

Similar on Paper, Different in Practice: Well-being and Identity Divergence During BME Doctoral Qualifying Examinations

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Using Composite Vignettes to Examine Identity and Well-being in Biomedical Engineering Doctoral Students During the Qualifying Examinations Process

Introduction

This full empirical research paper explores the evolution of engineering and research science identities, and well-being of biomedical engineering doctoral students (EDS) in the buildup to their oral qualifying exam (QE). Professional identity formation is a crucial link between higher education and employment [1], and engineering graduate students develop engineering and research science identities [2], [3] often characterized through students' reported perceptions of recognition by others, performance/competence, and interpersonal skills [4]. These identities remain malleable as students integrate feedback and negotiate personal and social definitions of engineering [5]. The QE is a crucial milestone and entry point to candidacy and research independence [6], [7]. The gatekeeping nature of QEs [6], [7], [8] carries implications for EDS' trajectory [9], [10], poses significant threats to well-being [7], [11], [12], and may contribute to attrition [13], [14]. Despite their importance, QEs are understudied, especially for underrepresented populations [14].

Seligman's PERMA framework captures an individual's 'flourishing' by measuring *Positive emotions, Engagement, Relationship(s), Meaning, and Accomplishment* [15], [16]. Others expanded PERMA to PERMA-V, adding *Vitality* to more fully capture a person's well-being [17], [18]. Engineering education researchers have used this framework to capture aspects of well-being among EDS [19].

Examining identity and well-being during high-stakes doctoral milestones presents methodological challenges, particularly regarding participant confidentiality. Doctoral students in specific programs represent small, identifiable populations where unique combinations of demographic characteristics, laboratory affiliations, and personal experiences could enable readers to identify individuals despite pseudonymization [20].

This study employs composite vignettes to combine data from multiple participants to create accounts that protect individual identity while maintaining analytical meaning [21], [22], [23]. Through constant comparative analysis of interview data, two pairs of participants emerged as particularly noteworthy: within each pair, participants were demographically and academically similar (e.g., both first-generation students from non-BME engineering backgrounds), yet demonstrated contrasting well-being trajectories and divergent framings of both their professional identities and the qualifying examination itself. These naturally occurring within-group contrasts—where students who appear similar 'on paper' experience the same institutional milestone very differently—became the foundation for the two composite vignettes presented here. This approach allows examination of how similar demographic starting points can lead to divergent outcomes, directly challenging deficit models that treat demographic categories as deterministic predictors of experience [24].

Positionality Statement

Positionality shaped both the research design and interpretive approach. The research team consisted of a faculty member, an engineering education postdoctoral researcher, and a BME undergraduate student at the study institution. To mitigate power imbalances inherent in faculty-student relationships, the faculty member was blinded to recruitment, participant identities, and all data until after data collection was complete. Only the postdoctoral researcher—positioned as a relative outsider who does not have evaluative authority over participants—conducted recruitment and all interviews. This design decision prioritized participant autonomy and candor, particularly important given the vulnerability associated with discussing well-being struggles and identity uncertainties during a high-stakes evaluative process.

The postdoctoral researcher brought lived experiences of QEs in both engineering and STEM education doctoral programs, including not passing the engineering QEs and successfully passing the STEM education QEs. These different trajectories provided critical insight into how students might experience similar high-stakes milestones differently based on context, preparation, and support structures, and informed a view of student struggles as reflecting complex person-structure relationships rather than individual deficits. The postdoc's immigrant background also provided some commonality with participants navigating U.S. doctoral education as children of immigrants—informing the interview approach by creating space for participants to discuss educational preparation, family expectations, and cultural navigation without researcher judgment, while requiring sustained attention to avoid conflating shared identity with shared experience. The undergraduate researcher's perspective helped the team distinguish undergraduate identity perspectives from doctoral-level professional identity development, and once data collection was complete, the faculty member's institutional knowledge proved valuable for contextualizing participants' descriptions of departmental structures and QE processes.

During analysis, we used the researchers' diversity of QE experiences (examiner, unsuccessful engineering examinee, successful education examinee, observer) and career stages to interrogate assumptions about what constitutes 'adequate support', 'reasonable stress', or 'burdensome workload' in the peri-QEs context. We explicitly attended to moments where participant framings challenged our expectations—for instance, when students with strong advisor affirmation nonetheless expressed profound imposter syndrome, or when students described laboratory 'fit' in ways that resisted simple categorization as 'good' or 'bad' mentorship.

Methods

Participants

Nine second-year biomedical engineering EDS preparing for oral qualifying examinations were recruited from a mid-size private R1 university. Consent, demographic information, and Engineering Identity (EI) and Research Science Identity (RSI) measurements were collected via Qualtrics survey. The study was approved by the institutional IRB of Northwestern University [STU00223764]; informed consent was given as part of the survey and at the start of each interview.

