Unveiling the Crisis: Decoding the Working Conditions of Doctoral Engineering Students and the Call for Decent Work

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"Research guided only by the controlling yardstick of profit undermines the role of the university as a public sphere dedicated to addressing the most serious social problems a society faces. Moreover, the corporate model of research instrumentalizes knowledge and undermines forms of theorizing, pedagogy, and meaning that define higher education as a public good rather than as a private good" [1].

-Henry Giroux

Introduction

What has been coined as a crisis in graduate education, is evidenced primarily by 1) high attrition rates and 2) a mental health crisis among graduate students [2], [3]. The issue of attrition is of interest to various stakeholders including faculty advisors, academic administrators, funding agencies, the federal government, and doctoral engineering students themselves. Attrition within the current discourse in the field is said to represent a waste of resources, both human and financial, from various parties[4], [5]. Neoliberal economic principles, which dominate modern-day higher education, would dictate that attrition is therefore an issue that should be addressed and mitigated to the furthest extent possible [1]. This seemingly high level of attrition is puzzling to those looking from outside of doctoral engineering programs. Look at the PhD program sections of websites of any engineering department at a research-intensive university and you will see that virtually all of the programs are fully funded, meaning all fees are paid for the student in addition to receiving a stipend. If these PhD students are receiving a "free" education, why do they not complete their programs? The reality is that what might appear as a great way to advance one's education is actually an exploitative system that prioritizes the extraction of financial value from PhD students [6]. As one might expect, this critical perspective is rarely discussed in higher education and is typically reserved for "dissident" and "radical" political movements. The exploitation that doctoral engineering students face, to be discussed in later sections of this essay, logically leads to the mental health crisis that graduate students in all disciplines face [3], [7], [8]. This mental health crisis is a real crisis, leading to various tragedies nationwide [9], [10], [11], [12], [13]. This crisis is a truly a matter of life and death and research that does not acknowledge this should be scrutinized.

A Journey to Engineering Education

A child of immigrants, I identify as Latino and use he/him pronouns. Growing up in Columbus, Ohio, my parents instilled a deep respect for formal education. This led to my graduation with a B.S. in Chemical Engineering from The Ohio State University in 2017. With some undergraduate research experience under my belt and motivation from my friends at SACNAS (Society for the Advancement of Chicanos and Native Americans in Science), I chose to pursue a PhD in Chemical Engineering at a research-intensive university, hereafter referred to as ABC University. ABC University was over 1000 miles from my home of Columbus and admittedly, I struggled living on my own for the first time in a new city. Family is central to my identity and homesickness made passing the difficult first semester graduate chemical engineering courses

near impossible. At 21 years of age, I was barely making it through my PhD program the first few months. I hoped things would turn around as I acclimated to the city and was paired with a research advisor the following semester. I was looking forward to joining a good lab culture like the one I had at my undergraduate institution and gaining some additional social support.

My second semester I was paired with an advisor that matched my research interests in energy technologies, which has been my passion since childhood. This advisor was tenured and now worked in the administration of the university. They told me early on that this was a new area of research for them and that they did not have the time to "hold my hand". At the time I did not see this as an issue since the research matched my undergraduate research, and I felt confident I knew what I wanted to do. At the time the lab was very small. Only a couple PhD students were there, and they were close to graduation. In addition, my work was computational while theirs was experimental and in a completely different subject area. I felt isolated even when surrounded by other PhD students in my lab. Though new PhD students joined the lab the following year, I did not have anyone to bounce ideas off of and no one to discuss the direction of my research. On top of struggling with my mental health I slowly began to disengage from the lab and research. I saw others from my cohort advance through the program and hit important milestones, while my research production was minimal. My advisor offered little in the way of support. They did not seem to have time for me, nor were they an expert in my research area. I watched my friends struggle with their mental and physical health in their program. They were verbally harassed by their advisors and told to work on the weekends. As international students they complied and put up with what I perceived as mistreatment because of their socio-economic situations. I had the privilege to leave the program if I chose to. Once I realized that my research was going nowhere and that I was not really adding anything of value to my career, I began seriously thinking about leaving. Previously I thought about leaving the program in a kind of distant and abstract way, but going into my third year I was growing tired and resentful of my research, of my circumstances, and being far away from home. The decision to leave was not made lightly. I felt that if I left, I would be marked a failure. As a high achieving undergraduate student, this was difficult to cope with. I also felt guilt when it came to my family. Growing up in poverty, I was acutely aware of the sacrifices my parents made for my education, providing deeply enriching experiences for me while working long hours and hard jobs. Moving to a new city required money that I did not have, so they supported me financially when I was struggling to make ends meet. I felt that leaving the program without a PhD would be wasting their effort and money as well as my own.

