The Conceptual and Disciplinary Segregation of Disability: a Phenomenography of Science Education Graduate Student Learning

Phillip A. Boda[1]

Abstract

Science teacher education has long sought to educate new science teachers to more fully understand "Science-for-all" and prepare them to effectively navigate diverse contexts. To adopt this "Science-for-all" mantra, we need to address what the labeling (i.e., categorical labeling and/or mislabeling) of students with disabilities means for science teacher education. This paper provides a critical inquiry to ground the claim that disability operates subversively and unrecognized as a marker of difference similar to labels that produce exclusion in science education (e.g., race, class, and gender). Using a phenomenographic design, this research studied graduate students' conceptualizations of disability as they progressed through the only required diversity course at a large, urban university in the American northeast. Primary data sources included in-depth, pre-/post-course interviews with supplemental data collected from biweekly course reflections. Phenomenographic data analyses addressed to what extent these graduate students embraced a disability studies perspective relative to disability—i.e., viewing disability beyond merely individual deficit. Findings suggest that the course sustained the relatively static conceptualizations about disability held by the participants related to individual deficiency rather than pushing for more critical views of disability beyond deficiency. Implications are discussed in relation to multicultural science teacher education course goals.

Keywords Sociocultural theory · Teacher cognition · Phenomenography · Science education · Disability studies

Introduction

The intention of inquiry in science education was to facilitate learning for all students, as seen in its reform documents over the past 50 years in the USA (cf. American Association for the Advancement of Science (AAAS) 1993; National Research Council (NRC) 1996; NGSS Lead

---

✉ Phillip A. Boda
paboda@stanford.edu

[1] Stanford University, 520 Galvez Mall, Stanford, CA 94305, USA

States 2013). Through these initiatives' persistence to forefront inquiry learning, science education presented itself as both a means and an end to civic goals (Rudolph 2014), which can also be seen more broadly in human rights initiatives more recently focused on "inclusion" of all citizens in ways that emphasizes specifically designing social contexts to actively *include* people labeled with disabilities (Goodley and Runswick-Cole 2015).

Through their framing of inclusion as a civic goal for all citizens, including those with disabilities, Goodley and Runswick-Cole (2015), as well as others (cf. Armstrong and Barton 1999; Rieser 2012a), articulate a vision for the inclusion in all disciplines as fundamentally a human rights issue. This ideology can be paralleled with John Rudolph's (2014) request to revisit science education as a means and end for civic goals, specifically one that places a prominent goal for science education to move toward more critical and equitable teaching and learning similar to the aforementioned disability studies theorists. While these two disciplines have concurrently articulated similar goals of human rights for *all* through "(Science) education for all," science teacher education research does not sufficiently address disability as a marker of difference in ways that disability studies (DS) scholars do, which leads to this study's purpose.

Purpose of the Study

Historically, disability has been framed within a deficit lens stemming from conceptual perspectives adopted in science and medicine, which then have led to ideologies imposed onto society that remain preoccupied with the perfection of the human body (Herndon 2011), as well as the efficiency of the human mind (Armstrong 2013). However, as Linton (1998) argued, we need to flush out the nuances between *impairment* and *disability*, i.e., physiological/psychological challenges and the socially constructed interpretations that support these limitations through lack of critical interrogation, respectively. She proposed that this discussion has yet to fully permeate the social institutions where those labeled with disabilities are more likely to be discriminated against (e.g., the workplace, schools, social service agencies, etc.).

This conception of disability beyond the medical deficiency perspective is crucial for understanding disability (and difference) beyond deficit (Rieser 2012a), which is fundamental for any inclusive educational agenda. The study of disability as a conceptual construct has been investigated in disciplines outside of science education to emphasize how the social construction of disability is related to cultural notions of who is assumed to be capable to learn and how discourse is produced around ability (cf. Brantlinger 1997; Heshusius 1989; McDermott and Varenne 1995; Nunes 1995). With that said, there have been liminal inquiries into how these conceptualizations of difference that encompass disability beyond individual deficit can be integrated into science education (one such volume recently published exemplifies an initial attempt of such an analysis in science teacher education; Hollingsworth et al. 2018). This volume's contribution, however, is not the norm in science education, elaborated in the subsequent sections related to literature on students labeled with disability in science education.

Alternatively to medical and special education models, framing disability from more progressive and productive perspectives, such as questions of planning physical space (Titchkosky 2011), metaphors of difference (Broderick 2010), and forms of neurodiversity (Armstrong 2013), considers disability as a form of "diversity" in the aforementioned conceptualizations—enacting a "social perspective" of disability that has transnational support for its pragmatic and philosophical impact in education and the lives of the youth as they

experience inclusion and exclusion (cf. Danforth and Naraian 2015; Erevelles 2011; Shakespeare 2013). These newer perspectives politicize the access and efficacy of human rights, as well as what these rights mean for the social institutions that produce citizens of a particular nation state, such as schools.

Indeed, coordinating these perspectives with the "Science-for-all" science education research agenda moves beyond the current multicultural science education argument that (intentionally or not) has excluded disability as a form of diversity relevant to science teachers and their practice (see, e.g., Atwater et al. 2013). This exclusion of disability from the multicultural science teacher education "table" is increasingly pertinent given that the disproportionate representation of youth of color placed in special education has been noted in the literature for decades (Annamma et al. 2014; Artiles et al. 2010; Reid and Knight 2006; Patton 1998). With this phenomenon in mind, disability is viewed as a marker of difference—often coded as personal deficit vis-à-vis race, class, and gender—that has not been adequately taken up by our science education community, which couches the purpose of this research in relation to the literature of disability and difference.

Literature Review

The World Health Organization (2011) provides a concise and poignant remark on "inclusive" education, henceforth referred to as inclusion, and its importance:

> Children with disabilities are less likely than children without disabilities to start school and have lower rates of staying and being promoted in school. Children with disabilities should have equal access to quality education, because this is key to human capital formation and their participation in social and economic life. While children with disabilities have historically been educated in separate special schools, inclusive mainstream schools in both urban and rural areas provide a cost-effective way forward. Inclusive education is better able to reach the majority and avoids isolating children with disabilities from their families and communities. (p. 225–226)

Inclusion in this proposition refers to "a child's right to belong to her/his local mainstream school, to be valued for who s/he is and to be provided with all support s/he needs to thrive" (Rieser 2012b, p. 201). This ideology of inclusion stems from earlier articulations within the multicultural movement that challenge the justifications used for excluding students from learning in mainstream schools across racial and cultural lines (Ferri and Connor 2005). However, as this research shall show, the ideology of "inclusion" within science education remains stringently aligned with more traditional notions of diversity-to-be-included vis-à-vis racial, gendered, and classist analyses, and less along intersectional analyses that include disability.

Riding on the coattails of the multicultural movement of the 1960s, disability studies provided a new way to envision disability within existent frameworks of difference. Further analyses reframed inclusion from a disability studies perspective as an integral part of conceptualizing the purpose of education beyond a material realist perspective (i.e., solely valuing tangible attributes and pragmatic resources as the largest limitation to inclusion; Allan 2010). This analysis further highlighted the intentional disconnection made between traditional labels of social difference (race, class, gender, etc.…) and disability, not yet interrogated.

A disability studies analysis critiques how disability as a *label* is insufficient to conceptualize the support needed for inclusion of students, paralleling claims that also suggest this

"naming" of racial, gendered, and classist labels is insufficient for diversity work in science education (Rivera Maulucci and Mensah 2015). With the importance of disability studies grounded in the larger multicultural reform movement through the increasingly diverse student population within the USA, educating graduate students for the task of meeting the needs of *all* students is crucial not only within the larger educational context but also in specific disciplines, such as science.

In other words, as the U.S. classroom becomes more diverse, the need to educate new science teachers in ways that address disability exclusion *in connection with* other markers of difference currently emphasized in multicultural science teacher education (e.g., race, class, gender) is paramount. Moreover, as shown below, since special education courses often teach these science teacher cohorts that disability is inherently individual and maintains stringent commitments to only pragmatic accommodations, the preparation of science teachers to teach *all* students, including those with disabilities, falls short of "Science-for-all."

Disability and Multiculturalism in Science Teacher Education

Science teacher education has had a prominent shift toward inclusive education of all students since the onset of integration in the 1960s. Most recently, this includes community-based science teacher education that focuses on how the experience of teaching science education beyond the classroom could influence understandings of science teaching and learning (Calabrese Barton 2000; Cone 2012), the generation of multicultural curricula that showcase the nature of heterogeneity in scientific accomplishments throughout the ages (Pringle and McLaughlin 2014; Suriel and Atwater 2012), and work geared toward emphasizing socioscientific issues in science education, where students' place in the world is valued (Lee et al. 2012; Zeidler et al. 2005).

Critical science education researchers have also focused on social-justice frameworks in science education that complement an anti-racist science education, which responds to injustices within students' local communities (Mensah 2011; Rivera Maulucci 2013) and a culture-based approach to pedagogy within urban settings, where the lived realities of the students are brought into the classroom to teach science content (Emdin 2010; Seiler 2013). Within this tradition, however, there remains a prominent neglect of the consideration of what conceptualizations are developed to approach disability and the critical nature of disability as a sociocultural phenomenon, which grounds the need for the research provided in this paper. This, then, leads into the question: What research is being done in science education for students with disabilities?

Material Realism and Disability in Teacher Education The vast majority of reform for science teacher education dealing with disability specifically focuses on educating science teachers through the material realist perspective of disability (i.e., focusing on resources; Allan 2010) and, rather poignantly, seeks to mediate the experiences of students with disabilities in science classes through professional development that emphasizes this paradigm. This reform-based agenda for disability through material realism is continually maintained within science teacher education for students with disabilities (presented below) even while special education (SPED) training within this professional development model has been shown insufficient in its efficacy for SPED student achievement (e.g., Feng and Sass 2013). Thus, there is a disconnect between the reform-minded view of disability inclusion through material realism and the goal of *inclusive education for all* if disability is solely viewed and taught to teachers within this perspective.