Each participant completed multiple semi-structured interviews before QEs and one shortly after. The participants comprised five who identified as female and four who identified as male. Three participants identified as White, three identified as Latinx, two identified as Asian, and one identified as Asian and Latinx. Two participants identified as first-generation students. Six participants held engineering undergraduate degrees and three held science degrees.

Data & Coding

Interviews (30–40 min, Zoom or in-person) covered topics of classwork, research efforts, QE preparation strategies, relationships, and well-being. Semi-structured protocols included brief explanations (Int. #1) or reminders (Int. #2–3) of PERMA-V and engineering and research science identity to frame those discussions. Data coding was performed using ATLAS.ti. After other methodological coding work [25], approximately three rounds of *de novo* inductive coding [26] using a constant comparative approach [27] produced 21 code groups and 131 codes. The patterns presented in this paper emerged through team discussion, leading to selection of two student pairs (n=2 each) that comprise the composite vignettes (see next).

Narrative Analysis with Composite Vignettes

Identities are constructed through narratives—at their core ‘a telling of who one is’ [27, p.14]—through which a person conveys their understanding of themselves relative to the world [29]. Constructing composite vignettes, with decisions about what to include and how to sequence events, is itself a form of narrative analysis [23], [30].

The constant comparative approach described above surfaced two pairs of EDS whose sufficiently common personal and academic contexts, combined with contrasting well-being trajectories and divergent identity framings, made them natural candidates for composite construction. Each pair's shared patterns across identity development, well-being indicators, and QE views anchored the overarching research question: **How do BME doctoral students describe their identities and well-being longitudinally in the lead up to qualifying examinations?**

Direct quotations represent actual participant language, lightly edited for clarity and confidentiality; when both participants expressed similar ideas, the quotation most clearly articulating the shared experience was selected. Laboratory contexts and specific demographic details were altered to prevent identification while preserving analytically relevant features. Tensions and contradictions in the data were retained.

Vignette #1: Linh

Linh is a second-year doctoral student in biomedical engineering. She is the first in her family to pursue graduate education, the daughter of immigrant parents from Vietnam. She completed her undergraduate degree in electrical engineering at a large public university. “[My state] *is not known for great education*” she notes matter-of-factly, “*it seems like the community I grew up [in] wasn’t on par with, like some of my peers... ..which is okay. I came here for an education,*

like, you're supposed to be learning.” This pragmatic orientation—acknowledging gaps while asserting her right to fill them—characterizes much of her approach to doctoral study.

Linh's research focuses on stochastic signal processing for neural prosthetic device development. *“I'm building off of [signal processing algorithms] that we've already made...and I'm just modifying them for a different purpose”* She works in a co-advising arrangement between a primary advisor in electrical engineering and a secondary BME advisor who leads a neuro-engineering lab. When asked about her professional identity, Linh describes a shift that occurred during graduate school: *“Once I became a grad student, I started associating myself with the research identity more.”* She distinguishes engineering from research science by the nature of the work: *“Engineering, I kind of associate that with more like just making something work, you know...you're given a task, you have to fix this, fix that, versus research—I feel like it's a little bit more social in a way, because you have to share your data with everyone else, and you have to do your papers.”*

Rather than experiencing this shift as threatening to her engineering identity, Linh frames it as complementary. Her engineering foundation enables her research work—she is learning new modes of thinking while retaining what brought her to graduate school. The co-advising structure reinforces this integration: *“Both of my advisors work together a lot, so I think they're familiar with what each other would like, ask...The reason I'm co-advised between the two is because they've been collaborating for like 10-plus years already...it just makes me think about my project more...it's just helpful, because it makes me see my project more of as a whole.”*

Linh approached qualifying examination preparation strategically and with clear boundaries about what she can control. *“Both of my advisors are pretty cool with...understanding when...I can't get as much lab work done...because I'm preparing for quals.”* When stress becomes overwhelming, she knows she has recourse: *“If I really am struggling, I know I can sit down with my PIs and just be like: ‘can I have just like a week or two to just focus on quals?’ ”*

Despite being in an electrical engineering lab, Linh's laboratory environment provided substantial peer support. *“I've been getting a lot of support from other students. They all offer to give me an audience, to sit down with me, look through my stuff, try to ask me questions. So that's been really helpful.”* Both laboratories—the primary electrical engineering lab and the secondary BME lab—had structures to support students through QE preparation: *“In [my BME advisor's] lab...there's multiple of us going through quals, defenses, stuff like that...they let you sign up for a slot for lab meeting to go ahead and do a practice trial of like whatever you're preparing for.”*

Linh experienced anxiety, but it remained manageable and specific rather than existential: *“I'm a little bit scared...I do feel a lot more stressed right now...there's a lot of pressure...because...that [quals] is like them [the committee] saying I'm qualified to be in the program.”* Importantly, this anxiety does not appear to extend to doubts about her belonging or capability.