I chose to leave with a master's degree at the end of my third year, which coincided with the COVID-19 pandemic. Despite having to endure the pandemic like everyone else, I felt free in ways I had not before. I was fortunate enough to find a job at a national lab performing technoeconomic analyses of energy technologies. For the first time in my life, I made a living wage and was actually able to support my family through the economic downturn that accompanied the global pandemic. I learned so much working remotely for the national lab and thoroughly enjoyed the team I worked with. However, I knew deep down I still wanted to become a professor, which is what drew me to a PhD in Chemical Engineering in the first place. After a couple of years working for the national lab, I became aware of a newer PhD program in

Engineering Education at Ohio State. It felt like the right path, one that would credential me enough to become a professor.

An Early Researcher's Exploration

Upon beginning the program at Ohio State, I was presented with an abundance of information. A field that I knew almost nothing about a few months ago, had decades of publications. My first semester coursework in the program I found to be engaging, due in large part to the closeness of my small cohort of four students, including myself. Initially I wanted to do community work with the Latino/a/é population, speaking to my own struggles attending inner city schools with little representation and few STEM opportunities. However, my previous PhD experiences lingered. I wanted to know what was being done in the space to help PhD students, so that people would not endure the struggles that I or my friends did at ABC university.

I was surprised. The problems in doctoral education were being studied as attrition issues. Researchers were asking questions related to why students were choosing to leave their doctoral engineering programs. For me the answer was obvious. PhD programs are difficult, and my experiences informed my belief that PhD students are exploited. I immediately felt that there was some bias in the way the research area was being approached. To what extent are professors who were able to complete PhD programs capable of doing research on why others did not finish their PhD programs? Have they now assimilated into the professorship, cognitively minimizing the difficulty of their experiences? In my experience up to that point, people that received their PhD's and become professors were usually exemplary PhD students. Might they have a blind spot when it comes to the PhD experience? Being someone that struggled through a PhD program in the past, I knew this was research that I was uniquely equipped to do. I switched my research focus to that of the experience of doctoral engineering students, hoping to convince others to see the experience through my eyes in order to make real change. It is my hope and desire that by presenting this narrative of my journey to humanize myself and others that have gone through similar experiences. My tone through this essay may take on a self-asserted tone, but it is through my experience as a former PhD student that I have become an expert in my own experiences. I wish for these experiences, combined with evidence from other scholars, to persuade others to view the doctoral engineering student experience for what it truly is, a work experience that mistreats and takes advantage of people.

Current Research in the Field

Scholarly publications in the field are dominated by research that seeks to mitigate attrition [4], [5]. Despite the discourse shifting to viewing attrition as not necessarily a negative outcome, the research is still focused on understanding why doctoral engineering students choose to leave their programs [14]. Within this outcome, or attrition-based research, there exists a significant amount of studies on various topics. These topics include: the advisor-advisee relationship, a sense of belonging, socialization, identity (race/ethnicity and gender), as well as peer interactions. Though well-intentioned, by framing the problem to be solved as a problem of attrition, research done on the subject becomes a means to end. An implied mechanism is proposed when we frame the work as contributing to a solution for the attrition problem. For

