

Using clusters of models of disabilities to describe support for mentees with disabilities

Constance M. Doty (she/her)

Department of Physics, University of Central Florida, 4111 Libra Dr., Orlando, FL, 32816

Dan Oleynik (he/they)

Department of Physics, University of Central Florida, 4111 Libra Drive, Orlando, FL, 32816

Erin M. Scanlon (she/her)

Department of Physics, University of Connecticut – Avery Point, 1084 Shennecossett Rd., Groton, CT, 06340

Jacquelyn J. Chini (she/her)

Department of Physics, University of Central Florida, 4111 Libra Dr., Orlando, FL, 32816

Students with disabilities involved in postsecondary physics education may benefit from research opportunities and mentorship. However, the literature documenting supports provided by physics mentors to disabled students is limited. In this study, we analyze interviews with five mentors who either instruct physics courses or lead a research group for examples of how they support disabled students doing research or seeking career advice. Furthermore, we contextualize the examples of supports using six models of disability. Models include the cause of disability (medical/social), the effect of impairment on well-being (tragedy/affirmative), and the dichotomy of dis/ability (minority/universal). We find mentors discuss supports provided to disabled students in research settings that align with clusters of models of disability. While there is not one set of models that yields a one-size-fits-all solution, the universal model plus social model cluster can help mentors design useful and durable supports.

I. INTRODUCTION

Students with disabilities are present in all levels of postsecondary education [1], with 10.3% of individuals receiving a research doctorate in physical sciences reporting at least one disability [2]. Mentors can provide support for students with disabilities, such as research opportunities or advice about future careers. Strong mentor-mentee relationships can support the growth of a science identity for undergraduates [3] and positively impact self-efficacy of doctoral candidates [4]. Disabled students have also reported benefits of participating in undergraduate research opportunities [5], and mentorship can help doctoral students with disabilities persist in research activities (i.e., students with depression benefit from positive mentor-mentee interactions [6]). Since mentors play a significant role in who continues to participate in the physics community (i.e., fostering acculturation into the field [7]), it is important to understand their perspective of disability when they support disabled students.

In this study, we use a constant comparison method [8] to analyze interviews with physics faculty from institutions across the United States to expand the literature about mentor support for students with disabilities in physics settings. Disability is a colloquially dynamic word that is context dependent. For example, in some government policies disability might refer to the incapability to work, while in social settings disability might refer to the lack of access to social resources [9]. For this reason, we categorize the examples of mentor supports using a framework that blends models of disability together into a cluster [10]. We aim to answer the following research question: How do the supports mentors provide to disabled students align with models of disability? The goal of this paper is to investigate current support for disabled students provided by physics mentors, as well as to encourage continued and improved support for students with disabilities in the physics community.

II. CLUSTERS OF MODELS OF DISABILITY

To capture complex views of disability in physics mentors' reasoning for providing specific supports to disabled students, we applied a three-dimensional framework for considering "clusters" of disability models, where models differ in how the cause, effect, and dis/ability dichotomy are construed [10].

A. Cause dimension: social versus medical

The cause dimension describes the underlying cause of disability and provides a distinction between the roles of impairment and disability. The social model focuses on the interplay between impairment (i.e., mind and/or body limitation that is made clear in specific settings [11]) and the environment. Disability occurs when an impaired person's opportunity to fully engage with the environment is lost due to physical or social barriers [10,12]. An example of the

social model is the use of accommodations in the classroom is providing extra test time and extended deadlines [13], which reduce barriers in the instructional environment and provide access. On the opposite side of the spectrum, the medical model focuses on the individual and/or the impairment (i.e., body and/or mind dysfunction [11]) as the cause for not having access, and the burden for change is placed on the disabled individual [10,12]. For example, instructors might inappropriately discuss medication use with a student struggling with time during exams [14].

B. Effect dimension: affirmative versus tragedy

The effect dimension defines disability with respect to quality of life and well-being as a result of having an impairment. Under the affirmative model, it is recognized that impairments do not only cause harm, and a disabled person's well-being may even be enhanced by their impairment [10]. Additionally, impairments are celebrated as an important aspect of diversity [12]. For example, an instructor might recognize an autistic student as someone who quickly interprets patterns and has an attention for detail [15]. On the opposing side of the spectrum, the tragedy model describes a disabled person's well-being as diminished due to their impairment, and that disabled people might desire to be able-bodied [10]. Someone who espouses the tragedy model of disability might show pity for disabled people or describe successful disabled people as "brave" for overcoming disability [10]. An example of the tragedy model in action is when instructors demonstrate ableism by acting surprised that a student who has performed well in their course requests to use an extra test time accommodation [14].