Knowledge gaps were consistently framed by Linh as opportunities rather than indictments. *“I think I'm behind a little bit, which is okay,”* she reflected when comparing her educational background to that of her BME peers. Rather than presenting any indicators of imposter

syndrome, she articulated a growth mindset: *“School...is about learning and just bettering yourself. I’m just grateful...I have the opportunity to be here...to make the most of it even if I’m starting...behind...my peers.”* This orientation toward embracing challenge extends to her research practice. When facing technical problems she hasn’t encountered before, *“I’m not afraid to just try something...I don’t need a whole [plan]...if I just have an idea I’m totally fine with just trying it out...I’ll just go figure it out...I’m kind of okay with just jumping into things that I don’t really know how to do...I’ll figure out as I go.”* Linh is presenting agency—the belief that she can learn what she needs to know, and she has, or will have, the ability to tackle challenges.

As the QEs approached, Linh reported increasing stress like most of her peers, but also feelings of increased confidence: *“I don’t know if it’s just because we’re getting closer and I’m just becoming a little delusional...I think I should probably be a lot more stressed about it...At this point I’m kind of just like I know what I know...I’m nervous, but I also feel like fairly confident that I know what I’m talking about.”*

Vignette #2: Ngọc

Ngọc is another second-year doctoral student in biomedical engineering. Like Linh, she is the first in her family to pursue graduate education, the daughter of immigrant parents from Vietnam. She completed her undergraduate degree in chemical engineering with a specialization in BME electives. *“I majored in chem-eng. I really hit the ground running with research...[flagship state university] is known for being a big research institution, so I started doing research in a chemical engineering lab.”* Ngọc started doctoral studies excited about the possibilities of translational research—*“I really just enjoyed...doing research and working in labs...being able to ask questions...designing my own experiments to...figure out answers.”*

Ngọc's research involves developing polymer-based therapeutic delivery systems, requiring integration of chemistry, immunology, and cell biology. *“I work with [redacted technological details] and I can't do one [engineering/science] without the other. I have to do the quality and process [engineering], and the R&D [research science] to get my project to work.”* Her laboratory is interdisciplinary: *“We have a mix of people in my lab...some biomedical engineers...some chemical engineers...some people from basic biological science.”*

Ngọc’s concept of her professional identity reveals internal tension. On one hand, she articulates an integrated perspective on her work: *“I agree. I think it’s [engineering and research science] the same. Because I can’t do one without the other, at least for my project...I need to establish a process that could be replicable for other people to do whenever I publish it. But I also need to be...rigorous in my experimental design.”* Such language indicates she understands her work as requiring both engineering and research science competencies, but when asked which identity feels more natural, her answer reveals strain: *“I definitely identify more as an engineer. I feel like engineering thinks more high level...it is problem solving. And I feel like research science is very detail oriented, which I’m not that way...I don’t get bogged down in...the mechanisms of why something biologically happens.”* She experiences the QE as expecting to the point of demanding or even imposing a research science identity that conflicts with her self-concept: *“Quals is forcing us to use our science identity. As engineers, we’re not that interested in what’s*

happening in the back end. If they truly believe engineers problem solve, then why are we just doing the science?"

Her laboratory structure reinforces this divide. While Ngoc's project requires both engineering and biological expertise, *"in my lab, a Chem-E [chemical engineering student] could never touch a cell...[whereas] a lot of the biology people only work with cells."* She explains how other students maintain disciplinary boundaries that Ngoc's project requires her to cross—but without clear mentorship for how to do so: *"I just don't really know what either of these things [engineering identity vs. research science identity] are...so I think that's why I get confused."*

During QE preparation Ngoc faced competing demands with pressure to continue research. *"there's...pressure to keep making progress even though I should be focusing more on quals. [My advisor] didn't really ask me if I wanted to do these [experiments]...just kind of started planning [for me] to do it."* The timing feels particularly unfortunate: *"I do mainly [chemical engineering work] but now I'm supposed to be doing a lot more [research science]".* Ngoc would prefer to pause research entirely: *"Research is still continuing...unfortunately, because I would like to just study literature. But unfortunately, if we don't keep doing our studies the mice will get too old to be used."* By the second interview, responsibility for slow experimental progress and the competing demands on Ngoc's time was being externalized and with resentment: *"the mice are too old, now, at this crucial time. I think [it's] a lapse in the judgment of my PI."*