More recent publications also showcase how special education focused professional development begets negative views toward inclusion of students with disabilities in general education classrooms (Woodcock and Hardy 2017) and that inclusive professional development requires intersectional and holistic views of teaching and learning to fulfill the goal of truly including students labeled with disabilities within the general education classroom (Waitoller and Artiles 2013; Waitoller and King Thorius 2016). Therefore, the question remains: Why maintain this materialist preoccupation in the face of evidence questioning its expected outcomes?

Disability in Science Teacher Education The focus on the pragmatic needs of students to learn science content is grounded in the realities that science teachers face when trying to teach students with disabilities. Through the material realist paradigm for science teacher education, this goal advocates for a practice-based approach toward learning ways to engage students with disabilities rather than explicitly challenging the conceptual knowledge that these teachers hold about disability, schooling, and society. Because there has been too little interrogation of the ways disability contributes to exclusion (those that often occur within conversations about race, class, and gender as part of multicultural science education research), there are limited ways that teacher educators and their students think about disability beyond an individual solely "in need."

This reality leads to limited understandings of disability as a social construct and its influence on students' access and participation in science classrooms resulting from the teacher's conceptualizations about disability (Boda 2018). Moreover, these limiting perspectives are insufficient for a truly *inclusive* "Science-for-all" goal that is at the crux of emphasizing critical science education. This is especially the case if the goal of "Science-for-all" including students with disabilities is limited to recommending how SPED sectors can improve science instruction for these students, without multicultural science education also interrogating this topic, which is seen in the extant literature of the field, noted below.

The most recent studies focused on inclusive "Science-for-all" related to students with disabilities include professional development to "raise awareness" and adopt "inclusive practices" through multidisciplinary collaboration (Brusca-Vega et al. 2014; Kirch et al. 2007) and adopting more technologically assistive pedagogies into the science classroom (Bargerhuff et al. 2010; Gomes and Mensah 2015). They have also focused on viewing the impact of inquiry-based activities on achievement for students with disabilities and their attitudes toward science (Mastropieri et al. 2006; Therrien et al. 2011) and attending to a practitioner-based research agenda for meeting the needs of students with disabilities in science (McGinnis 2013). All of this research on science for students with disabilities neglects any explicit goal to challenge and change science *teachers'* conceptions about disability *before* they go into their classrooms, as well as reconceptualizing courses to more fully realize this goal within teacher educating institutions.

It should not be surprising, then, that when surveyed in 2014, science teachers ($N = 1088$) felt they had received little to no formal training and felt unprepared to meet the needs of students with disabilities in the K-12 science classroom (Kahn and Lewis 2014). Compounding the attitudes and perceptions science teachers come into their classrooms with, even when co-taught with a special education teacher, students with disabilities in science classrooms continue to not receive a form of science pedagogy that meets the needs of these students (Moin et al. 2009). This also corroborates more recent findings that center the general education teacher as the main disseminator of science knowledge (King-Sears et al.

2014) and the difference in perspectives toward science instruction that occurs between students with and without disabilities (Preston-Smith 2015). Indeed, science teacher education is *by design* and *implementation* not meeting both science teachers' and science students' needs in relation to disability theorizing *combined with* practical models.

These accounts of research intervention, and calls for increased science teacher preparation geared toward meeting the needs of all students, echo past research in urban and multicultural science teacher education. This inquiry then requires further empirical research on how this reconceptualization of disability in science teacher education can move beyond a solely practice-based approach toward an integrative and critical conceptualization-to-practice approach for "Science-for-all." This emphasizes that *all* students will be able to learn because of the teacher education provided by the science teacher education research community. In this way, the charge for science teacher education more broadly, begins with an inquiry process into the courses that we design to meet the needs of our students to fulfill an inclusive "Science-for-all." Through this new conceptual frame, there can be an evidence-based assessment of what multicultural science education is currently teaching its students, in relation to disability, and suggestions to move the field forward—a call taken up explicitly within this research report.

Conceptual Framework

Disability studies (DS) was used as the conceptual framework for this research. DS as a field focuses on the deconstruction of normalcy in the educational perspectives currently lived and used to justify exclusion (Davis 2010). It also presents medicalization, science, culture, and social institutions as influential to the ways people conceptualize the body and the mind (Davis 2014). Science teacher education research concerned with students labeled with disabilities, through this paradigm, would focus on learning about the relationships between the diverse forms of exclusion, while actively addressing the nature of disability as a prominent factor for students being seen as unable to participate in novel science instruction because of this label of disability. Disability, thus, operates conceptually as a marker of difference—coded as an individual deficiency of the student outright, rather than also an interrogation of the learning environment.

The reality remains that when diversity is labeled as deficiency, it is done through means of identifying and diagnosing "the Others" that exist in juxtaposition to the standard white norm (Ladson-Billings and Tate 1995; Miller 2016). Thus, there is a need to conceptualize disability and the perceived capabilities of students that fall into the ranges of categories within that label, through a similar juxtaposition that has bred the realities of exclusion for these students (Annamma et al. 2013; Broderick and Ne'emen 2008; Leonardo and Broderick 2011).

This poses an additional research agenda not yet fully implemented in science teacher education, and the call for such a research inquiry is further supported most prominently in a recent study with university teacher educators, where the majority of participants automatically referred to disability as merely a code for "SPED and "rehabilitation," and these teacher educators attest that disability is often only included in one course, if at all (Cosier and Pearson 2016). The need for a place for disability at the proverbial 'multicultural education and urban science education table' is needed, now more than ever; with a rally call against disability's "separate but equal" status within the research in these fields.

Disability, as used henceforth, describes both visible and nonvisible cues, with consideration across medical, material realist (SPED), and social (DS) perspectives (Davis 2014), all of

which contribute to teachers' perceptions of students labeled with disabilities (Broderick et al. 2006). Medical perspectives focus on a curative mentality that sees any type of disability as one that can, and should, be eradicated from human experience, so as to alleviate social, personal, and economic strain (Rieser 2012a). This perspective is the most traditional of the three and is pervasive in all forms of media representation of disability. Material realists focus on the immediate resources and limitations that face people with disabilities in their personal, private, and professional lives. They seek to mitigate the limitations set up in the realities that face people with disabilities so as to have them be productive members of the already existent status quo of society (Rieser 2012a), and assimilate them into the "normal" student subject position that is docile, obedient, and valued, vis-à-vis their ability to contribute to the economic ends of civil society (Farnen and Sunker 2016; Nielsen 2012).

Social perspectives of disability, however, envision disability as diversity—both in the tangible material realist sense and cognitive approaches toward neurologically based disabilities that emphasize a neurodiversity/neurodivergent mentality (Armstrong 2013). This paradigm also critiques societal contexts and its institutions that are designed to exclude rather than include (Titchkosky 2011). Indeed, when paraphrasing Len Barton, Roger Slee (2010) elaborates on the importance of disability studies in education: "Special Educational Needs was [/is] a euphemism for the failure of schools to educate all children" (p. 68). While there has been extensive research in the multicultural science teacher education community in terms of traditional labels of difference (i.e., race, class, gender), the inquiry into disability as a marker of difference is not just lacking, it is invisible and, thus, indiscernible for teacher educators, their teacher candidates, and graduate students in science education given the minimal research in this area of inquiry.

Given the substantial inquiry into science teachers' belief systems concerned with "multiculturalism" over the past 20 years (cf. Bianchini and Soloman 2003; Calabrese Barton 2000; Cone 2012; McDaniel et al. 1995), there remains no substantial model of conceptual development integrating disability as a discernable construct of difference, let alone an inquiry attempting to describe how a lack of critical interrogation of disability may influence pedagogical decisions and lesson planning of science teachers to meet the needs of this population. Through this lack, the ways that we educate graduate students to confront these realities in their future classrooms are relegated to only those ideologies taken up in special education. And with the current over-representation of students with disability being from diverse racial backgrounds, the call for such a description of learning that occurs within the singular courses used to educate graduate students about multiculturalism and urban science education is imperative, now more than ever.

In creating the argument for disability's place at the multicultural table, this research moves beyond nonconceptual mediators vis-à-vis perceptions *of* students, toward explanations and conceptualizations used *by* teachers *for* student learning in diverse contexts—i.e., what students are able to discern as critical pieces to attend to within scenarios related to disability. This research provides a revised view into the influence of how disability is attended to after learning within the sole diversity requirement course for both preservice science teachers and doctoral candidates, as well as challenging how science teacher educators approach the task of integrating disability, from separate but equal to a valuable form of diversity for inquiry. For these reasons, disability studies were adopted as a conceptual frame to reconceptualize how disability can be placed on similar grounds to researching exclusion in science classrooms. The following research question and subquestion, thus, were employed for this inquiry:

1. To what extent does a "Science-for-all"-driven graduate course help students develop capacities to discern disability as a form of diversity?

    a. What conceptual understandings of disability do these students exhibit?

Methodology

Phenomenographic methodologies are utilized when inquiring about how humans conceptualize experience beyond dualism (Marton and Pang 2008), while "focussing [*sic*] on conceptions of specific aspects of reality, i.e. on apprehended (perceived, conceptualized or 'lived') contents of thought or experience" (Marton 1981, p. 189). Therein, the methodology of phenomenography is used to study how peoples' experiences influence and change their responses to phenomena, and how such discernable responses can be systematically showcased as an *outcome space*. Phenomenography envisions learning as a relationship between variation across specific dimensions and as a reflection of the structure and organization of awareness (Marton and Pang 2008). Additionally, as Tight (2018) elaborates in his review of phenomenographies published since the 1980s, "phenomenographers operate with the underlying assumption that, for any given phenomenon of interest, there are only a limited number of ways of perceiving, understanding or experiencing it" (p. 18).

