflective Process." *International Journal of Qualitative Studies in Education* 22: 431–447. https://doi.org/10.1080/09518390902736512 • Korstjens, Irene, and Albine Moser. 2017. "Series: Practical Guidance to Qualitative Research. Part 2: Context, Research Questions and Designs." *European Journal of General Practice* 23: 274–279. https://doi.org/10.1080/13814788.2017.1375090
Decide on a study design (and sample)	Given our research question, we opted to conduct a descriptive qualitative study using semistructured interviews. Semistructured interviews involve posing a common set of questions to all participants, while maintaining flexibility in question order to follow the course of conversation and asking follow-up questions as needed to elicit more detail. We sampled purposefully to maximize the likelihood we would capture the range of negative mentoring experienced by undergraduate researchers. We recruited our undergraduates via email, keeping several factors in mind. We wanted all participants to have recent negative experiences so they could report on experiences that were relatively fresh. We also sought variation on several dimensions, including their personal characteristics (race, ethnicity, gender), geographies, and institution types, as well as how negative their experiences were.	• Creswell, John W., and Cheryl N. Poth. 2016. *Qualitative Inquiry and Research Design: Choosing among Five Approaches*. Sage. • Starks, Helen, and Susan Brown Trinidad. 2007. "Choose Your Method: A Comparison of Phenomenology, Discourse Analysis, and Grounded Theory." *Qualitative Health Research* 17(10): 1372–1380. https://doi.org/10.1177/1049732307307031

(table continues)

TABLE 1. (cont.)

Step	Example	References
Collect and analyze data systematically	Having a semistructured interview guide helped us to systematically collect data from participants. After interviewing about 30 participants, we began to recognize similarities in situations or interactions, which hinted that we were approaching saturation. We conducted a few more interviews to ensure that no new ideas were emerging. Then, we shifted entirely to analysis, which involved coding to consensus as a team. Our team included undergraduates, graduate students, postdoctorate students, and faculty, who provided different perspectives on undergraduates' experiences and helped us feel more confident in our findings. Ultimately, we identified 29 different distinct types of negative experiences undergraduates had with their research mentors (e.g., coercion, insufficient technical instruction, micromanagement), which we then grouped into seven themes (e.g., insufficient career support, interpersonal mismatch) that fit two overarching ideas: absence of positive support and actively harmful behavior.	• Castillo-Montoya, Milagros. 2016. "Preparing for Interview Research: The Interview Protocol Refinement Framework." *Qualitative Report* 21: 811–831. https://doi.org/10.46743/2160-3715/2016.2337 • Knott, Eleanor, Aliya Hamid Rao, Kate Summers, and Chana Teeger. 2022. "Interviews in the Social Sciences." *Nature Reviews Methods Primers* 2(1): 73. https://doi.org/10.1038/s43586-022-00150-6 • Morse, Janice M. 1997. "'Perfectly Healthy, But Dead': The Myth of Inter-Rater Reliability." *Qualitative Health Research* 7: 445–447. https://doi.org/10.1177/104973239700700401 • Morse, Janice M., Michael Barrett, Maria Mayan, Karin Olson, and Jude Spiers. 2002. "Verification Strategies for Establishing Reliability and Validity in Qualitative Research." *International Journal of Qualitative Methods* 1(2): 13–22. https://doi.org/10.1177/160940690200100202 • Roulston, Kathryn, Kathleen deMarrais, and Jamie B. Lewis. 2003. "Learning to Interview in the Social Sciences." *Qualitative Inquiry* 9: 643–668. https://doi.org/10.1177/1077800403252736 • Sandelowski, Margarete. 1995. "Qualitative Analysis: What It Is and How To Begin." *Research in Nursing & Health* 18(4): 371–375. https://doi.org/10.1002/nur.4770180411 • Sandelowski, Margarete. 2001. "Real Qualitative Researchers Do Not Count: The Use of Numbers in Qualitative Research." *Research in Nursing & Health* 24: 230–240. https://doi.org/10.1002/nur.1025 • Tracy, Sarah J. 2010. "Qualitative Quality: Eight 'Big-Tent' Criteria for Excellent Qualitative Research." *Qualitative Inquiry* 16: 837–851. https://doi.org/10.1177/1077800410383121
Interpret and write results	Although we have separated analysis from interpretation and writing, they are connected. As you write, you will refine and optimize how you think about your findings and gain new insights. The process of writing helped us refine all of the types of negative mentoring into larger themes and overarching ideas. To accomplish this, start by articulating your research question and drafting an outline. Keeping your question at the forefront as you work through your data can help to ensure that what you write actually addresses your research question. For each big idea or theme, identify what aspects of the theme need to be presented. For each of these aspects, identify two to three quotes that you think reflect that aspect. After outlining all themes and relevant aspects, go back and refine the quotes. Keep quotes that are: (1) readily understood by readers unfamiliar with the totality of your data and (2) clearly illustrate the claim you are making. Once you have your results mostly written, you can begin interpretation, when you will compare your results to what exists already in the literature. (The reading you did earlier to select a worthy topic helps here, too.)	• Anfara, Vincent A., Kathleen M. Brown, and Terri L. Mangione. 2002. "Qualitative Analysis on Stage: Making the Research Process More Public." *Educational Researcher* 31(7): 28–38. http://www.jstor.org/stable/3594403 • Goldberg, Abbie E., and Katherine R. Allen. 2015. "Communicating Qualitative Research: Some Practical Guideposts For Scholars." *Journal of Marriage and Family* 77: 3–22. https://doi.org/10.1111/jomf.12153 • Sandelowski, Margarete. 1998. "Writing a Good Read: Strategies for Re-Presenting Qualitative Data." *Research in Nursing & Health* 21: 375–382. https://doi.org/10.1002/(SICI)1098-240X(199808)21:4<375::AID-NUR9>3.0.CO;2-C