As the QEs approached, her stress continued to grow: *"The overall theme filling up to quals is...increasing...stress."* By the second interview, the distress had become pervasive: *"I'm just very miserable right now. I think there's like a dark cloud looming over me"*. The stress was not confined to QE prep and research, but affected multiple life domains: *"When I'm stressed, I tend not to take care of myself in like normal functional ways...I don't eat when I'm stressed...no fun activities, nothing that would...relieve stress...there's...no time to allow for it."*

Ngoc's critique extends beyond personal struggle to systemic condemnation: *"I hate it. I feel like it's [quals] not an accurate assessment of whether somebody's a good researcher or not. And honestly, I feel like sometimes it's an excuse to offload certain students who may not be performing as desirably as a professor wants."* She locates agency outside herself: *"They built the system that way...you cannot move forward unless you pass your quals...it's not my decision to...have it be that way."*

Ngoc recognizes that her advisor is positive about her progress, but cannot accept it: *"I think it's [the advising relationship] been going well, she seems to have...a lot of confidence in me which... I don't know... I think obviously I trust her judgment. But then also, I'm like, what if she's just saying that? I mean, it's just my imposter syndrome talking like I'm just like, what if she's just saying that because she's being nice and not because she actually means that she thinks I'm gonna do well. I think she's just giving me like good support, like as an advisor like feedback on stuff. And we did our practice talk, and that that went well, too, and she also gave me positive affirmations...which was definitely a confidence boost—I think that's been pretty helpful for me. Obviously, she also gives feedback on the technical stuff. But honestly, I feel like my biggest obstacle right now is confidence, and not like lack of foundational science knowledge."* The

insight—that confidence rather than knowledge is the barrier—coexists with inability to resolve it.

Despite the absence of any academic or research indicators to suggest problems, Ngọc openly describes imposter syndrome. *“On paper I’m a very good applicant...but...I struggled a lot with imposter syndrome. As I spent more time in the lab...I had a hard time working...my confidence...decreased and I started getting depressed and...afraid to do science...and be afraid of messing up.”* This fear of failure connects to concerns about her standing: *“I have this fear of being essentially kicked out of the program because I’m not, like, doing well enough. I think once I’m past quals, I’ll be convinced that I can actually get a PhD. But honestly, I think right now, I don’t really believe that I’m going to get a PhD.”* The conditional framing is striking—passing the QEs would not confirm her competence but merely allow her to believe she might eventually succeed. The imposter syndrome manifests in constant comparison: *“It really intimidated me...I would compare myself to my peers...for a lot of them, it was just another...doctorate in the family.”* Even productive days offer no respite: *“I think I just always have, like those thoughts in the back of my mind, even while I’m studying. And even if I feel like I’m doing well or had a productive day, a lot of times it feels like whatever I was working on was the wrong stuff.”*

Discussion

Linh and Ngọc have similar backgrounds and share some aspects of their doctoral experiences, yet there are substantial differences between the two. However, they had notably differing experiences with lab groups, views on the QE process, and well-being trajectories.

Advising and lab environment in identity development

Faculty advisers aid in the learning of the sociocultural expectations of doctoral education and provide psychosocial support, helping EDS develop academic identities [31], [32] and integrate into academic communities of practice [6], [33]. Both Linh and Ngọc’s PIs helped them get integrated into their research groups. Linh gets *“support from both...PIs”* and has regular meetings with them to update them on her research progress. Ngọc’s PI believed that first year students need to *“hit the ground running with research from the very beginning”* considering the interdisciplinary nature of her lab groups’ research. Both students also volunteered their perceptions of their PI as emotionally supportive, particularly during challenging times. Linh described her PI as understanding, that if she was *“really struggling, I know I can sit down with my PIs and...can I...just focus on quals.”* Ngọc described her PI as emotionally supportive especially when she needed to *“take a step back from research [for personal reasons].”* These findings suggest the importance of faculty advisers in developing students’ engineering and research science identities [2], [9]. Furthermore, both Linh and Ngọc felt supported regarding personal concerns. Linh characterized this support as compatibility with her PIs *“in terms of communication...general worldviews, and...priorities.”* Ngọc described her PI as *“the type of person that...can make me feel better”* and who *“sees all her students as people who have needs and feelings.”* These particular findings with this set of students (in the midst of preparing for QEs) match prior findings with students’ retrospective data suggesting that PIs are supportive of their students [34].