example, a researcher may want to study the advisor-advisee relationship as they believe that the advisor-advisee relationship has a significant impact on a student's decision to leave their doctoral engineering program. Inherently there is nothing wrong with this. Should we not study the factors we think lead to attrition? Of course, we should. However, we should also investigate the outcomes that this research leads to. This type of work leads to recommendations like better mental health support and access to services, a work-life balance to be modeled by faculty and mentors, and open dialogue with faculty and mentors about attrition [14]. All good things. Even so, when viewed through a critical lens we see that none of these recommendations seek to empower graduate students themselves. Nor is a lack of organizational power on the side of doctoral engineering students even acknowledged. This issue is compounded further when we understand that universities now operate within a corporate business model [1], [6]. The discourse regarding attrition is therefore driven by neo-liberal economic values evidenced by phrases like reducing wasted efforts and losses of funds [4]. Critically, from the recommendations that come out of the work in the field and how the issue is framed, it becomes clear that modern corporate universities only care about graduate students to the point at which is affects their bottom line. Despite financial compensation and safe working conditions being a hot-button issue in graduate education for decades, nowhere in engineering education research is it discussed [15]. Should research in our field align itself more with the university than the populations being studied? How should we be studying doctoral engineering students? What problems should we be highlighting?

The Role of Doctoral Engineering Students

To decide what direction work in the field should take, we must first understand what roles and responsibilities doctoral engineering students have at their universities.

As existing literature and legislation reflect, the doctoral engineering student has long existed in an ambiguous space [15], [16]. Universities do not consistently classify them as either staff or student. Graduate students wear many hats, and though it is unfair to generalize the experiences of an entire group, there are some things that most graduate students share in common.

First, graduate students take coursework to advance their own knowledge of the field they are in and to inform the research they conduct. In fully funded doctoral engineering programs, the tuition is paid for either by the advisor, department, or university. Historically, this has been a very appealing aspect of a PhD in engineering. Tuition costs continue to increase and what is communicated as free education is very appealing [17]. Universities will emphasize this aspect of the PhD experience because it benefits them financially that PhD students are perceived first and foremost as students. If they were anything more than students, say workers, they would need to receive compensation and benefits that they currently do not.

Second, graduate students usually receive a stipend as compensation for either teaching assistantships or research assistantships. These assistantships usually do not exceed what is considered a part time basis, or 20 hours per week. PhD students are expected to sustain themselves using this stipend, as universities typically bar PhD students from working outside of the university. Though many PhD students will work outside of the university to supplement

their income, they risk expulsion from their programs. The option of working outside of the university for supplemental income is nearly eliminated for international students who are on visas as they run the risk of being deported, which are much higher stakes than mere expulsion. It is then important to ask if the stipends PhD students receive is enough to support them through their programs. The vast majority of the time, PhD students do not in fact receive a minimum living wage as defined by MIT's living wage calculator which will be discussed in a later section [18].

Finally, graduate students perform research toward their dissertation. On top of managing coursework and a part-time job at the university, PhD students actually need to make progress toward graduating with their degrees. The work they do for their dissertations is not financially reimbursed by the university. This is something that should be scrutinized because there are financial beneficiaries to their dissertation work that do not include the students themselves. These beneficiaries are primarily advisors, universities, and grant or contract funding entities. The delayed financial gain of a doctoral degree and increased future earning potential does not impact the current material conditions of the PhD student. Considering that so many other parties benefit financially from PhD students conducting high quality work and that academic research programs driven by doctoral students perform around half of the foundational research of the United States, PhD students should also see some financial compensation as a result of their work [19].

So are doctoral engineering students, students, workers, or something in between? Though I personally believe that doctoral engineering students exist outside of this binary discussion because of their important societal role in contributing to knowledge, within the binary they do contribute economically and do work that they are not sufficiently compensated for. They do work, plain and simple.