This study utilized phenomenography to study how an *Urban and Multicultural Science Education* course did, or did not, facilitate students developing attentiveness toward disability beyond the medical and SPED perspectives of disability. Phenomenographic analysis requires an interview protocol centered on a trigger scenario, one in which participants are presented with a disciplinary-relevant scenario, in which they need to apply the concept of inquiry (disability). In this course, disability was taught along with other concepts such as culture, science, and urbanity (see the following link for the entire syllabus with details of the assignments and readings: https://figshare.com/s/58101 cab39e00a720660). Thus, to ensure that participants attended to disability as a marker of difference, and measure their conceptualizations as they changed as a function of the course, the interview scenarios were purposefully designed to elicit a response about how disability was discerned, as discussed below.

A descriptive protocol of incidents in a classroom was employed, with each interviewee provided with four individual scenarios of student behavior, which constituted the first part of the interview protocol for the ten volunteer graduate students in the course. The second part of the protocol generation was to include a response to the behavior directly after each of the scenarios, to provide an interpretation for the interviewee to also think about in relation to how disability may have been conceptualized. These responses came from a previous project and related specifically to the nature of how disability is often discerned (i.e., the medical/SPED model). This provided the evidence base for the in-depth analysis used to address Research Question 1a. Continued questioning (probing) was used during the interview to inquire more deeply into the interviewee's thought process (i.e., *why* she/he thinks the way they do, and why they said what they said). This was followed with further questions about their personal experiences, as well as any additional ideas from their academic degree program that may have been "at-play" in the scenario and teacher response, but were not explicitly addressed.

Setting and Population

The study site was a graduate course in a science education program designed to engage preservice teachers and education researchers in multicultural issues that affect urban science education, its theory, and practice. The researcher of this study was the graduate assistant of the course and was charged with providing feedback to students' assignments in the form of questions but was not in charge of the grading of any assignment. Students were recruited on the first day of class via an informed consent request made in-person, and all but two students in the course participated in the study (22/24 students). The researcher was previously charged with updating the syllabus for this course to be representative of the most recent literature within the field of urban and multicultural science education, as well as including readings about disability that focused on the intersections of markers of difference (i.e., Collins 2013; Erevelles 2000).

The professor on record taught this course as he had in the past with only an inclusion of the research measures designed to "catch" the phenomenography of the course (i.e., pre-/post-course interviews), and these measures were only implemented with those students who volunteered to participate in this study (10/22 participants). There was no change in the nature of the course curriculum and pedagogy by the researcher other than the collection of data from the participants. This study took place at a large, urban university in northeastern USA and was the sole "diversity" requirement for graduate students in the science education program. This project enlisted ten volunteers to participate in the in-depth pre-/post-course phenomenographic interviews. Sixty percent of the entire cohort ($N = 22$) was from the science education program, while the other 40% were from outside the program—the same proportion as among interviewees.

For the purpose of anonymity, respect for participants' naming themselves, and given this research was not focused on gender differences among participant responses, I did not seek to parse out individualized conceptualizations related to any identity label that was not self-disclosed in the participants' utterances. Thus, the singular "they" was used throughout the findings in recognition of a nonbinary form of a singular pronoun beyond the option of she/he as recommended in other research genres (Bodine 1975; LaScotte 2016). This was purposeful to make sure the reader checks any biased lens they may use toward gendered voices in the data.

Data Collection

The data collection followed the phenomenographic design listed above. The interviews were implemented in the first 2 weeks of class and the last 2 weeks of class at an out of class location, all of which were private meeting rooms within the college's library. The exact scenarios, as well as responses from teachers that participants were asked to discern together, are provided in the Appendix. Three course-required assignments, that were previously used by the professor before this study took place, were also collected as evidence of any changes in the ways these ten participants and the cohort more broadly, conceptualized disability as a form of diversity (in the interviews). These were autobiographical and theoretically grounded assignments designed to elicit students' capacities to critically reflect on their past experiences, the course's curriculum, and the ways that they would adopt a multicultural perspective in their future urban science classrooms. These data sources provide insight into if, and to what extent, the cohort was engaging with an interrogation of disability among the other forms of difference being discussed within the course, outside of the in-class discussions, to provide time to reflect.

Data Analysis

The phenomenographic method of interview data analysis of Wan et al. (2013) and Charmaz's (2014) application of grounded theory were used to analyze the interview data collected. Given that phenomenography is couched in using an interpretative lens toward data analysis, the interview data were analyzed both grounded in a constant comparative method toward data analysis using an interpretative lens (Fram 2013) and using the open-coding process emphasized in grounded theory (Birks and Mills 2015). Using both focused and inquisitive approaches during data analysis provided the base from which the categories of description for the concept of inquiry (disability) could emerge. This was also the method used to analyze the descriptions of thought that the interviewees were using to justify their conceptualizations. This use of multiple theoretical lenses to analyze data, and providing a thick description emphasized by qualitative research as a process that should be implemented throughout the analytic procedure (Freeman 2014), allowed for insight beyond the employment of a singular data analysis method (such as grounded theory alone). This process has also been highlighted as a fruitful data analytic process with which to observe multiplicity of interpretation that would not be achievable within a highly specific structuring of data analysis (Berge and Ingerman 2017). A more detailed description of this process is provided below.

The interviews were openly coded, with a focus coding process of those open codes done to "compare codes with codes and think about the ones that may be promising tentative categories" (Charmaz 2014, p. 140). An axial coding process was then done, to parse out the variations among the interviewees' focused codes, and thus describe what subcategories exist within the larger category of the focused code and describe how they were related (Strauss and Corbin 1998). Finally, following phenomenographic analysis, thematic codes were then generated from the focused codes and the subsequent axial coding process that were used to "map-out" the findings for the research question.

These final codes represented the themes (categories of description) participants used to conceive the concept in question (disability) and how these conceptions vary based on the thought processes used to justify these dimensions of knowing (i.e., the variations in the dimensions of thinking participants employed when elaborating on their discernments). The findings from each time-series data collection (pre/post) were compared to one another to refine final categories of description and descriptions of thinking within the final analysis that was to be reported. Following the phenomenographic tradition of variation theory as a premise to understanding changes in learning, as defined by qualitatively different discernments that can be described through the differences in conceptualization (Tight 2016), variations between the categories of description for the concept of inquiry (disability) were also identified.

Dependability After this final coding process was done, examples from this qualitative analysis were provided to a panel of stakeholders in education interested in teacher education in two iterations. Both iterations showcased three examples of how the researcher connected the data with the provided interpretation; thereafter, the panelists' perspectives were recorded to provide multiple perspectives toward the interpretations that the researcher identified and to refine the focal argument. This iterative process was finalized with consensus being made across panelists and the researcher in terms of the validity of the arguments related to their claim, evidence, and reasoning, which led to the findings reported in this research.

Findings

In terms of the phenomenographic outcome space, three categories of description were identified intersecting with four descriptions of thinking, as per the phenomenographic method. In Table 1 are representative examples from the data set of each category of description for the concept of disability, so that the reader can concisely interpret the thematic descriptions presented thereafter. Presenting these examples allows the reader to analyze the findings with a greater understanding of what the categories mean and be able to discern the nature of the more finite analysis across the dimensions of thinking used by the participants.

The outcome space for this phenomenographic analysis is also provided in Table 2, with explanations of both the categories of description and their intersecting descriptions of thinking. Within the qualitative analysis of differences between the categories of difference, two variations in conceptualizing disability were identified as elaborated below. As almost all of the intersections (except that of "Disability as Perception" and "Critical" justification, shaded in gray in Table 2) between the categories of description and the descriptions of thinking were present within both the pre- and post-interviews, only the post-interview data are presented in the findings of this research question.

Among these three categories of description, there were distinct ways in which the participants conceptualized disability. Within the "disability as label" category (henceforth referred to as labeling), a medicalized perspective of disability was employed to justify the notion of impairment as being merely a part of a labeling process that leads to a naming of impairment as disability. This conceptualization became situated almost entirely in the student, and therefore, students labeled with disabilities in this category are conceived of as "in need" of help to cure this impaired state (intrapersonal), or this label of disability is determined by the nature of comparison of the individual to others without a labeled disability (interpersonal).

However, within the "disability as integration" category (henceforth referred to as integrating), a more special education perspective was employed to justify the notion that while students *have* impairments, the nature of disability is such that these impairments can be

Table 1 Representative samples of each category of description for the concept "disability" collected from the phenomenographic interviews with the ten subset of participants in the course cohort

Categories of description	Examples of each category of description
Disability as label	Participant 3 stated: "I say it because it seems like those are some pretty good examples of a kid who has some social/emotional learning deficiencies." This represented disability as a label, as something the student "has" (i.e., social/emotional deficiencies).
Disability as integration	Participant 4 reflected: "There was a student, a couple of students there, that would occasionally display behaviors similar to this but teachers worked together and also created a classroom environment where [pause] like the lessons would still progress even though the students were making noises." This represented disability as something to assimilate, something to normalize, and to tolerate.
Disability as perception	Participant 5 contemplated: "I think that's a default kind of way of thinking oftentimes when you are in these urban environment when you are positioned to internalize all these different ideas about students … is it a matter of context, culture, so I think that teachers should have some way to reframe their ideas about students, particularly in urban schools." This identified disability as a perception based on bias teachers' hold, something to problematize.

Table 2 Phenomenographic outcome space of the category of description "disability" from 20 semistructured interviews collected from the ten interviewees pre-/post-course: Intersections blacked out were not observed in the pre or post-course data

Categories of Description (Disability)	Descriptions of Thinking			
	Intra-personal Description enforces attribute of the person; something that the person has or derives from the individual	Inter-personal Influence from outside source is emphasized in statement; a description of comparison to others	Contextual Multiple places and spaces are compared as factors that can change the interpretation of the concept	Critical Attentiveness to intersections of power, systems thinking, and identity are at the crux of the interpretation of the concept holistically
Disability as Label	*	*		
Disability as Integration		* (Variation 1)	*	
Disability as Perception			* (Variation 2)	*

* All intersections (blank spaces) emerged from the data and are elaborated below in their own section

normalized toward becoming like a non-disabled student in the general education classroom through interaction (interpersonal). It also focused on the attendance to (or lack thereof) places and spaces where disability is constituted (contextual) in the hope to achieve "normality" for the student labeled with a disability, by *assimilating* their impairment into a set of tolerated behaviors/accommodations and having their needs met in spite of their disability (similar to how a non-labeled general education student would need scaffolds).