C. Dis/ability dichotomy dimension: universal versus minority group

The minority model describes a clear distinction between being disabled and non-disabled (i.e., dis/ability dichotomy) [10,12]. For example, an instructor might only allow changes to the course design for students who seek approval through a Disability Services Office, where students often must disclose and document their disability status to benefit from such services [16]. In the universal model, disability describes the inherent variation in peoples' needs, abilities, and interests. In this model, disability is conceptualized as a spectrum of capabilities, rather than a dichotomy [10]. Under the universal model, an instructor may intentionally design their course with the variety of student abilities in mind using Universal Design for Learning [17].

III. METHODS

A. Interviews with mentors

Five physics faculty from different U.S. postsecondary institutions participated in remote, semi-structured interviews about their experiences mentoring and teaching

students with disabilities in either Spring or Fall 2022. Participants were recruited via disability-specific physics surveys where they indicated interest in participating in an interview (as described in [18-20]) or personal contacts of the authors. Each interview lasted one to two hours, as selected by the participant; participants were provided with an option to participate in a longer interview if they preferred. Participants varied in terms of their age, gender, U.S. nationality status, and disability status. To protect the anonymity of participants, we only share pieces of identity that help with contextualization of the findings, and we refer to participants by pseudonyms.

Questions in the interview protocol were structured to prompt participants to use different models of disability as part of our investigation of how various models manifest in physics settings. Therefore, participants may have been prompted to use specific models when discussing how they support mentees.

B. Data analysis

Using the six models of disability as *a priori* codes, the first author (C.M.D.) analyzed each interview to identify instances of each model that manifest within the verbatim transcripts of the interviews. Codes along varying axes are not mutually exclusive allowing for the clustering of models. Then, C.M.D. discussed a single interview with D.O. (co-author) until they reached agreement about the implementation of the codes. Next, C.M.D. combed through the interviews for physics-specific examples of mentor decisions to support students with disabilities. C.M.D. then discussed an example from each interview until agreement was reached with co-authors, J.J.C. and E.M.S.. Afterwards, C.M.D. used constant comparison to compare and contrast decisions made by mentors [8]. While we identified multiple types of mentor supports, we will focus this paper on describing research support and career advice given by mentors to disabled students as these topics are not well described in extant physics education literature.

While we present examples expressed by individual physics mentors, our intention is not to critique these individual instructors. Rather, we recognize views expressed by individual mentors as indicative of the academic physics community, and we understand the academic physics community to both be shaped by ableism, (i.e., valuing and accepting some abilities which influences our worldly perspectives [21]).

C. Positionality and language

Research team members experience a variety of impairments, including emotional/mental health, physical/mobility, health, and hearing impairments (access [22] for explanation of these categories). While C.M.D. identifies with several impairments, she does not have a personal preference between person-first or identity-first language. We use a variety of person-first and identity-first

language throughout this study 1) to relate our study with language familiar to mentors and 2) to promote inclusivity with how a student or mentor might identify.

IV. FINDINGS

We frame each example of support described by the participants using clusters of models of disability [10]. The examples presented in this paper do not represent an exhaustive list of supports for students with disabilities. For clarity, we delimited our findings for this paper to examples that can be clearly described by the six models of disability. Future work will include a wider range of examples and possible room for critique of the models.

A. Providing access to research environments for students with mobility impairments

Two mentors, Ren and Brad, both tenure-track faculty at research intensive universities, described supports they have used for graduate students with paraplegia. When asked about accommodations made in their research lab, Ren, an experimental lab-based researcher, discussed two main supports for a graduate student with paraplegia. Ren said, “*We worked on making the lab more accessible, and, you know, with the wider corridors ... plus seek support from the [college that houses Ren’s department] to buy a special, specialized wheelchair that allowed the student to access a machine...*” In this excerpt, Ren describes two accommodations, which each are aligned with a different model of disability on the cause axis. We interpret widening the corridors as aligning with the social model because the physical environment, rather than the individual, was modified. This alteration removed a barrier both for the specific student and future users who may need additional space to maneuver, which potentially aligns with the universal model as well. Additionally, Ren provided access for the student to reach lab equipment by purchasing a specialized wheelchair. The specialized wheelchair does not permanently eliminate the barrier for future users by altering the environment, but rather modifies the individual student’s mobility, so we interpret this accommodation as aligned with the medical model. We posit that an advantage of analyzing the supports physics mentors have provided is to propose more durable solutions. In this case, Ren and equipment producers could apply the social model by implementing principles of Universal Design [23] to make the laboratory equipment usable by a wide range of users.