I am not alone in this line of thinking. Legally, the classification of graduate students as employees has gone back and forth since the 1990's. At private institutions, this dispute falls under the National Labor Relations Act. Specifically, the decision as to whether or not graduate students at private institutions are employees falls under the National Labor Relations Board which is a board made up of president appointed members. The two-party system in the US means that with a change in administration, the decision of graduate students as employees also changes. Most recently, the National Labor Relations Board has decided that graduate students at private institutions are in fact employees and deserve all the rights that employees in the US are entitled to, including unionization [20]. For graduate students at public universities, determination of graduate student workers as employees is left up to state legislature and/or the university depending on how the state law is written. Sometimes state legislature will allow universities themselves to classify graduate student workers and other times, the state legislature will explicitly exclude graduate students from worker's rights like collective bargaining [21].

With inconsistent recognition as employees by the federal government, state government, and their universities combined with the feelings of graduate student workers that they are overworked, underpaid, and ultimately exploited; it is easy to see why graduate student unions are so salient and why we are seeing so many massive strikes [22], [23], [24]. In many cases,

graduate student workers are realizing they deserve to be paid a living wage among other things including access to childcare, adequate healthcare, and protections against bullying and harassment [25].

Two very different pictures are painted of the doctoral engineering student experience when viewed from the perspectives of researchers and the students themselves. Researchers trying to solve attrition rarely take a political stance when it comes to questions of exploitation and unfair working conditions of doctoral engineering students while the population of study itself seems to declare that working conditions are a significant issue. Though researchers in the field may choose to neglect these more dissident and political aspects of their work by hiding behind their selected research paradigms, choosing to study attrition without acknowledging the greater systematic issues at play does a disservice to the population they are studying, ultimately reinforcing the existing power structure.

Decent Work and the Psychology of Working Theory

Understanding that engineering graduate students do perform work and provide quantifiable economic value universities through research and teaching that are critical to the business model of universities and essential to the advancement and dissemination of scientific knowledge allows us to begin to recontextualize doctoral engineering students as workers. When recontextualized as workers, many frameworks and theories can be used to explain the experiences of doctoral engineering students and perhaps why attrition is such an issue. One promising framework is the Psychology of Working Theory (PWT) [26]. Central to the PWT is the concept of decent work. The PWT claims that in order to have access to well-being in an affluent western context, decent work is necessary. Decent work is defined within the PWT as having five components: (1) physically and interpersonally safe working conditions, (2) hours that allow for free time and adequate rest, (3) organizational values that complement family and social values, (4) adequate compensation, and (5) access to adequate healthcare. Decent work exists when all these components are present. Well-being is defined here as a combination of physical, emotional, and mental health. Decent work is not a new concept. For decades organizations, including the International Labor Organization (ILO), have been defining and using the concept of decent work, a standard of work all individuals should have [27]. The ILO's definition of decent work primarily relates to economic and political agendas. The definition of decent work within the PWT relates to well-being; it is worker focused. Figure 1 shows the relationship proposed in the PWT between decent work, its components, and well-being.