Advising relationships shape both students' research development and how they navigate the competing demands of research productivity and QE preparation [31], [32]. Faculty advisors face a similar tension: investment in their students' development as researchers and passing the QEs, two compatible priorities but can clash in the compressed QE time frame [6]. How advisors resolve that tension has direct consequences for students. Both Linh and Ngọc described their PIs as supportive in the affective domain—Linh characterized her advisors as understanding of her workload constraints, while Ngọc described her PI as “*very approachable and kind...I can go to her if I am going through personal problems or struggling academically*”—consistent with findings that EDS generally perceive their advisors as supportive [34], [32]. But emotional support and workflow agency are not the same thing. When Linh needed relief from research work, she could initiate that negotiation directly: “*I know I can sit down with my PIs and just be like...can I just have a week or two to just focus on quals?*” Her advisors' approach to the research-QE tension included student input. Ngọc's PI resolved the same tension differently, making unilateral decisions about her research workload during QE preparation—“*[they] didn't really ask me if I wanted to do an animal experiment*”—leaving Ngọc to absorb competing demands she had not consented to and attributing the situation to a systemic failure: “*faculty even complain about how we're so less productive...but the way they run quals incentivizes us not to be productive.*” These findings suggest that the power asymmetries inherent in adviser-student relationships [9] can reduce or amplify the stress of managing competing demands [11], [32].

The broader laboratory environment shapes students' access to peer support, a key facet of integrating into a research community of practice [6], [9], [33], [35]. Both Linh and Ngọc worked in medium-sized laboratories with strong faculty support, but their experiences with peers diverged substantially. Being co-advised gave Linh access to peers across two laboratories (n=25), the majority of whom were engineers, and this translated directly into utilized support: “*a lot of students from both labs have offered to sit down with me, look through my stuff.*” Ngọc's laboratory (n=13) was similar in size to Linh's primary lab (n=11) but organized differently. When describing her lab, Ngọc noted that “*a Chem-E could never touch a cell, [whereas] biology people only work with cells*”—characterized by an internalized disciplinary boundary that structured who worked with whom. For Ngọc, whose project required her to straddle that boundary, available peers modeled either the engineering *or* the science orientation, but not the integration her work demanded. Disciplinary composition may therefore matter as much as group size, particularly in BME which is inherently cross disciplinary. These findings suggest that laboratories providing both adequate peer network size *and* disciplinary alignment with students' work may offer different scaffolding than those that provide numbers without that alignment—a distinction that may be especially consequential during QE preparation, when students are being evaluated on their capacity to integrate across exactly those boundaries.

QEs as learning opportunities

Ideally, QEs are opportunities to develop doctoral skills and facilitate full membership in scientific communities of practice [6], [33]. Oral QEs require more than technical mastery—they require the ability to translate and communicate these ideas across audiences [6], [7]. This communication aspect is rarely made explicit in program requirements, but is nonetheless consequential [7]. Linh's preparation engaged this hidden curriculum directly—by forming study groups that drew from multiple BME subdisciplines she was practicing the synthesis and translation work the oral format demands. Ngọc's preparation, by contrast, concentrated on the

technical content and solving problems to get research into the clinical phase and not focusing on developing communication skills. This difference in experiences reaffirms that implicit expectations may leave students underprepared [7].

While faculty may frame QEs as learning opportunities, many feel QEs embody a deficit mindset deeming EDS as unfit for candidacy until they pass [5], preserving cultural meanings of merit, excellence, and rigor [6] within an engineering culture characterized by hardship, suffering, and stress [36], [37]. Such framings differentially shape students' experiences even among those who appear similar on paper. Linh acknowledged her EE background left her “*being a little behind...compared to some of my peers*” requiring her to “*compensate more [in] biology because I didn't really study that much [biology] in my undergrad.*” Furthermore, Linh was “*grateful to...be...learning and just bettering yourself*” and considered the QEs as a learning opportunity.

Deficit framings, often internalized by students of color, foreground student shortcomings which become the baseline from which students work [5], [34]. Ngọc offered an explicit structural critique—QEs are “*not an accurate assessment of whether somebody's a good researcher,*” and are sometimes “*an excuse to offload certain students*”—consistent with documented concerns about QEs' gatekeeping function and limited ability to identify research aptitude [5], [6], [7], [14]. Yet she simultaneously internalized the deficit framing she criticized, describing escalating self-doubt despite no academic indicators suggesting she was struggling. Her advisor's confidence offered no relief, and passing the QE was not a confirmation of competence but the minimum condition for believing she might eventually succeed. These findings show that the coexistence of systemic critique and self-doubt is an outcome of an embedded deficit framing in the QEs [5], critiquing the system does not preclude students from internalizing their meanings [38].

Wellbeing implications

Engineering education is a source of significant psychological stress [37] and QE preparation intensifies stressors already present in research training—including research progress demands, coursework, and relationships [11]. Examining Linh's and Ngọc's experiences through the PERMA-V(N) framework illuminates how these shared stressors produced substantially different well-being trajectories.