The two first categories remained fixated on disability within the student (i.e., labeling) or having students labeled with disabilities become just like their normal and more able, non-disabled counterparts (i.e., integrating). However, the third category "disability as perception" (henceforth referred to as perceiving) focused on how the context of where disability is learned and employed can influence the biases that teachers hold about students because of their labels of disability (contextual). This category also focused on the ways that society more broadly constructs disability as a deficit (as the two other categories embody) with consideration for the ways these sociocultural constructions of disability manifest in assumptive biases of capability, denigration of self, and outright exclusion (critical). This third category of difference employs *one of many* perspectives of disability coined within disability studies.

Labeling In terms of the category of description labeling, two distinct ways of thinking were identified. The first, intrapersonal thinking, placed the focus on disability as a conceptual construct attributed and derived within the individual. The second, interpersonal thinking, placed the focus on disability as an exchange or dialogic process between two or more individuals, which led to a constitution of disability through comparison to the "normal" student. As seen below by discernment from Participant 1, when trying to make sense of Mary's disability label imposed on her in scenario 3, we find that this labeling of disability as impairment maintained that there was something wrong with the student, and in attributing this label as fundamental couched in the individual, the goal was to get help for this "lacking" positionality. Even as the claim wavered between a definitive need "or not," the justification remained solely within the individual student as the producer of disability:

> I think again, like this, she's been labeled emotional unstable and learning disabled so again I would just question that because now I'm starting to see that kind of label possibly just like a mask for someone who is disruptive or you know has something else going on that maybe she does need a co-teacher and an IEP but maybe she doesn't. (Participant 1)

This is also seen as discerned by Participant 3 when they noted this intrapersonal notion of disability as labeling again in the nature of how disability operates in schools based on the participant's personal experiences. Through the attribution of disability as labeling (not to be misinterpreted as a comparative contextual analysis), we see that the participant justified disability as individualized, centered in positionalities derived from negative behavior, and as typical of "disability" in that it was abnormal and in need to reform the individual:

> I mean I've definitely seen teachers you know do their very best to evaluate the whole student. You know there were several examples that you gave this teacher of these specific behaviors that you know to me it sounded like just things that I've seen before but I've typically seen *those* things in a special education class. (Participant 3, emphasis in utterance)

Moreover, this notion of disability as intrapersonal description became nuanced in that even though disability goes through a labeling categorization, and was conceptualized as dependent on an individual's attributes, the nature of whether it was deficit remained within the medicalized notion of whether the impairment was seen as "curable" (i.e., eradicable), as participant 10 discerns from their personal experiences after discussing Gus's bullying incident in scenario 4:

> [Have I experienced this?] Not really. Not where they have uncontrollable behaviors. Like I mean we had one kid who had like, who would make movements but it wasn't really disruptive and people didn't really mock him so it was different. (Participant 10)

Indeed, this individual attribution of disability as labeling also manifested within notion of "protection" wherein because of the disability label, and its inherent connection to the individual as unable or proverbial broken, the individual was in need of safety, an attribute that the student was incapable of reaching alone. Participant 9 discerned this from their experiences in classrooms after discussing Mary's label of disability in scenario 3:

> I've worked in a special education school this semester. I just remembered there was a girl – they were all special ed – but there was a girl that was so sweet and so nice and so respectful and so deferential and everything about her just made me want to take care of her. (Participant 9)

Participant 5 also discerned this protective need in an intrapersonal way as a function of labeling when attending to the teacher's response to Gus's bullying scenario:

> To me, it almost seemed like she was protecting or trying to also protect him from [pause] like if he has a disability and has troubles, she wanted to protect him from potential negative interactions with students, I think that's how disability plays a role 'I have to try to protect this student' … she could've also took that situation in a different way with the student and maybe use it as a teachable moment and try to really address some of the deeper issues with the student but instead she's just trying to protect the student and put him with the well-behaved student so they [Gus's bullys] don't say anything to that student and they don't hurt that student's feelings. (Participant 5)

Through these examples, we see a consistent attention paid to disability as a labeling process that spoke to the individual student's inability, to their deficit, and to their need. This intrapersonal thought process was also considered further through the lens of the medical perspective based on the disabled student's individual ability to hide impairment and therein not exhibit a disability label. This labeling categorization was also found within another way of thinking exhibited by the participants in the study: "interpersonal."

As this labeling categorization played out in the conceptualizations of the participants, an interpersonal thought process was adopted to justify the construction of disability as in need of cure due to its deficient attribution through comparison with a "normal" student positionality. Within these interpersonal ways of thinking, the participants shifted their relevance to conceptualizing disability as an interactional constitution that occurred between two or more individuals, and thus required something "beyond" the capacities of the individual student to ameliorate the deficit embodied in a disability label. Participant 3 exemplified this interpersonal thought process when responding to Gus's "abnormal" behaviors in scenario 2 as they reflect on their personal experiences, as well as how the role of the teacher is limited by time and skill. Through the justification of need as comparison to

other aspects (and students) the teacher must be attentive of, participant 3 couched disability through a labeling of "unteachable":

> I've had kids that were similar to this and I don't know that most teachers have the skill set that's necessary to manage their class and manage this uncontrollable behavior. There's just not enough time in the day, you have a finite amount of time as a teacher to get the lesson across and it's [pause] you have to have interventions and I think that's what she's saying. (Participant 3)

More prominently seen throughout the participants as they conceptualized disability as a label that was constituted between people was the notion of disability being part and parcel to diagnostic procedures—as being constituted and defined by an outside expert comparing those being labeled with a disability with those who are not in need of such help. Participant 4 showcased this conceptualization process as they explicitly identified disability as an interpersonal placement of label from outside of the individual student through comparison to those who do not need a label: "disability does get mentioned in there as the official process of diagnosing a student with a disability." Indeed, participant 4 further constituted this interactive placement of label when elaborating on their experiences with teachers and the labels of disability that should be applied if and only if the process of diagnostic labeling was done to identify these deficits:

> Well I guess [pause] this isn't reminding me of the teacher's response but is kind of a counter to this, the opposite I've seen is that there's this group of set students in the high school I was observing and whenever I would [pause] quite a few of the other teachers when I would talk to them would say 'oh, most of those students need to be on IEPs' and I was like 'but, you know there's not' [and they would reply] 'well they're not officially diagnosed with that but that's what they need' just that in contrast to this more thoughtful approach, reminds me again of this just because of its contrast. (Participant 4)

Participant 4 then moved on to identifying, like that of participant 10 above, disability labeling through the notion of controllable and uncontrollable attributes that were specific to the student. However, participant 4 included a different justification within their response when Gus is being bullied in scenario 4 that without the diagnostic process—an interpersonal constitution— required for this conceptualization of disability as a deficiency, disability was not identified:

> and disability, I don't know I might change my mind about that [pause] It doesn't talk about trying to get him diagnosed but I feel like there is an assumption made that the student can control [pause] their behavior. (Participant 4)

This labeling of disability through comparison to the "normal" child as a procedural constitution of the concept was, finally, considered as an expected process that teachers are required to do, and thus followed the medical perspective of diagnostics to "find" disability, identify it, and cure the impairments that might "plague" the student. Participant 10 exemplified this in recalling their personal experiences after making claims about Mary in scenario 1:

> My own experience as a teacher like when this is happening, where this is what we are supposed to do. Like I'm taught to do this as an employee of the [city's] public schools. You talk to the guidance counselor, you call home, you have a meeting, you think about if they need to be evaluated for special education. Definitely, this is what we are taught to do as teachers. (Participant 10)

In these readings of disability as label, and therein from a medicalization perspective of impairment, the ways of thinking adopted by the participants (intra- and interpersonal) embodied the curative perspective toward disability. These ways of thinking reinforced the notion that disability was a labeling process, defined either by the impairment constituted within the individual (intrapersonal) or constituted by comparison (interpersonal). It was through these discernments that 90% of the participants envisioned disability by the end of the course. However, as we shall see within the "integrating" category of description, another perspective toward the special education notion of assimilating impairment, to attain "normal" student positionality, was concurrently used.

Integrating As stated above, the categorical description of "integrating" focused on the SPED perspective of disability, where the identification of impairment leads to a label of disability. This category was different from that of the category of labeling, where the purpose was to identify deficiency for intervention as a *curative* solution. Within this integrating category, the purpose of this categorization of disability was to provide accommodations so that the deficit that was identified as impairment can be *normalized*, rather than (explicitly) cured. Within this integrating categorization, the student labeled with a disability could (hopefully) embody the positionality of student who was on par with that of the normal student position, and that the impairment (coded as a disability) would be *assimilated* into the general education classroom by the teacher providing accommodations and the students tolerating these modifications to the general education curriculum, pedagogy, and assessment.

Rather than medicalized aid that required eradication of the impairment, the notion defined by the integrating categorization, then, could (implicitly) consider disability as a *possible* form of difference. This alternative conceptualization of disability entailed a qualitatively different level of discernment illustrative of variation 1. For instance, within a labeling categorization, the purpose was always to "cure," but that was not the case (at least in the explicit sense) within the integrating category of disability. Moving from labeling to integrating, for these participants, meant to think about disability beyond explicit notions of cure and, instead, think about disability as something that could be seen as more "normal" in terms of a tolerable form of difference that could occur through accommodation of impairment to participate in the general education classroom. And while this notion of "normalizing" has salient tones of cure within it, the nuance was that labeling was not implicit, rather that when disability was labeled it was an explicit and visible semantic component of their conceptualizations as "cure." This was qualitatively different when participants used integrating to discern disability.