Responding to a similar prompt, Brad, a physics researcher whose research mainly takes place outside of a physical lab, described how they accommodated a student with paraplegia by holding remote meetings using video-conference software. Brad commented, “*...we've never had a conversation about the wheelchair per se, it's just a thing that's true and obvious and made me realize that getting to my office is really not accessible for them ... and so a lot of those meetings on Zoom for other reasons, but a benefit of*

having them on Zoom is that the student doesn't have to worry about things like getting into my office or getting to places that are maybe not easy to get to." Like Ren, Brad's support aligns with the social model since an environmental barrier to access and participation was eliminated. Brad's accommodation is aligned with the minority model by initially using the accommodation for a single student. Later, Brad mentioned using the same accommodation for colleagues located in other places, perhaps due to the increased accessibility of technology as a result of the COVID-19 pandemic [24]. Brad noted, "*And that's accessible in the sense that people can be wherever they want and whatever is comfortable for them.*" This perspective might align with a common critique of the universal model: interest convergence. Interest convergence refers to the idea that equality occurs when interests of a minoritized group are in alignment with the interests of the majority group [25]. Within this context, it is possible that giving equity-creating support to every person undermines the needs of people with disabilities who originally needed that support to have equal opportunities for access. Further research is necessary to examine the effects of interest convergence on disabled students' participation in physics spaces.

Ana is a senior professor at a small private university with the leading role of teaching physics courses. During the interview, Ana described using her van to assist mobility-impaired students with transportation to research conferences. Ana explained, "*... I have a van which I use for [family member] with the tie down things [straps], so I can do that to transport the students, but actually, even sometimes uh, teachers sort of borrowed my van to do that, because not everybody have their own van to transport that. Actually recently, when I complained, uh University purchased the minivan with the wheelchair accommodation.*" After complaining to the university, Ana successfully removed the barrier for the students with disabilities, which is aligned with social model. Initially, acquiring a van after emphasizing the need for help with transporting disabled students to conferences aligns with the minority model since the focus is supporting students with mobility impairments. Afterward, the school's resources now provide access for a wider range of users, which is in line with the universal model. In Ana's example, accommodations for disabled students might not happen unless faculty create pressure to make change.

B. Supporting students with mental health impairments

Will, Brad and Ren all discussed examples of providing advice to disabled students about their future career or continued involvement with physics. Will teaches physics courses at a two-year college, and Brad and Ren both mentor physics students at a research-intensive university.

When asked about the impact accommodations have on preparing students for their career, Will described a conversation with a student with anxiety who used an extra

time accommodation for class exams: "*I said, "Well, you know, what is it you want to do?" Wants to be an ER physician. And I'm sitting there thinking, "Wait a minute, you have extreme anxiety under stress, and you want to be an ER physician? Um, maybe someone needs to have a conversation with you." He's like, "Oh, no, I've already looked into it. You know, the medical schools will accommodate that." I'm just going, "Wait a minute. I don't want you as my ER physician that, 'Okay, give me ten minutes. He may be spouting blood; I need ten minutes here!'*" In their conversation with the student, Will fixated on the student's impairment inhibiting their ability to treat a patient, which closely aligns with the tragedy model. Since low levels of anxiety positively impact student performance [26], Will could potentially better support the student by considering benefits of anxiety that may enhance a doctor's practice like preparing multiple plans of action [27].

Like Will, Brad described a time when they encouraged a student with mental health impairments to re-consider their future career, specifically to leave the physics graduate program. Brad said, "*Fundamentally, what I, what I felt was this student needed the support of successfully finishing something, while also getting away from the toxic environment that grad school can be, which was not helping them. And so, I supported that, I supported them in doing that ... They eventually left with [a] masters, and I hope they're doing better.*" Brad points out that the student's impairment and the toxic environment of graduate school are both harming the student's well-being, which is in line with the tragedy model. However, since the mentor fixated on removing the student from the environment rather than mending the environment, Brad's support aligns with the medical model. From Brad's example, it is possible some mentors might need help supporting students with disabilities because the scope of support is beyond what a mentor can change on their own, which might prompt a mentor to encourage a student to leave a program. Instead, physics graduate program coordinators might consider modifying departmental policies to create a more supportive environment (i.e., reform key components of graduate program like professional development, advising requirements, curriculum and candidacy exam [28]).