Note: These steps are presented in a linear fashion, but in reality they are nonlinear, iterative, and overlapping. We recommend that you read them first linearly, and then use them iteratively. For example, you might start by collecting and analyzing data and then realize that your original research question is not actually the most compelling question the data can address. So you formulate a new research question, which warrants a new analytic approach.

Formulate a Question

Once you have selected a topic and identified a knowledge gap, consider research questions that, if answered, would address the knowledge gap. Recall that qualitative research is suited to questions that require a descriptive (what) or mechanistic (how) answer.

Decide on a Study Design

Just like quantitative research, qualitative research has characteristic approaches, designs, and methodologies, each of which has affordances and constraints (Creswell and Poth 2016; Merriam 2014; Miles, Huberman, and Saldana 2014). Creswell and Poth provide a valuable resource for learning more about different types of qualitative research study designs, including which designs are suited to address which kinds of research questions. Given the labor intensiveness of qualitative data collection and analysis, it is critical to think carefully about how to recruit and select study participants. What this looks like and who might be appropriate study participants will depend on many factors, including the knowledge gap, research question, study design, and methods. Questions that can be helpful to ask are: Who do I need to study to answer my research question? What should the study participants have in common? In what ways should study participants vary to provide rich, complex, and varied insight into what I am studying? To whom do I want to generalize my findings, keeping in mind the qualitative nature of the work?

Based on the answers to these questions, you may opt for purposeful sampling in which you collect data only from participants who meet the characteristics you decide upon given the aims of your study. In this case, you will likely send a screening survey to potential participants to determine what their characteristics of interest are, which will help you decide if you will invite them for further data collection or not. A purposeful sample contrasts with a convenience sample where essentially any person who agrees to participate in the study will be selected for further data collection.

Collect and Analyze Data Systematically

Qualitative data can be collected in a variety of ways, including surveys, interviews, and focus groups, as well as audio and video recordings of learning experiences such as class sessions. To decide which method(s) to use for data collection, it is helpful to consider what you aim to learn from study participants. Surveys tend to be easier to distribute to a larger sample, but may elicit shorter or shallower responses, which are challenging to interpret because there is less information (i.e., words) and no opportunity to clarify with participants. Focus groups can be effective for quickly gathering input from a group of participants. However, social dynamics may result in one or a few people dominating the discussion, or "group think," when people agree with one another rather than providing their own unique perspectives. Interviews with individuals can be a rich and varied data source because each participant has time and space to offer their own distinct perspective. Interviews also allow for follow-up questions that are difficult through survey methods. Yet, conducting interviews skillfully—avoiding leading questions and ensuring that the line of questioning yields the desired data—takes a lot

of thought and practice. Kvale (1996) offers detailed guidance on how to design and carry out research interviews. Observing an expert interviewer and having them observe and give feedback as you interview can help improve your skills. Audio and video recordings of learning experiences like class sessions or group work can provide a plethora of information (e.g., verbal and nonverbal exchanges among students or between students and instructors) in a more natural setting than surveys or interviews. Yet deciding what information will serve as data to answer your research question, or how that large body of data will be systematically analyzed, can be cumbersome.

Regardless of the data collection method, you'll need to decide how much data to collect. There is no one right sample size. A good rule of thumb is collecting data until you reach "saturation," which is the notion that the same ideas are coming up repeatedly and that no new ideas are emerging during data collection. This means that your data collection and analysis are likely to overlap in time, with some data collection then some analysis and then more data collection.

Analytic methods in qualitative research vary widely in their interpretive complexity. As natural scientists, we favor sticking close to the data and analyzing using a method called qualitative content analysis. Content analysis involves taking quotes or segments of text and capturing their meaning with short words or phrases called codes. The process of developing codes and systematically applying them to a dataset is called coding. Coding is highly iterative and time-consuming because it typically requires multiple, careful passes through the dataset to ensure all codes have been evenly applied to all data. In a recent study, we spent 10 to 15 person-hours to code a single interview, and about 400 person-hours to complete coding for a 30-participant study. The time involved in coding depends on what is being studied, the type of coding, and who is coding the data. Saldaña (2016) provides excellent guidance on the coding process, including various ways of making sense of codes by grouping them into themes. Content analysis is just one approach to qualitative data analysis. We encourage you to learn more about different forms of qualitative approaches and choose what works best for you, including your skill level, research goals, and data (e.g., Creswell and Poth 2016; Starks and Brown Trinidad 2007).