As with the categorization of disability as labeling, the categorization of integrating exhibited two distinct ways of thinking: interpersonal and contextual. Within their interpersonal thinking, like that of the labeling categorization, disability was considered by the participants as a constitution between two or more people. However, the nature of that constitution within the integrating category was upheld by the purpose to assimilate students labeled with disabilities into the classroom in ways which would require others to tolerate their disability, as a function of the interaction between people—not just the individual being cured of their own impairment by medicine. Participant 1 embodied this conceptualizing of disability when discerning the concept being constituted within Gus's abnormal behavior in scenario 2:

> I mean I guess screaming episodes in the middle of class would be disruptive. So now after taking this class I feel like disrupting your class a little is fine so, I don't know, maybe that's okay. But again, I feel like we're going to disability because she's thinking

like [pause] I mean it sounds like something is [pause] you know, he's got a lot of noises going on, so maybe that is some sort of disability or Tourette's or I don't know what. So I would go with disability - and then she talks again about getting the parents and guidance counselor involved, did she say parents here? (Participant 1)

This participant's conceptualization remained grounded in the purpose to integrate the student into the general classroom structure in ways that would normalize this particular student's perceived impairment ("disruption" and "noises") with attention paid to outside sources (i.e., parents and guidance). Participant 1 further highlighted this conceptualization of disability as an interaction between people with the purpose of integrating after their description of Gus's abnormal behavior in scenario 2. While referencing their personal experiences, and ideas from their degree that pertained to the scenario, participant 1 stated:

Well I think I told you last time that I have a brother who sounds like this and as a sister it's really [pause] he's a hard brother to have because everywhere we went he was disrupting things and he ended up going to a boarding school for his specific learning needs and then he integrated into a local school when he was in 5th grade and you know I think he really was not in regular classes, I think he had a integrated homeroom and then went off to segregated classrooms and then he still had lunch in the main cafeteria and integrated [again] then. So I really think about him when I think about this to sort of say you know some things people do to be disruptive are kind of fun and some are 'oh, I wish I didn't have to do that but I'm doing that' … I am trying to think more in terms of like if someone is like that, if it could possibly work, if the class could possibly absorb that distraction and move on, you know is it possible to keep him engaged in that classroom, I think that would be the goal. (Participant 1)

With lingering notions of contextual factors that would influence the nature of how disability was conceptualized as integrating, participant 1's response represented the fringe between interpersonal and contextual ways of thinking. It is through this conceptualization where disability was focused on in terms of the purpose to assimilate the "disabled" student into the "normal" classroom positionality, with "normal" student interactions emphasized as the exemplar. The participant remained focused on the tolerating factor that would involve other students and the goal to "keep him engaged" in similar ways as the other "normal" students.

Indeed, this integrating conceptualization of disability was further complicated by the notion that, through interpersonal interactions, impairment (and therein a departure from an expectation of "normal") was defined and identified through the comparison to that "normal" student positionality. Thus, there was an emphasis on the purpose of this conceptualization to assimilate the "disabled" positionality into a "normal" positionality. Participant 8 discerned this integrating conceptualization within a special education perspective and its interpersonal reliance, when relating scenario 4 of Gus being bullied by his classmates with their own personal experiences, focusing on the purpose of assimilation:

I mean I really feel like she has to talk to those other students about it because Gus is part of the school culture and part of the class so yeah again I don't have any real personal experiences with a student [pause] because Gus has [pause] Does Gus have an IEP? Researcher: No, nothing like that was said.

Ok, so then he's just part of the class and the students are just being distracted by whatever Gus is doing and need to be talked to. But kids [pause] yeah I don't really know what Gus's situation is. (Participant 8)

Highlighted in this conceptualization was the notion of assimilating the impairment exhibited by Gus, thus constituting disability only when students bring attention to this deficit. Subsequently, this utterance exemplified a strong reliance on special education, first and foremost to make sense of the "abnormal" behavior that Gus exhibited. This conceptualization then transitioned to trying to conceptualize the impairment beyond Gus to emphasize the integration of Gus into the "normal" positionalities within the class. However, the participant then retreated to locating disability as still constituted through Gus's interactions. This, then, constituted disability through the original interpersonal justification that Gus does, or does not, have an impairment to normalize through SPED accommodations provided by an outside source—the individual education plan (IEP).

Participant 4 shared these same interpersonal constitutions of disability as a way to emphasize integrating students labeled with disabilities into a "normal" student positionality. This arose when participant 4 was speaking about an "inclusive" classroom that they had experienced first-hand, subsequent to reading scenario 2 with Gus's abnormal behavior:

Sometimes a couple students would start tantrums in the class and [pause] and even in those scenarios they had a system worked out with the student so they could say you know 'hey I feel like your behavior is approaching this and I would really like it if you could bring it down to here'. So they had quick personal communications that had already been worked out in like longer talking processes and then they also [pause] so they also address it but then get back to the general classroom. And the way that the [general education] students, seeing the way that their teachers also included these students, they did not seem to be disrupted by it. (Participant 4)

Here we still find that integrating was the foremost purpose of describing disability. In particular, this conceptualization did not depart from an interpersonal constitution. This utterance still emphasized how the interactions between parties contributed to the constitution of disability as an integrating purpose—the students were seen as contributing parties to assimilating and normalizing disability into the general education "way of doing things." Departing from this interpersonal justification for the integrating constitution of disability, contextual descriptions of thinking were also prominent in the evidence gained from the participants.

Within their contextual thinking, participants exhibited the notion that place and space were important components when thinking about how disability was constituted. Participant 8, below, after Mary had received a SPED label in scenario 3, discerned that disability would be applied no matter the context. Moreover, through the special education perspective, the participant focused on that the impairment related to disability plays out through the integration, or lack thereof, of those students labeled with the disability. In this utterance, participant 3 exemplified how integrating disability was fundamental to understanding disability, but also that contextual factors of exclusion (in their experience) were the "norm," emphasizing that no matter the context, disability existed and therefore could be understood in this way:

This scenario is sounds like she's talking about disability. 'If she has an IEP this student' [pause] the teacher is putting a lot of responsibility on the special education teacher. So whether it's a self-contained or inclusive class she's saying that the special education

teacher should be getting her the work, the student the work, and maybe helping trying to figure out how to control her and calm her down and to transition properly. So it seems the teacher is putting this in the disability category because of how much emphasis and responsibility she's putting on the special education teacher … I mean [pause] again growing up in my school we were, students who did not have IEPs were very very much separated from students that did have IEPs so there was not a lot of mingling in between. So if a student had an IEP they would rarely be in classes with students that didn't have IEPs so they rarely rarely ever saw each other, it was very segregated in our school, the way that we were taught. And so this reminds me of that because it just seems like the content teacher don't really know or aren't trained or aren't really sure what to do with students who aren't 'normal' students. (Participant 3)

Along similar lines of contextual thinking, emphasized above by participant 3, participant 7 discerned from their personal experiences that emerged after scenario 3 when Mary was labeled with a disability, that disability, indeed, exists devoid of context. As shown below, participant 7 elaborated on the notion that disability can be accommodated to "normalize" the impairments that exist within the student. However, they are dependent on a separate context and set of skills that could only be provided through a special education perspective of disability.

Again that student teaching placement, that was an ICT class and we did have a special education teacher but they weren't really [pause] it was kind of weird because they didn't really plan together. She [the special education teacher] would just be in the class and offer support but not necessarily be super involved and for a lot of things. They would pull the students out – like if they were doing labs – they would pull the students that needed that extra support out of the class so it reminds me of that.
Researcher: When they pulled them out of the class, did they still do the labs?
Yeah they did [pause] so it was kind of weird because they would make it sound like 'oh we're choosing different groups' but they were pulling the students that had IEP's out of the class and then they'll bring them into another setting and then they'll work with the special education teacher for those labs. But I don't think that was beneficial because sometimes she just didn't know, like the content, so she would run to the classroom and ask questions so I feel like the students were missing out on that a bit
Researcher: So, the only students that were pulled were students with IEP's?
Yeah, that needed that extra support.
Researcher: Did the general education students ever say anything about that?
No, they were kind of accustomed to it because they always knew and they had a list and they would call them out and they knew that they were going to separate the class so they were [pause] it was normal to them to just be separated like that. It was interesting. (Participant 7)

Interestingly, through this utterance, participant 7 exemplified the notion that exclusion was not "beneficial" because of the lack of students interacting with the general education teacher who is fluent in science. However, participant 7 remained confident that these students "needed that extra support." In this way, disability as integrating represented the special education perspective in that *sometimes*, and *for some students*, exclusion from participation in the general education classroom was not only necessary, but common practice in the nature of schooling—an inevitability for *these students*. This justification provided outright support for exclusion, even as it categorized disability as normalize-able—accommodation took precedence over participation.

Indeed, this notion of inclusion or exclusion ("of context") constituting disability as a conceptual construct, particularly one that was used for integrating students labeled with disabilities into a general education curriculum, was also apparent when participant 5 was discerning scenario 3 after Mary receives a formal disability label. Consequently, as participant 5 reflected on their personal experiences, context remained a prominent influencing factor for conceptualizing disability:

> She immediately thought about a self-contained classroom or an inclusive classroom, which oftentimes is the setting in which special education students with disabilities are instructed. She also talked about trying to formulate a plan, which I don't think is bad to have individual plans for your students but I think a lot of that stems from the idea of her having this disability, they decided that she was incapable of receiving what other students were receiving because of the disability the student was diagnosed with … Like sometimes I would remember my own teaching practice where I would have to be careful about comparing a student with a disability to another student who I felt was more normal and so like a lot of times that happened in my first year like 'fresh experience', not really an expert in the field and so the language around how I would talk about different students would be very tricky because even though a student may have a disability it doesn't mean they're not a normal student and so you have to careful about the words you use and I think similar situations have helped me think about that. (Participant 5)

Through participant 5's elaboration of how disability was constituted through context as an integrating process, they also attended to how experiences within these contexts influenced this conceptualization of students beyond the "norm," and the students' positionalities because of that comparison. It was here, where the line between the categories of integrating and perceiving was less finite, and from this utterance, we found a bridge to present the difference between integrating as a special education perspective of disability and perceiving as a step toward one of many perspectives that are used in "disability studies" toward the concept of disability.