Across nearly all PERMA-V(N) dimensions, Linh maintained indicators of flourishing. She reported positivity alongside her anxiety, noting “*I'm nervous, but I also feel fairly confident that I know what I'm talking about.*” Her engagement remained high; she described diving into unfamiliar problems with curiosity rather than avoidance. Her relationships dimension was actively maintained: study groups, lab meeting practice slots, and peer networks across two laboratories all remained accessible and utilized. She reported clear meaning in her work, framing quals as a legitimate developmental milestone rather than an arbitrary barrier. And she described concrete accomplishment indicators—conference presentations, successful experimental iterations—that reinforced her sense of competence. Her vitality, while stressed, was protected by deliberate coping strategies: regular exercise and protected weekend time for non-academic activities.

Ngọc's PERMA-V(N) profile showed deterioration across multiple dimensions simultaneously, reflecting what Jensen and Cross [37] describe as the compounding effect of stressors in

engineering culture. Positivity gave way to pervasive distress: *“I’m just very miserable right now...there’s a dark cloud looming over me.”* Engagement contracted rather than expanded under pressure. Relationships—a critical buffer during high-stakes transitions [35]—were undermined both by the mentorship gap following her senior lab mate’s departure and by her lab’s disciplinary fragmentation, which limited access to peers who could model her particular path through QEs. The meaning dimension was particularly disrupted: rather than framing the QE as a meaningful milestone, Ngọc experienced it as an imposed demand that conflicted with how she understood herself as a researcher. And her sense of accomplishment was systematically undermined by imposter syndrome that could not be resolved even by direct positive feedback from her advisor—*“what if she’s just saying that because she’s being nice?”*

Implications for Practice

These findings are drawn from a small sample at a single institution, and we offer the following not as prescriptions but as possibilities worth considering. Programs might examine whether institutional communications—handbooks, orientations, and advisor conversations—frame QEs as developmental milestones or inadvertently signal gatekeeping and deficit orientation. Advisors and programs might also consider establishing explicit plans for balancing research productivity and QE preparation, recognizing that emotional support and workflow agency are distinct: personal support does not preclude unilateral research demands that compound stress. Finally, programs might reflect on whether positive feedback alone is sufficient to support students experiencing imposter syndrome during peak stress periods; sustained, behaviorally-specific feedback over time may be more effective than in-the-moment reassurance for students whose confidence has eroded across multiple dimensions simultaneously.

Conclusions

The cases of Linh and Ngọc challenge the assumption that demographic similarity predicts experiential similarity—students who appear identical on paper can have radically divergent experiential trajectories, with the meaningful variation located in ‘fit’ between identity and lab/research environment, advising structures, and peer network quality rather than in the students alone. Ngọc’s experience further illustrates that well-being deterioration is multidimensional and mutually reinforcing, such that interventions targeting a single dimension may be insufficient when multiple PERMA-V domains are simultaneously compromised. Perhaps most importantly, Ngọc’s clear-eyed structural critique of QEs coexisted with profound well-being deterioration, suggesting that programs cannot assume students who can articulate systemic problems are buffered from internalizing them.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant 2306239. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