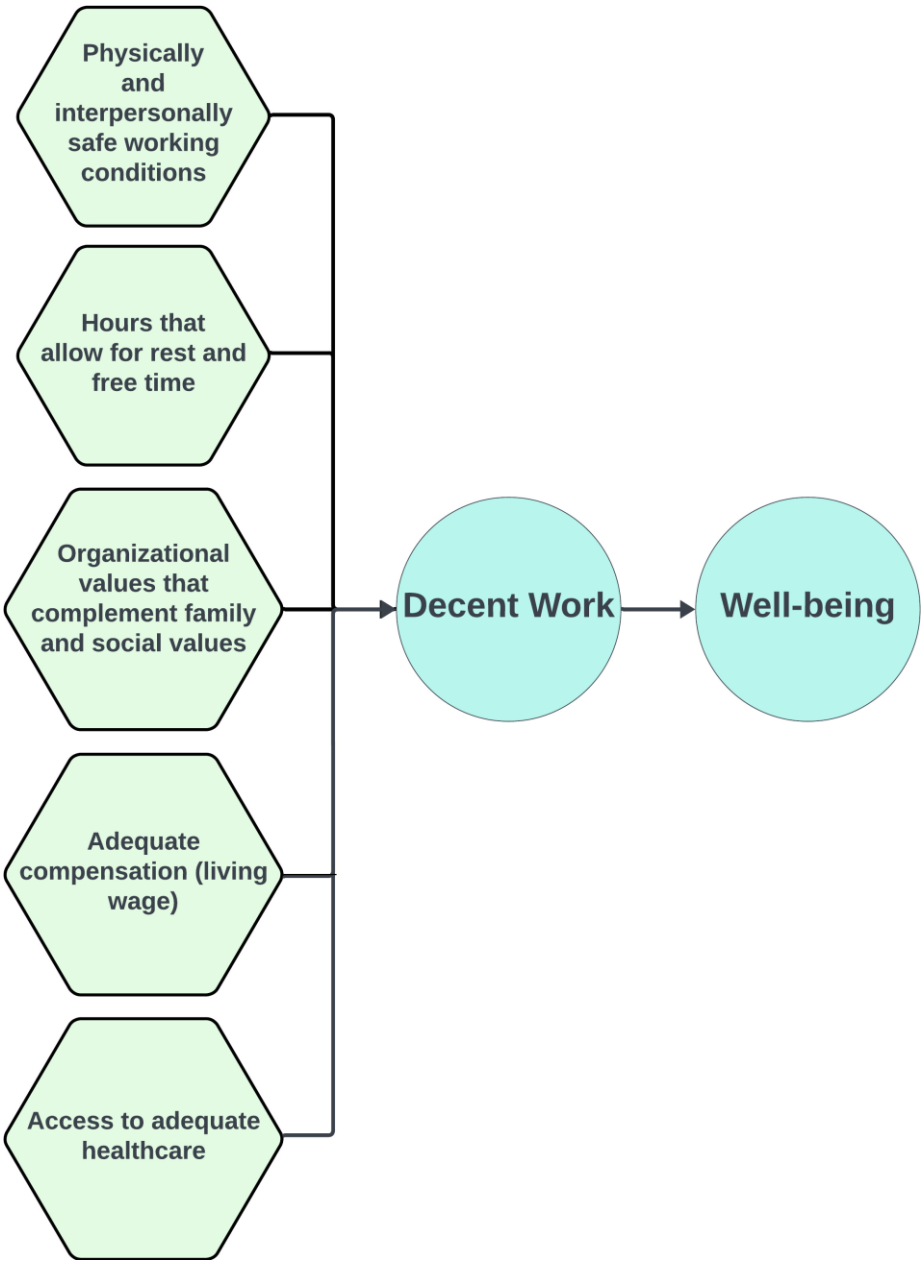

Figure 1: Psychology of Working Theory, adapted from Dufy et. al., 2016 [26]

The PWT is extremely useful for the aforementioned application. In addition to including many of the aspects of the doctoral engineering student experience that are currently studied in the field, the PWT includes some that are not explicitly discussed. Table 1 shows how many commonly studied aspects of the doctoral engineering student experience have analogues within the PWT. In addition, things like economic constraints, critical consciousness, and a proactive personality are rarely discussed in relation to a doctoral engineering student's experience.

PWT	Commonly Studied Aspects in the Field
Marginalization	Race + Gender
Social Support + Interpersonally Safe Working Conditions	Belonging + Socialization + Advisor Relationship
Well-Being	Mental Health
Adequate hours for rest and free time	Work-Life Balance
Economic Constraints	Rarely Explicitly Discussed
Critical Consciousness	
Proactive Personality	

Table 1: Overlap Between PWT and Commonly Studied Aspects of the Doctoral Engineering Student Experience in Engineering Education Research

It should be noted that the PWT is an empirically backed theory with various relationships having evidence in literature. Within the realms of counseling and organizational psychology, PWT is a well-regarded theory and approach to describing the work experiences of many individuals. PWT is therefore a useful framework when discussing the work experiences of doctoral engineering students. Each component of decent work will be discussed in the context of the archetypical doctoral engineering student work experience to determine if doctoral engineering students do in fact have access to decent work or if some components of decent work may not exist for all doctoral engineering students.