Perceiving Just as with the other two categories of description for disability, perceiving also had two district ways of thinking that justified its conceptualizations, i.e., contextual and critical. Like that of the integrating category, perceiving utilized a contextual frame from which to view disability as a conceptual construct. Here, however, disability as perceiving in the contextual sense, moved beyond conceiving of disability as impairment to "normalize" and, instead, emphasized the need to interrogate context through the ways that experiences within particular spaces may dictate perceptions of students who are labeled with disabilities. This became the fundamental difference in the way that these participants conceptualized disability.

This second variation, moving from integrating to perceiving, was qualitatively different in that the focus was no longer on the positionality of the student in comparison to the "norm" (integrating and interpersonal), nor was the focus on how to tolerate and accommodate the plight of an impairment through a "separate but equal" instructional model for students with disabilities (integrating and contextual). Rather, in perceiving, participants conceived of disability as a conceptual construct, constituted through bias, that stemmed from the assumed positionalities of students (and teachers) in particular contexts (perceiving and contextual).

Moreover, one participant also viewed disability as a conceptual construct that can elicit particular ways of viewing hierarchies of value within classrooms and the assumptions of *appropriate* positionalities therein (perceiving and critical).

An emphasis of context was focused on in conceptualizing disability as a perceptual quality that fostered assumed positionalities of students and teachers. Participant 6 elaborated on their personal experience after scenario 1, in which Mary was presented as a disorganized student, which represented the intersection of contextual thinking and the perceptual quality of disability:

> I would have to say that for student teaching, like now that I've been a student teacher and this is the first time I've ever been with another teacher in the same room. I remember that most of the ways that she reacted to students who behaved this way was just assuming that something was wrong and, I mean she assumed something was wrong as if there was something wrong with at home or the student had something or just [pause] or just trying to involve people who are higher up as basically as quickly as possible. Where for me it was 'ok, maybe just the student was like just that day he just had a bad day'. The teacher did mention this but I think what I'm trying to say is sometimes we [pause] at least my cooperating teacher was really quick to make assumptions … Well, at least from my degree program, for me [pause] I don't know, for me it's really hard thinking about what my degree program has made me think about other things here because to be honest when I was in class and when they were talking about classroom management and just, or disability, or any point, I wouldn't really agree with what the degree program said. For example, if a student is acting out you have to immediately control it and control the student and I really don't agree with that. I don't know, I just don't see [pause] I think I'm a little bit more [pause] Like I think I let things slide more which is in contrast to my program where they teach 'oh, no, you have to have a set of structures in place otherwise the students are never going to listen to you or you're never going to have them on task or whatever'. So, for me, I don't know. (Participant 6)

In their explication of the contextual factors that have influenced their conceptualizations of disability as a form of perceiving, participant 6 used context as a way to make sense of how different places have constituted disability—*compounded onto* interpersonal interactions. Particular emphasis was also placed on ways of describing disability that did not interrogate how assumptions were being produced and disseminated because of how these spaces constituted disability as inherently tied to deficit in comparison to the "norm". This differed from an integrating conceptualization. The focus, instead, was not on assimilating disability to reach the norm, but rather the purpose was to think about how disability was constructed due to these contextual factors—to perceive disability as dependent on the contexts that produce its nature.

Participant 6 went on to elaborate further on disability in this category after scenario 3 when Mary received a disability label. This categorization constituted how people should perceive the concept of disability vis-à-vis "abnormal"/"normal" positionalities imposed onto students. This conceptualization of disability was then adopted by participant 6 based on their experiences in particular contexts where the perceiving of disability was impactful:

> Well since I'm seeing IEP in here, I'm just going to say disability because IEP like at least for what I [pause] at least from my student teaching experience and just working in schools previously whenever I hear IEP normally everyone just thinks about disabled or

like the student is just deficient in some way. They're not [pause] it's not even different it's maybe just the schools. (Participant 6)

Indeed, following this utterance, participant 6 elaborated on some personal experiences and the nature of their academic degree where the participant discerned the nature of the context where the concept of disability was learned as influential to more practical moves that would be performed by teachers due to this conceptualization:

Whenever I hear differentiation I always think when teachers say differentiation, and even my own peers when they made us do our lesson plans and they said how are you going to differentiate. Basically what we did was try to find some source that says 'well, this is what differentiation is and for these students these are the categories of things you could do' but a lot of the times we didn't understand what does this even mean, is it that this, let's say for example for a student that has [pause] what would they say on an IEP [pause] problems with skills acquisition, they would say that the differentiation could be that you have to start with the student modeling what you're going to do, the activity for that day, but then it just says that. And it does seem pretty specific but when you do it in practice you see the differentiation really isn't there because a lot of times the student is just like 'okay? I saw it and I did it, but I'm not understanding what's going on' and even if we did the differentiation, and even sometimes we think ok we see it, but are we actually learning how to do it well or are we actually [pause] or is this just some generic thing that someone says that really doesn't seem to be something that can work in real life or just some type of disconnect between what differentiation is as learned in our program and what actually happens in the classroom. (Participant 6)

While a superficial analysis might relegate the above utterance as an integrating conceptualization, the participant was attempting to make sense of the concept of disability through the perceptions that had developed in context. The purpose, then, was not such that the student labeled with a disability was to be cured, or required to be accommodated because of their impairment. Rather, the nuance of this conceptualization was that disability was constituted through perceptions that are derived from the contexts, which enforce particular ways of interpreting disability. In this way, integrating was not the focus; perceiving was the focus in these utterances. Through these distinctions of context and its influence on perception, participants conceptualized disability as something that constitutes both a cognitive component, as well as performative component. However only two participants out of the ten adopted this conceptualization of disability. The perceiving category, however, also showcased more critical ways of thinking about disability, which constituted the final disability construct in the analysis.

As stated in the beginning of the discussion of this research question, all intersections between the categories of description and descriptions of thinking that were present within the pre-course interview were also present in the post-course interview, with the exception of one. This new intersection between perceiving and critical, while not adopted by 90% of the interviewees, did emerge in one post-course phenomenographic interview. It should be evident that the perceiving category is less prevalent than the other two categories of description (namely, labeling and integrating) based on the use of exemplars for each category expressed by individual participants. Nine out of ten participants in the post-course interview discerned disability under the categorization of labeling, while seven out of the ten participants in the post-course interview discerned disability to be within the integrating category. Only two out of ten participants discerned disability to be "perceiving" and only one did critically.

Below in participant 2's conceptualization of perceiving disability as constituted through a critical lens, and therein through a nuanced intersectional nature, wherein systems and interactions are put under inquiry to conceptualize this concept, disability was being constituted as a construct related to perceiving. This participant saw disability as a conceptual construct that became constituted through systems that (re)enforce labeling as paramount for thinking about disability and difference (i.e., edTPA) and interactions within the teaching community that constituted disability as deficiency to be under surveillance (i.e., from cooperating teachers). This moved beyond a mere contextual analysis. This one critical discernment is presented below, coming from personal experience in scenario 3 after Mary was labeled formally:

> I certainly recall times where my cooperating teachers have said to me 'oh, you know, watch out for so and so because he's got an attention disorder' or 'watch out for her because she's persistently disruptive' and before I even meet the student I've got this label on them, this like picture of them, and so I guess in that sense it reminds me but I've never [pause] You know the other thing I'll add is that in my last student teaching placement when I was doing my edTPA, I had to write the kind of 'context for learning' thing and one of the things you have to do is complete a table about all the particular modifications to learning your students need – or whatever the right terminology is for edTPA. And it's basically 'ask your cooperating teacher for a list of all the IEPs and ELLs' and so again before I even started my teaching I had my students listed out with their IEP numbers and their ELA scores attached to them. Which I think about it, as much as I tried for that not to influence my approach to the students, I think that does affect my relations with the students. I'm not saying that that information shouldn't be given to teachers because plainly the more information you have on any student the better but I think that I had to make a conscious effort not to let labels like this kind of put the blinkers on me in terms of getting to know the student beyond that label. (Participant 2)

This participant conceptualized perceiving disability as a constitution of intersections that influenced bias on who students labeled with disabilities are in terms of their identity. They then went on to elaborate on how this could then lead to teachers' actions representing those assumptions in classrooms onto these nonnormal student positionalities—in effect, denying these youth agency and being seen as "capable students."

This participant delved into this reality of systemic and interactional factors that have influenced their perceiving of disability as a conceptual construct. They then move into a critical constitution in that they recognized the limitations in them to devoid their cognition of that label, with subsequent reflection on what that could then mean to student identity formation through the eyes of the teacher. Finally, and most critically, they also considered how through the actions of the teacher particular positionalities were imposed and enforced onto the students that have been labeled with a disability, also connecting it to another form of difference (English fluency). Indeed, the categorization of disability as a perceiving act, of something that is to be discerned beyond a medical impairment or special education label, did not remain isolated from the categorization as labeling or as integrating—as this participant also adopted the labeling and integrating categorizations, within their post-course interview discernments, as well.

These interviews can also be compared to the course assignments, which required more internal motivation to discuss disability. Of the 22 students who submitted three separate essays thinking about forms of difference and their effect on urban science teaching and

learning (particularly as it deals with multicultural issues), only two out of that 22 opted to discuss disability explicitly—both of those two also being interviewees, serendipitously. Of their conceptualizations, both utilized a perceiving categorization of disability as a way of critically thinking about how disability is constituted. However, their categorizations were completely dependent on a separate explanation being derived from the readings themselves, rather than a description from their conceptualizations and sense-making skills. Utilizing the course readings as grounds for their claims about disability, inclusions of disability by participant 4 and participant 10 as a form of difference are presented below, one after the other:

> An additional example of the negative effects of how teacher perceptions of students based on a mismatch of what counts as showing engagement and knowledge is found in Martinez-Álvarez's (2014) description of the way that a bilingual first grader, Esteban (pseudonym used) is classified as having a specific learning disability (SLD) and 'semilingual' by his teachers, meaning he is limited in his home language and English, because his language is not "at grade level" based on schoolwide rubrics of oral and written proficiency. (Participant 4)
>
> Emdin (2016) explains that teachers should "recognize the biases they hold and how these biases impact the ways they see and teach students." If a teacher believes that students classified as having a disability will do poorly, they likely will do poorly and it will become a self-fulfilling prophesy. (Participant 10)

Within both conceptualizations, the participants' understandings of disability were focused on the aforementioned perceiving category of description and then viewed critically as negative biases that influenced students labeled with disabilities. In the interviews, these two participants did not discern disability in this perceiving and critical way (only participant 2 held this discernment pattern). Thus, this begs the question whether this critical lens, taken toward disability in a perceiving way, would be the actual response adopted by these participants when presented with a classroom scenario that they were required to discern and conceptualize in all its complexities, and in the moment.