Interpret and Write Results

There are many ways to effectively write up results, often called findings, from qualitative research. Because qualitative research involves extensive interpretation, it can sometimes be easier to integrate the results and discussion of a qualitative paper. Integration allows the interpretation (discussion) to be directly supported by the evidence in the form of quotations (results). The conclusions of the paper

should avoid repeating the results and instead comment on the implications and applications of the findings: why they matter and what to do as a result. Because qualitative data are quotations rather than numbers, qualitative papers tend to be longer than papers presenting quantitative studies. That said, qualitative papers should still aim to be succinct. For instance, depending on the approach and methods, quotations can be lightly edited to remove extra words or filler language (e.g., um, uh) that is a natural part of language but otherwise irrelevant to the findings. Presenting only the most pertinent part of a quotation not only facilitates succinctness, but helps readers attend to the specific evidence that supports the claims being made. Another strategy to shorten qualitative papers is to present some findings in supplemental materials.

Final Recommendations

In closing our article, we offer some advice that we wish we knew when we began conducting qualitative research. We hope that these recommendations will help you think through issues that are likely emerge as you delve deeper into qualitative analysis, both as a producer and a consumer of qualitative research.

Consensus Coding in Qualitative Analysis

In qualitative analysis, we work to ensure that the analysis yields trustworthy findings by coding to consensus, meaning that the analytic team reaches 100 percent agreement on the application of each code to the data. Any disagreement between coders is discussed until a resolution is resolved. In some cases, these discussions may result in a code description being redefined. Redefinition of a code requires that all data previously coded using the original code be reanalyzed to ensure fit with the revised definition. As you might imagine, coding to consensus can be time-consuming. Yet, in our experience, the time invested in coding to consensus is well spent because the analysis yields deeper insights about the data and phenomenon being investigated. We also see coding to consensus as a great way to take advantage of the diverse viewpoints that team members bring to our research. By coding to consensus, we consider multiple interpretations of the data throughout the analysis process. We are well-positioned to develop theory (as appropriate for our study design) as a team because we all have engaged in meaningful conversations about our findings throughout analysis.

Some qualitative research relies on a calculated measure of intercoder reliability (ICR) instead of coding to consensus. ICR values indicate how often a set of coders agree on the application of a code in the dataset. This quantification of coding is tempting because we love numbers, yet it can also be problematic (O'Connor and Joffe 2020). For instance, aiming for high ICR can create situations when coders are pressured to agree with each other rather than bringing their own unique perspective to the coding

process (e.g., Belur et al. 2018; Morse 1997). Quantifying qualitative work also can imply a false precision in the analysis. In some research, ICR is calculated partway through the analysis to determine whether an "acceptable" level of agreement has been reached, at which point the remainder of the data are coded by just one researcher. This approach of using ICR as a cut-off runs counter to what many argue is the value of qualitative research: generating new theoretical understandings informed by multiple perspectives.

Using Numbers in Qualitative Analysis

Although numbers certainly have a place in qualitative analysis (Sandelowski 2001), we encourage researchers to move beyond word clouds or frequency counts of codes and themes in their results for two reasons. First, a code or theme that is infrequently observed in the data set can still be important to the phenomenon being studied. As an analogy, consider making qualitative observations of living cells under a typical light microscope. We would most frequently see a relatively stationary cell that is punctuated by a relatively rare cell division or mitosis. If we only reported stationary observations in findings, we would overlook describing mitosis, one of the most dynamic and fundamental processes that cells display. Second, given limited sample sizes, it may be that a unique and important code or theme is reported by only one participant in the data set. In fact, rare observations can serve as "a-ha moments" that lead to a more comprehensive understanding of the phenomenon under investigation. These rare observations also may inspire new studies about topics that were not initially anticipated; this speaks to the value of qualitative research.

Closing Thoughts

We encourage readers to continue to learn about qualitative research as there is much that could not be addressed in a single article. For instance, we did not introduce how philosophical stances, like how someone views the nature of truth or what counts as evidence, influence the research process. (Creswell and Poth 2016). For now, we will close with one final piece of advice. We both became better qualitative researchers by working with mentors and collaborators who have this expertise. We encourage you to find colleagues in your networks or at your institutions who may be interested in being a collaborator, mentor, or critical friend. The complexity of students and their experiences lend themselves to qualitative approaches. We hope this article might serve as an impetus for you to learn more about qualitative research and even start your own investigations.

Data Availability Statement

The data included in this commentary have been published in an open-access journal under a Creative Commons license. Citations are included in the text.

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