Physically and Interpersonally Safe Working Conditions

STEM graduate students often face physically unsafe working conditions with a lack of proper safety training [10], [15]. In addition, obvious power differentials between advisors and advisees can lead to harassment, abusive and exploitative supervision, bullying, encouragement to engage in unethical behavior, and authorship concerns [11], [28]. Further compounding these issues, graduate students from historically marginalized groups, such as women, people of color, and

those of non-heterosexual orientation tend to face more interpersonal aggressions [29], [30], [31]. These conditions matter. John Brady received his doctorate in electrical engineering in 2017, a year after passing away. After hearing and reading the documentation that his son recorded from Sayeed, his father believes that his time in the lab contributed to his death. Sayeed's lab had unusually high turnover with administration receiving occasional complaints but nothing really being done. "Sayeed regularly hurled the F-word at students, threatened to 'fire' them and called them 'monkeys,' 'babies who do not use the brain to think,' 'dumb asses,' 'liars' and more" [32]. It is a lack of oversight and overly common abusive engineering research cultures that allow things like this to happen. Physically and interpersonally safe working conditions are therefore not a guarantee for all doctoral engineering students.

Hours that Allow for Rest and Free Time

When determining what constitutes as "adequate hours for rest and free time" under the PWT, it should be noted that one size does not fit all. The amount of time working for one person, may not be the optimal amount of time to work for another. Everyone has different abilities and contextual pressures or obligations that they must satisfy when understanding how much they should be working. However, there are some limitations to what the human body is capable of. The working hour cutoffs for what is considered "long working hours" varies by study. However, 40 hours is the most ideal cutoff if additional health risks, physical or mental, are to be avoided. Experiments have shown that work weeks of 30 hours may lead to higher productivity and better outcomes for the workers [33]. Though 40 hours may not be the most ideal amount of work per week, we will be using this amount as a baseline since it is still currently the most widely accepted amount of weekly working hours in the US.

There is a significant literature gap regarding the working hours of graduate students. In academia, and especially engineering graduate school culture, there is an expectation that graduate students should be working significantly beyond the culturally accepted 40 hours per week to "succeed" as graduate students. Though many departments and universities will publicly and explicitly state that graduate students should not work for more than 40 hours per week for any reason, the research lab culture often contradicts these limitations [34]. This culture of working beyond 40 hours a week as a doctoral student is especially prevalent in science and engineering fields where ideas of rigor, merit, and effort are seemingly built into the fields themselves [35]. Much of the evidence regarding long working hours is anecdotal, often existing on online forums, news articles, or social media. Letters from advisors, department chairs, and faculty have circulated the internet, exposing the public to calls of "working weekends and evenings" and "working 80-100 hours per week" [36], [37]. Publicly universities will state that graduate students will not work more than 40 hours a week, however, behind closed doors, they echo the academic rigor and dedication that has been perpetuated in academic circles for decades [38].

Most recently, *Nature* released the results of their 2022 global survey of graduate students, among their results are self-reported working hours from both master's and doctoral students. Around 70% of the students reported working more than 40 hours per week [39]. Around 40% reported working over 50 hours per week, and around 18% reported working over 60 hours per

week [39]. These figures are troubling. Combined with 47% of the students surveyed reporting that a work-life balance is extremely difficult for them, it paints an image of graduate students feeling overworked.