Discussion and Implications

To reiterate, the course under inquiry was the sole diversity requirement for all students enrolled in the science education department at the university where this study took place. With this in mind, the course was then charged with interrogating culture and difference as they manifest as factors that influence the teaching and learning of science in urban contexts. This "Science-for-all" course is therefore the crux through which all graduate students in this program would prospectively be taught how to engage with students of diverse cultural backgrounds and the markers of difference that influence these teachers' conceptual understandings of their students' positionalities, as well as these teachers' own subject positions. For disability, in the context of the course, the ten subset of participants from the larger course population did not grow substantially as a cohort to conceive of disability as a form of diversity, on par with the more familiar markers of difference related to race, class, gender, language, and the like.

The participants initially were capable of attending to how disability was constructed through the medical perspective (as in the labeling category) and could also conceive of disability through the SPED perspective (as in the integrating category). They could also attend

to the contextual factors that influence how disability could be interpreted (as in the perceiving category), but few did in this way (three of ten participants). Thus, as participants entered the course, they held two main categories of description that they used to make sense of disability, and discerned how disability may affect instruction. Also, it should be noted that when coming into the course, the participants held a high regard for guided inquiry (a disciplinary pedagogical structure) as the most appropriate way to teach science, even if the instruction was taking place in urban contexts that contained students with disabilities.

With this incoming reliance on guided inquiry as the "right way" to teach science to students, no matter the context or disability labels that exist within the classroom, this evidence of the participants' perceptions showcased that they were focused on inquiry as a "catch-all" way to approach urban contexts of culturally diverse students, who may or may not have been labeled with disabilities. Given this strong alliance with disciplinary pedagogy coordinated with medical and SPED perspectives of disability at the onset of this course, a possible hypothesis could have been that these participants would grow in their capability to discern disability as a form of diversity, on par with critiques of race, class, and gender, therein changing their approaches to the contexts in which these markers of difference exist. This emergent understanding would hopefully lead to a more poignant attendance to the complex nature of the needs of the students within these classrooms (i.e., to first and foremost participate in a *critical* scientific literacy).

While there was one participant who was able to discern disability critically by the end of the course, and two more who were able to maintain their conceptualization of disability as a way to perceive contextual differences, the majority of this subset of participants (seven out of ten) did not discern disability as a form of difference critically. Even more, the data support that 90% of the participants still used the medical perspective of disability to conceptualize its use. In other words, the majority of the participants (seven out of ten) did not develop the capacity to discern disability as a form of difference, nor did the vast majority of them (nine out of ten) challenge the medicalized perspective they inherited from their personal experiences, which leads to another question: *Why* does a "Science-for-all"-driven graduate course *not* help this subsample of ten students develop capacities to *critically* discern disability as a form of diversity?

One explanation could be that disability was not in the foreground of the curriculum of the course and instead was siphoned into only two readings (one book and one journal article) that specifically discussed disability in a critical way, one in the first half of the course and the second in the latter half of the course. As shown in the literature review, disability in science teacher education has maintained stringent alignment to special education models, and that section also emphasized that urban and multicultural studies in science education have not fully taken up disability as a form of difference in their research. Therefore, the choice to include only two readings was purposeful, to see if the existent literature utilized in the course was sufficient, alongside minimal interrogations of disability, to induce transfer of critical discernments in relation to disability.

More concertedly, through almost all of the science education readings, the course was focused on culture as a proxy for talking about race, class, discourse, and gender. However, as shown in the literature review, these publications neglect disability as a form of difference. The extant literature in the multicultural science education field neglects to address disability, and the course did not address disability as a form of difference *on par with* race, class, gender, and language. Therefore, the concept of disability was relegated—quite literally (as in the curriculum) and metaphorically (as in the lack of purposeful inclusion in understanding culture)—to a "separate but equal" status. It is not surprising, then, that the subset of participants did not develop the capacity to discern disability as a

form of difference—it was *by design* excluded from having a seat at the proverbial "equity" table in this course. In all, this leads to a conclusion that science education literature (multicultural or not) is not sufficient to challenge graduate students' conceptual understandings of disability, beyond the medical and SPED perspectives, which neglect the sociological aspects of this concept as it plays out in classroom practice.

This neglect, seen more thoroughly throughout the literature and now explicitly identified in this research, maintains that disability is a "special" case of difference, particularly one that does not "emerge" from merely discussing culture more broadly in the context of racialized, classist, gendered, and linguistic critiques of systemic oppression writ large. Indeed, the literature highlights that disability is one of the primary tools for excluding students of color from instruction in the general education classroom and that this exclusion is disproportionately hindering poor youth of color from access to appropriate *science* instruction taught by content specialists. Thus, courses such as this one have not yet recognized the limitations in their own conceptualizations of difference toward disability, in their curriculum, or their lenses toward both difference and disciplinary learning. Without such an interrogation, what do we *really* mean by inclusion and who are we *really* thinking about when we say "Science-for-all"?

Principal Contribution of This Study to Science Education Research

While scholars outside of science education have argued for a more cultural approach to disability, and their findings seem to mirror those that are presented here (e.g., Heshusius 1989; McDermott and Varenne 1995), the principal differences between that work and this study are two-fold: (1) lacking specificity of how disciplinary commitments may mediate perceptions of students and (2) the methodological nature of their inquiries. As the research shows, science education, as in other disciplines, holds specific expectations about what "effective" teaching and learning looks like, when educating students to become scientifically literate—the premise of literacy itself being primarily focused on communicating in specific ways and through specific practices (e.g., argumentation and discourse emphases in science education and policy changes related to practices, i.e., the Next-Generation Science Standards; NGSS Lead States 2013). Through this expectation, preservice teachers and graduate students are charged with different expectations that they may not be familiar with, while researchers may have deeply seeded familiarity with these expectations and have learned to navigate these demands. Indeed, noting the methodological processes focused on in these previous studies also sheds light on the importance of discernment patterns based on the population sampled.

In both studies (Heshusius 1989; McDermott and Varenne 1995), the primary population generating the themes of the claims made is researchers; they provide a glimpse into what *researchers can discern*. In turn, choosing the population sample of this study as a focus on what *preservice teachers* and *graduate students can discern*, highlights that discernment patterns are possible for this particular population. This is a significant contribution to these previous works in that it should not be assumed that because researchers can "see" disability in various ways that preservice teachers and graduate students also hold the same capacity to discern the sociocultural realities of differential markers of difference without experience and exposure—many researchers have decades of experience with students, education, culture, and cognition, while preservice teachers and graduate students may not.

Given the nature of science education being deeply couched in inquiry-based pedagogies, it has, indeed, been a long and hard journey for multicultural theories to transfer into this disciplinary field. However, as noted in the empirical findings from this research, even as

these *ideological* critiques become more prominent within science teacher education research (limited as they are to address disability), their impact on graduate students' learning of both disability and difference more broadly is limited in their applicability for critical praxis, for reflection and action. With the empirical findings of this research as a guide, the data suggest that professors should interrogate the curricular choices that are infused within multicultural science education courses and study if and how they are effective, toward achieving goals that aid in the transfer of critically analyzing difference in relation to race, class, gender, and discourse to also include disability.

Courses such as this one, I argue, if not specifically designed to meet this goal (within the courses themselves and within the program's scope and sequence), may not attain critical praxis across all markers of difference—they will not help their students transfer ideological critique into critical reflection or transformative action. Given these findings, a new research agenda looking at disability and difference is warranted, both by those in multicultural education and science education. Without such a self-critique, disability will continue to remain in the proverbial realm of "separate but equal" from "pertinent issues in (science) education" due to the (intentional or not) segregation of disability—conceptually and disciplinarily—as separate from and not similar to issues that are emphasized in urban and multicultural science education research and practice. This task, indeed, will not be easy, but it is our charge as critical teacher educators when we seek to help others make sense of "the word and the world."

Appendix: Phenomenographic Interview Scenarios and Teacher Responses

Pre-course Phenomenographic Interview Prompts

Scenario 1: Mary P.1

"Mary consistently fails to retrieve important information from memory (e.g. their next class room), misplaces important papers or objects (e.g. worksheets given to them at the beginning of class are lost shortly afterwards), misinterprets the language and behavior of others (e.g. reacts defensively when any student or teacher talks to them or even accidentally touches them), and resists transitions from one activity to another (e.g. doesn't go back to their seat after group work when asked)."

Teacher Response to Scenario 1

I would talk with whoever the school specialist is because if it's not just a disorganized thing, if she is, in fact, thrown off behaviorally even by slight changes in my lesson, I would say that's not a pedagogical thing to deal with and I would want to make sure that someone has actually addressed her, like, 'what's going on'. See if anyone has any ideas of what's that about. I would probably go to guidance first. I would probably go to her

counselor and find out if there's some additional information I should know about her and potentially if there were additional information I should know or concerns I have about her behavior being abnormal classroom behavior, I might ask a special education person. But I would go to her counselor first to see if maybe I missed some documentation somewhere along the way.

Scenario 2: Gus P.1

"Gus frequently has uncontrollable behaviors varying from soft, personal noises to screaming episodes at school, often in the middle of your class."

Teacher Response to Scenario 2

I have had students in my class that do those types of things and most of the time I have simply tried to go on with the routine. Well it depends, if the person has Tourette's and those are parts of the ticks that you have to deal with, and unless it is truly disruptive, I would just go about my lesson and try not call attention to it and hope other students do not call attention to it. If, in fact, it's outbursts of screaming that do not seem like ticks but more like major eruptions then I would probably again, ask for additional support to find out what specifically that student I need to know if I do not. I am assuming I would already know enough information about my students to know where the source of that is coming from because if it is a simple issue of ticks and a medical diagnosis then I would do whatever is appropriate for that student. If it's actually outbursts that are behavioral and not related to something that is an 'outbursty' disorder, then I would address it with the counselor.