Ren shared the idea that internships outside of academia might help a student with anxiety, especially anxiety exacerbated by imposter syndrome (i.e., feelings of inadequacy pertaining to ability with role performance [29]). Ren responded to a prompt about how a student's impairment positively impacted their physics experience, by commenting, "*The positive aspect, I think the student asks really sharp questions. Um what's surprising is that when I say, 'that, that was really good questions that you're asked,' it doesn't make this person feel better.*" Here, Ren's realization that the student's questioning skills are positively impacted by the student's anxiety is in line with the affirmative model. While Ren states that these praises do not seem to make the student feel better, implying that Ren

thinks the student's impairment is negatively impacting their well-being, we still interpret this excerpt as aligned with the affirmative model, since the tragedy model only allows for a negative perspective of disability. Ren continued to discuss their plan of support, which involved sending the student to an internship outside of academia. Ren said, "... *what I'm trying to do is to basically send this person to internship where they can actually work with professional scientists that work regular job, unlike ourselves as a physics professor, so that they understand and then talk to real people.*" Here, Ren's plan is embedded in the social model because Ren is changing the environment to support the students' well-being and career success. While Ren's support plan aligns within the minority model due to its implementation with a single student, Ren's perspective of internships holds a universal model approach as they continue to provide more details. Ren continued, "*I think everyone should be sent to internships anyways. Yeah, because a lot [of] students who do so well in undergraduate physics program, they might come into grad school thinking that they should just do what they're best at, and then they might not know exactly what they want to do after graduating from grad school.*" In Ren's excerpt, the idea that students can benefit from an internship outside of academia lies within the universal model because there is a potential to reduce imposter syndrome and provide useful resources to all students. Additionally, Ren's support is an example of a resource that can counter the narrative painted by Sophia below related to non-inclusive physics culture. In general, postsecondary programs can leverage resources like internships in the STEM community to support students with disabilities and historically underrepresented groups [30].

C. Preparing students for physics culture

Unlike other mentors, Sophia, who teaches physics at a two-year college, talked about conversations with students about the culture of physics rather than discouraging students with disabilities from pursuing their desired career. In their interview, Sophia mentions the unwelcoming culture of physics to be a barrier for people with disabilities, and maybe even specific disabilities. Sophia stated, "*I think there's a lot [of barriers] in physics as a culture. But it does seem to me like there, it's still very much focused on being, you know, perfectly able-bodied and be brilliant in certain ways. ... And when I think, you know, it's specifically for people with disabilities that is not welcoming and not inclusive and not um yes, just not okay.*" Furthermore, Sophia warns students from minoritized groups about the unwelcoming culture of physics. Sophia commented, "*So I don't think I've ever discouraged or at least not consciously discouraged someone because of an impairment or disability. Um, I can imagine having conversations with a student who is really interested in physics, but was, well and I have had, they were a minority, they're just minorities in other ways. You know, the reality is the [physics] culture tends to be fairly*

unforgiving of differences." We interpret Sophia's advice as aligned with the minority model, since she uses the word "minority" and only provides a warning about the culture of physics to specific students. Both of Sophia's excerpts are possibly in line with the tragedy model because of the implication that minoritized groups, including students with disabilities, struggle with fitting in to physics spaces, which might impact a student's well-being. Instructors could consider discussing the physics culture with the whole class, including brainstorming ideas about how the instructor and class members could create a more inclusive environment within and beyond the classroom.

V. DISCUSSION

In this paper, we provide examples of how mentor supports map onto clusters of models of disability in physics settings. The affirmative model was the least prevalent model used by mentors when supporting students in this data set. Future work will investigate the prevalence of each model and identify opportunities for mentors to use the affirmative model.

We do not pinpoint a cluster of models that is the most appropriate to use in academic contexts. Rather, we provide examples of support linked with models of disability with the intention of sparking reflection within the physics community on what supporting disabled students currently looks like and potential room for improvement. For example, the social plus universal cluster of models aligns well with implementing Universal Design for Learning-aligned instructional practices. The elimination of barriers that deny some students access to course material fits within the social model while implementing practices that support access for all students without having to make an accommodation for individuals fits within the universal model. By using such practices in classrooms and research settings, mentors and instructors potentially eliminate the need to make retrofits to their design while considering inclusion.

VII. LIMITATIONS AND FUTURE WORK

The main limitations of our study are our sample size and sample demographics. Our sample does not include mentors in industry or races and ethnicities historically underrepresented in STEM. In future work, we will continue to recruit participants from a variety of backgrounds. However, it is possible individuals from minoritized groups in mentor positions already feel burdened to share their experiences [31,32]. Also, to solidify the effectiveness of the support provided by the mentors, we will triangulate our findings from this study with interviews with mentees and we will follow-up with participants (i.e., member checking).

ACKNOWLEDGEMENTS

This work is supported by NSF CAREER Grant 1750515.

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