References

- [1] M. Tomlinson and D. Jackson, "Professional identity formation in contemporary higher education students.," *Studies in Higher Education*, vol. 46, no. 4, pp. 885–900, Apr. 2021, doi: 10.1080/03075079.2019.1659763.
- [2] H. L. Perkins, M. Bahnson, C. Cass, M. A. Tsugawa-Nieves, and A. Kirn, "Development and Testing of an Instrument to Understand Engineering Doctoral Students' Identities and Motivations," presented at the 2018 ASEE Annual Conference & Exposition, Jun. 2018. Accessed: Dec. 02, 2024. [Online]. Available: <https://sftp.asee.org/development-and-testing-of-an-instrument-to-understand-engineering-doctoral-students-identities-and-motivations>
- [3] N. H. Choe and M. Borrego, "Prediction of Engineering Identity in Engineering Graduate Students," *IEEE Transactions on Education*, vol. 62, no. 3, pp. 181–187, Aug. 2019, doi: 10.1109/TE.2019.2901777.
- [4] H. Perkins, M. A. Tsugawa-Nieves, J. N. Chestnut, B. Miller, A. Kirn, and C. Cass, "The Role of Engineering Identity in Engineering Doctoral Students' Experiences," presented at the 2017 ASEE Annual Conference & Exposition, Jun. 2017. Accessed: Sep. 11, 2024. [Online]. Available: <https://peer.asee.org/the-role-of-engineering-identity-in-engineering-doctoral-students-experiences>
- [5] S. Basir and E. Burkholder, "Investigating faculty perspectives on written qualifying exams in physics," *Phys. Rev. Phys. Educ. Res.*, vol. 20, no. 1, p. 010139, May 2024, doi: 10.1103/PhysRevPhysEducRes.20.010139.
- [6] R. Liera, A. J. Rodgers, L. N. Irwin, and J. R. Posselt, "Rethinking doctoral qualifying exams and candidacy in the physical sciences: Learning toward scientific legitimacy," *Phys. Rev. Phys. Educ. Res.*, vol. 19, no. 2, p. 020110, Aug. 2023, doi: 10.1103/PhysRevPhysEducRes.19.020110.
- [7] M. Hooper, J. Tawney, E. Palmer, J. Ragan, M. Hooper, and Y. Gonzalez, "Student-led program to improve equity in Ph.D. oral qualifying exams," Jun. 2023. doi: 10.18260/1-2--44337.
- [8] S. Guloy, G. Hum, and D. K. O'Neill, "Voices at the gate: Faculty members' and students' differing perspectives on the purposes of the PhD comprehensive examination," *Assessment & Evaluation in Higher Education*, vol. 45, no. 2, pp. 279–291, Mar. 2020, doi: 10.1080/02602938.2019.1637819.
- [9] M. Bahnson *et al.*, "Inequity in graduate engineering identity: Disciplinary differences and opportunity structures," *Journal of Engineering Education*, vol. 110, no. 4, pp. 949–976, 2021, doi: 10.1002/jee.20427.
- [10] J. C. DiPietro, W. Drexler, K. Kennedy, V. Buraphadeja, Feng Liu, and K. Dawson, "Using Wikis to Collaboratively Prepare for Qualifying Examinations:," *TechTrends: Linking Research & Practice to Improve Learning*, vol. 54, no. 1, pp. 25–32, Jan. 2010, doi: 10.1007/s11528-009-0360-0.
- [11] J. F. Mirabelli, J. G. Cromley, K. J. Jensen, A. Hart, and R. D., "Work in Progress: Exploring the Landscape of Stressors Experienced by Doctoral Engineering Students," Jun. 2023, Accessed: Nov. 25, 2024. [Online]. Available: <https://par.nsf.gov/biblio/10488114-work-progress-exploring-landscape-stressors-experienced-doctoral-engineering-students>
- [12] M. Bahnson and C. G. P. Berdanier, "Current Trends in Attrition Considerations of Graduate Engineering Students in the United States," *International Journal of Engineering Education*, vol. 39, no. 1, pp. 14–29, Jan. 2023.

- [13] C. G. P. Berdanier and G. Sallai, "Let's Talk about Leaving: A Special Session on Attrition and Departure from the Engineering Doctorate for Administrators, Advisors, Mentors, and Graduate Students," in *2023 IEEE Frontiers in Education Conference (FIE)*, Oct. 2023, pp. 1–4. doi: 10.1109/FIE58773.2023.10342900.
- [14] L. A. Dove, C. E. Singer, and S. E. Murphy, "Bringing a Lens of Equity to Geoscience Qualifying Examinations," *AGU Advances*, vol. 5, no. 3, p. e2024AV001260, 2024, doi: 10.1029/2024AV001260.
- [15] M. E. P. Seligman, *Flourish: A Visionary New Understanding of Happiness and Well-Being*. Riverside: Atria Books, 2011.
- [16] M. Seligman, "PERMA and the building blocks of well-being," *The Journal of Positive Psychology*, vol. 13, no. 4, pp. 333–335, Jul. 2018, doi: 10.1080/17439760.2018.1437466.
- [17] J. Butler and M. L. Kern, "The PERMA-Profilier: A brief multidimensional measure of flourishing," *International Journal of Wellbeing*, vol. 6, no. 3, Art. no. 3, Oct. 2016, doi: 10.5502/ijw.v6i3.526.
- [18] A. Eacker, "Well-Being Definition and Measures in Medical Education," *Medical Professionalism Best Practices*, pp. 91–103, 2020, doi: 10.1001/jama.1971.03180370073017.
- [19] K. Shanachilubwa, G. Sallai, and C. G. P. Berdanier, "Investigating the tension between persistence and well-being in engineering doctoral programs," *Journal of Engineering Education*, vol. 112, no. 3, pp. 587–612, Jul. 2023, doi: 10.1002/jee.20526.
- [20] K. Kaiser, "Protecting Respondent Confidentiality in Qualitative Research," *Qual Health Res*, vol. 19, no. 11, pp. 1632–1641, Nov. 2009, doi: 10.1177/1049732309350879.
- [21] O. Johnston, H. Wildy, and J. Shand, "Student voices that resonate – Constructing composite narratives that represent students' classroom experiences," *Qualitative Research*, vol. 23, no. 1, pp. 108–124, Feb. 2023, doi: 10.1177/14687941211016158.
- [22] S. Sajadi, N. N. Kellam, and S. R. Brunhaver, "Exploring composite narratives as a methodology to understand and share research findings in engineering education," presented at the 2023 ASEE Annual Conference & Exposition, Jun. 2023. Accessed: Jan. 05, 2026. [Online]. Available: <https://peer.asee.org/exploring-composite-narratives-as-a-methodology-to-understand-and-share-research-findings-in-engineering-education>
- [23] R. Willis, "The use of composite narratives to present interview findings," *Qualitative Research*, vol. 19, no. 4, pp. 471–480, Aug. 2019, doi: 10.1177/1468794118787711.
- [24] S. R. Harper, "An anti-deficit achievement framework for research on students of color in STEM," *New Directions for Institutional Research*, vol. 2010, no. 148, pp. 63–74, 2010, doi: 10.1002/ir.362.
- [25] J. Tabora and D. P. O'Neill, "Reliability of PERMA-V(N): A Qualitative Coding Framework for Capturing Well-being Dimensions in Engineering Doctoral Students," presented at the 2026 ASEE Annual Conference & Exposition, Jun. 2026.
- [26] J. Saldaña, *The coding manual for qualitative researchers*, 2nd ed. Los Angeles: SAGE, 2013.
- [27] B. G. Glaser, "The Constant Comparative Method of Qualitative Analysis," *Grounded Theory Review*, vol. 7, no. 03, pp. 3–12, Nov. 2008.
- [28] A. Sfard and A. Prusak, "Telling Identities: In Search of an Analytic Tool for Investigating Learning as a Culturally Shaped Activity," *Educational Researcher*, vol. 34, no. 4, pp. 14–22, May 2005, doi: 10.3102/0013189X034004014.