During my time at ABC university, the majority of the students in the department worked 10-hour days during the week and spent at least a part of the day on Saturday in the lab. I estimate that most students spent 40 to 60 hours working in some capacity. The working load caused so much stress that in addition to mental health consequences, some students faced physical health issues. This anecdote is not singular. An internet search will show various stories of graduate students that feel over-worked or feel like they have little work-life balance. Graduate student workers are clearly working over 40 hours per week. These working hours do not allow sufficient time for free-time and rest. Therefore, graduate student workers, and likely engineering graduate student workers, are missing a component of decent work as defined by the PWT.

Organization Values that Reflect Family and Social Values

Little if any research, exists on graduate students' values as they compare to their organizations'. However, since we know engineering and academia are spaces dominated by rigor and meritocratic ideals, constructs that reinforce white heterosexual male privilege, it could be said that the organizational values in engineering and academia will likely not reflect those of anyone other than those from the dominant identity [35]. Additionally, graduate students may experience a calling that allows them to put up with unpleasant work conditions, unethical behaviors, and misaligned values due to their internal feelings of meaning and purpose [40]. A calling consists of three factors: 1) a transcendent summons, 2) alignment of work purpose with life purpose, and 3) a prosocial orientation [41]. The altruistic calling or sense of duty has been shown to be an adaptive construct, one that graduate students cognitively assimilate into in order to tolerate the struggles often seen in academia [42], [43], [44], [45]. For example, a Latino student who does not take off time to go to their sister's quinceañera to meet both the spoken and unspoken expectations for work set by advisors and peers. In this case, the student is putting aside some of their core beleifs, that family time is important, in order to better assimilate into academia. In summary, despite there being a lack of specific research, we can suggest that graduate students' values will likely not reflect their organizations' due to academia's pervasive meritocracy as well as a calling that is misaligned with their current working conditions.

Adequate Compensation

To answer if graduate students receive a living wage, graduate student stipends across the continental US were collected. All of the stipends came from R1 institutions at each of the major regions of the continental US and were then compared to MIT's minimum living wage calculator for the respective city or area [18]. The living wage in MIT's calculator is defined as "the local wage rate that a full-time worker requires to cover the costs of their family's basic needs where they live" [18]. Engineering graduate stipends are typically among the highest among doctoral students, yet rarely actually meet the living wage of their area. The results of the salaries that we collected in Table 2 show that none of the doctoral student salaries we collected meet the current living wage of the area the students live in.

Region	School	Salary (Per year)	Hourly Rate (20 hr work week)	Hourly Rate (40 hr work week)	Minimum Living Wage (Hourly, MIT calculator)	% Difference from Living Wage (40 hour work week)
Northwest	University of Oregon[1]	$22,207	$21.35	$10.68	$17.29	-38%
Northwest	University of Washington[2]	$31,032	$29.84	$14.92	$21.48	-31%
West	UCLA[3]	$32,400	$31.15	$15.58	$21.22	-27%
West	University of Nevada at Reno[4]	$22,800	$26.51	$13.26	$17.40	-24%
Southwest	University of Houston[5]	$15,174	$19.45	$9.73	$17.06	-43%
Southwest	UT Austin[6]	$18,306	$23.47	$11.73	$18.15	-35%
Midwest	The Ohio State University[7]	$28,373	$27.28	$13.64	$16.14	-15%
Midwest	University of Wisconsin, Madison[8]	$28,388	$27.30	$13.65	$17.49	-22%

Southeast	University of Florida[9]	$22,754	$21.88	$10.94	$15.41	-29%
Southeast	University of Clemson[10]	$27,000	$25.96	$12.98	$16.73	-22%
Mid-Atlantic	Penn State[11]	$29,340	$28.21	$14.11	$18.05	-22%
Mid-Atlantic	University at Buffalo[12]	$29,900	$28.75	$14.38	$16.24	-11%
Northeast	University of Delaware[13]	$30,213	$29.05	$14.53	$17.36	-16%
Northeast	University of Maine[14]	$26,667	$25.64	$12.82	$16.53	-22%

Note. Superscripts denote where the salaries were found.