- [29] J. M. Kane, "Young African American boys narrating identities in science," *Journal of Research in Science Teaching*, vol. 53, no. 1, pp. 95–118, 2016, doi: 10.1002/tea.21247.
- [30] M. Varelas, J. M. Kane, and C. D. Wylie, "Young black children and science: Chronotopes of narratives around their science journals," *Journal of Research in Science Teaching*, vol. 49, no. 5, pp. 568–596, 2012, doi: 10.1002/tea.21013.
- [31] B. J. Barnes, E. A. Williams, and M. L. A. Stassen, "Dissecting doctoral advising: a comparison of students' experiences across disciplines," *Journal of Further and Higher Education*, vol. 36, no. 3, pp. 309–331, Aug. 2012, doi: 10.1080/0309877X.2011.614933.
- [32] N. Curtin, A. J. Stewart, and J. M. Ostrove, "Fostering Academic Self-Concept: Advisor Support and Sense of Belonging Among International and Domestic Graduate Students," *American Educational Research Journal*, vol. 50, no. 1, pp. 108–137, Feb. 2013, doi: 10.3102/0002831212446662.
- [33] J. Lave, "Situating learning in communities of practice.," in *Perspectives on socially shared cognition.*, L. B. Resnick, J. M. Levine, and S. D. Teasley, Eds., Washington: American Psychological Association, 1991, pp. 63–82. doi: 10.1037/10096-003.
- [34] J. Tabora and D. P. O'Neill, "Work in Progress: Exploring Qualifying Exam Experiences in Engineering Doctoral Students using Well-Being Constructs," presented at the 2025 ASEE Annual Conference & Exposition, Jun. 2025. Accessed: Aug. 29, 2025. [Online]. Available: <https://peer.asee.org/work-in-progress-exploring-qualifying-exam-experiences-in-engineering-doctoral-students-using-well-being-constructs>
- [35] S. K. Gardner, "'What's too much and what's too little?': The Process of Becoming an Independent Researcher in Doctoral Education," *The Journal of Higher Education*, vol. 79, no. 3, pp. 326–350, May 2008, doi: 10.1080/00221546.2008.11772101.
- [36] E. GODFREY and L. PARKER, "Mapping the Cultural Landscape in Engineering Education.," *Journal of Engineering Education*, vol. 99, no. 1, pp. 5–22, Jan. 2010, doi: 10.1002/j.2168-9830.2010.tb01038.x.
- [37] K. J. Jensen and K. J. Cross, "Engineering stress culture: Relationships among mental health, engineering identity, and sense of inclusion," *Journal of Engineering Education*, vol. 110, no. 2, pp. 371–392, 2021, doi: 10.1002/jee.20391.
- [38] E. McGee, "'Black Genius, Asian Fail': The Detriment of Stereotype Lift and Stereotype Threat in High-Achieving Asian and Black STEM Students," *AERA Open*, vol. 4, no. 4, p. 233285841881665, Oct. 2018, doi: 10.1177/2332858418816658.