1. https://graduatestudies.uoregon.edu/funding/ge/salary-benefits

2. https://grad.uw.edu/wp-content/uploads/2022-23-TA-RA-SA_salary_chart.pdf

3. https://dailybruin.com/2022/09/27/ucla-graduate-students-point-to-ongoing-economic-structural-challenges

4. https://thenevadaindependent.com/article/graduate-assistants-deserve-a-living-wage

5. https://www.uh.edu/class/sociology/graduate/prospective-students/financial-assistance/

6. https://hr.utexas.edu/student/student-employee-compensation

7. https://physics.osu.edu/graduate-student-home-page/prospective-students/graduate-admissions-how-apply#:~:text=We%20offer%20financial%20support%20for,month%20(%2428%2C368%2Fyear)

8. https://grad.wisc.edu/funding/graduate-assistantships/

9. https://hr.ufl.edu/manager-resources/recruitment-staffing/hiring-center/preparing-an-offer/requirements-for-an-appointment/#salaries

10.https://www.clemson.edu/science/academics/departments/chemistry/academics/doctorate.html#:~:text=Entering%20Ph.,gross%20annual%20stipend%20of%20%2427%2C000.

11. https://guru.psu.edu/resources/rates-and-schedules/stipends-for-graduate-assistants?range=20222023&submit=Submit

12. https://www.buffalo.edu/grad/explore/funding/phd-level-funding.html#:~:text=PhD%20Excellence%20Initiative,-The%20PhD%20Excellence&text=competitive%20over%20time.-,All%20full%2Dtime%2C%20fully%20funded%20PhD%20students%20on%2010%2D,as%20the%20campus%20minimum%20stipend.

13. https://www.udel.edu/academics/colleges/grad/current-students/academic-support/policies/

14. https://gsbse.umaine.edu/programs/stipend/

Table 2: Selected Doctoral Student Stipends

Access to Adequate Healthcare

It is rare for universities to fully cover health insurance costs for graduate students [46], [47]. Rising insurance premiums and medication costs, combined with low stipends that do not meet a living wage means that adequate healthcare is not always accessible. These barriers to healthcare, which might include limited access, mean that this need is not being met for all graduate students, resulting in graduate students neglecting their physical and mental health [12]. This exacerbates the issues that graduate students face which include increased risk of stress and illness due to their high work demands [11], [48], [49]. International students are disproportionately impacted, as many universities require them to have health insurance, but may not provide financial aid to cover the cost [12], [50].

Decent Work for Doctoral Engineering Students

It should be acknowledged that little literature exists specifically for the doctoral engineering student, and though engineering is a unique discipline, there exists significant literature for graduate students as a whole that begins to show that decent work within the PWT probably does not exist for doctoral engineering students. All components of decent work need to exist for decent work to be present, and all of the decent work components are reasonably in question for doctoral engineering students. The lack of decent work needs to be acknowledged as a serious issue that prevent this population from reaching physical, emotional, and mental well-being.

Conclusions

This essay, through personal experiences and scholarly literature has shown that decent working conditions likely do not exist for doctoral engineering students. Attrition based research inquiries have been shown to miss the mark on the core issues in doctoral engineering by not acknowledging the systemic and political nature of studying attrition in the doctoral engineering population. The PWT and decent work concept are promising frameworks for evaluating the experiences of most doctoral engineering students.

Though we can continue to ask the question, why are doctoral engineering students leaving their programs?, we should be asking doctoral engineering students themselves what they want their experiences to look like and make efforts toward ensuring their working conditions are safe and meet a basic standard of living.

How would research that looks at working conditions differ? The work would be political. It would push against what universities claim doctoral engineering students to be. It would push against neoliberal economic policies that pervade modern universities. It would seek to empower an exploited and oppressed population. The research would no longer reinforce and serve the oppressive force of universities utilizing corporate business models to the detriment of the humans who work within them.

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