Scenario 3: Mary P.2

"The teacher finds out that the school counselor and school psychologist have labeled Mary 'emotionally unstable' and 'learning disabled'"

Teacher Response to Scenario 3

I would first of all try and get more specific information about what challenges she has to overcome whether it is mostly organizational, kind of executive challenges with keeping her on track. If, in fact, it's primarily those challenges to kind of organizing her day, organizing her files, organizing her notes, then I would try and work specifically on strategies to, you know, keep her notebook, keep her assignments, things like that on track in class and I would probably check in with her kind of throughout the class in subtle ways but check in with her 'did you get, did you write that down, did you get your, did you put your worksheet in your backpack, did you write in your homework book that you, that you have this to do tonight'. That kind of stuff and see if those more minor interventions are effective first and then kind of go from there. If she needs more one-on-one kind of time, more direction, I would kind of gradually set it up until I have scaffolded it to a level where she's more functional in class.

Scenario 4: Gus P.2

You observe other students mocking Gus's uncontrollable behaviors, especially during group work that consistently causes students within the group and outside Gus's group to get off task.

Teacher Response to Scenario 4

Whenever I see kids being disruptive or mocking other kids I do not address it as a group. I might, the first time, walk over to the group and say 'you know, listen, you are off task, this is what you need to do' but if it is a persistent behavior, if they are actually making fun of him, my personal strategy in terms of classroom management is to pull kids aside individually from the class because I find that they are much more uncomfortable having to address that behavior one-on-one with me then when they are in a group being silly. If I see kids giving other kids a hard time I will pull them aside first individually and methodically and if they, and typically that's as far as it goes because once they get called out on an individual level, that's like really uncomfortable as an adolescent, that typically takes care of it, but if I had to go beyond that then, in every school there's kind of procedures for next steps if a kid is actually harassing another kid, you are going to have procedures you need to follow but most of the time you can kind of nip it in the bud in class by calling their attention to the fact that you are watching and know what's going on in a subtle way. And if they do not take to subtly very well, which sometimes adolescents do not, I pull them aside one-on-one and tend to target who the group leader is first and see if that does not settle thing down and then if need be go to the other individuals involved. But, I would not make it an issue of the kid that's got the issue. Right? Because clearly, no adolescent, unless they have a real behavioral or medical issue wants to call that much attention to themselves in a negative way.

Post-course Phenomenographic Interview Prompts

Scenario 1: Mary P.1

"Mary consistently fails to retrieve important information from memory (e.g. their next class room), misplaces important papers or objects (e.g. worksheets given to them at the beginning of class are lost shortly afterwards), misinterprets the language and behavior of others (e.g. reacts defensively when any student or teacher talks to them or even accidentally touches them), and resists transitions from one activity to another (e.g. doesn't go back to their seat after group work when asked)."

Teacher Response to Scenario 1

First thing I would do is pull her aside and speak to her privately and figure out if there's something going on either with me or with some other student in the class. If that does not work, I would get her guidance counselor involved and the

guidance counselor would take it to the next level, probably counsel her a little bit, and then I would probably call her parents, call her house to see if anything is going on at home. If all that does not work, we'd probably have the parents come in, myself, the guidance counselor, and maybe the assistant principal and we would have a meeting to try to figure out what the issues are. If she's not a special education student, then that might be one of the issues that maybe she does need to be evaluated. And that's an official process but as time goes by you realize that that is the logical way to do it.

Scenario 2: Gus P.1

"Gus frequently has uncontrollable behaviors varying from soft, personal noises to screaming episodes at school, often in the middle of your class."

Teacher Response to Scenario 2

The first thing I would do is talk to the student privately and figure out what the issues are. If it's uncontrollable behavior, in terms of disrupting the class, I would also let the student know that if they do it again and they disrupt and stop the class, then I would have to get the dean's involved because they are preventing their peers from getting an education. If that does not work and disciplinary action does not work, then we would again get the guidance counselors and the parents involved. That's what we do.

Scenario 3: Mary P.2

The teacher finds out that the school counselor and school psychologist have labeled Mary "emotionally unstable" and "learning disabled."

Teacher Response to Scenario 3

Number one, if she's labeled emotionally unstable she would probably either be put in a self-contained special education class or an inclusive class, which is a class that has a general education teacher and a special education teacher, like a co-teaching class. The co-teacher and I (the special education teacher and I) would try to formulate a plan for her and differentiate the lessons based on that. So whatever lessons we are teaching that day the special education person would just kind of manipulate everything to make sure that we can get it to her, you know. In terms of the behavior, I would say that if they have diagnosed her and we know what her IEP says, then we would probably try to formulate some method of calming her down or figuring out some way to help her transition properly because she probably not going to respond like a normal student would.

Scenario 4: Gus P.2

You observe other students mocking Gus's uncontrollable behaviors, especially during group work that consistently causes students within the group and outside Gus's group to get off task.

Teacher Response to Scenario 4

If it is kids that are in his group I would re-assign him. When, in a situation like that, I think the teacher has to be hyperaware of the social interactions of every student in the classroom. And one of the things is that when we do grouping, you know, it's very purposeful. I would pick, in Gus's situation, I would pick the best performing student, the most well-behaved student to be his group member, to be his partner. Maybe I would break the groups down from 4 into just 2, you know, because sometimes I group of 4 does not work. In fact, a lot of times a group of 4 does not work, they just get off task. So I would pick the student in the room that's most well-behaved, and there's always, you know, at least one kid that is most well-behaved, and I would partner Gus with that particular student. Because the most well-behaved student is probably going to encourage him the most, give him the most praise, and help him the most. And when the other kids in the room see that, they are going to back off. They will, from experience, that's usually what happens, not all the time.

References

Allan, J. (2010). The sociology of disability and the struggle for inclusive education. *British Journal of Sociology of Education, 31*, 603–619.

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York: Oxford University Press.

Annamma, S. A., Connor, D., & Ferri, B. (2013). Dis/ability critical race studies (DisCrit): theorizing at the intersections of race and dis/ability. *Race Ethnicity and Education, 16*(1), 1–31.

Annamma, S., Morrison, D., & Jackson, D. (2014). Disproportionality fills in the gaps: connections between achievement, discipline and special education in the school-to-prison pipeline. *Berkeley Review of Education, 5*(1).

Armstrong, F., & Barton, L. (Eds.). (1999). *Disability, human rights and education*. Philadelphia, PA: Open University Press.

Armstrong, T. (2013). *Neurodiversity: discovering the extraordinary gifts of autism, ADHD, dyslexia, and other brain differences*. Philadelphia, PA: Da Capo Press.

Artiles, A. J., Kozleski, E. B., Trent, S. C., Osher, D., & Ortiz, A. (2010). Justifying and explaining disproportionality, 1968–2008: a critique of underlying views of culture. *Exceptional Children, 76*, 279–299.

Atwater, M. M., Russell, M., & Butler, M. (2013). *Multicultural science education: preparing teachers for equity and social justice*. New York: Springer.

Bargerhuff, M. E., Cowan, H., & Kirch, S. A. (2010). Working toward equitable opportunities for science students with disabilities: using professional development and technology. *Disability and Rehabilitation: Assistive Technology, 5*, 125–135.

Berge, M., & Ingerman, Å. (2017). Multiple theoretical lenses as an analytical strategy in researching group discussions. *Research in Science & Technological Education, 35*, 42–57.

Bianchini, J. A., & Solomon, E. M. (2003). Constructing views of science tied to issues of equity and diversity: A study of beginning science teachers. *Journal of Research in Science Teaching, 40*, 53–76.

Birks, M., & Mills, J. (2015). *Grounded theory: a practical guide*. Sage.

Boda, P. A. (2018). Exclusion from participation in science: confessions from an ally on the other side of the fence. In M. Koomen, S. Kahn, C. Atchison, & T. Wild (Eds.), *Toward inclusion of all learners through science teacher education*. Sense Publishing.

Bodine, A. (1975). Androcentrism in prescriptive grammar: singular 'they', sex-indefinite 'he', and 'he or she'. *Language in Society, 4*, 129–146.

Brantlinger, E. (1997). Using ideology: cases of nonrecognition of the politics of research and practice in special education. *Review of Educational Research, 67*, 425–459.

Broderick, A. (2010). Autism as enemy: metaphor and cultural politics. In Z. Leonardo (Ed.), *Handbook of cultural politics and education* (pp. 237–268). Rotterdam: Sense Publishers.

Broderick, A. A., & Ne'eman, A. (2008). Autism as metaphor: narrative and counter-narrative. *International Journal of Inclusive Education, 12*, 459–476.

Broderick, A., Reid, D. K., & Valle, J. W. (2006). Disability studies in education and the practical concerns of teachers. In S. Danforth & S. L. Gabel (Eds.), *Vital questions facing disability studies in education* (pp. 133–160). New York: Peter Lang.

Brusca-Vega, R., Alexander, J., & Kamin, C. (2014). In support of access and inclusion: joint professional development for science and special educators. *Global Education Review, 1*(4), 37–52.

Calabrese Barton, A. (2000). Crafting multicultural science education with preservice teachers through service-learning. *Journal of Curriculum Studies, 32*, 797–820.

Charmaz, K. (2014). *Constructing grounded theory* (2nd ed.). London: Sage.

Collins, K. M. (2013). *Ability profiling and school failure: one child's struggle to be seen as competent*. Routledge.

Cone, N. (2012). The effects of community-based service learning on preservice teachers' beliefs about the characteristics of effective science teachers of diverse students. *Journal of Science Teacher Education, 23*, 889–907.

Cosier, M., & Pearson, H. (2016). Can we talk? The underdeveloped dialogue between teacher education and disability studies. *SAGE Open, 6*(1) 2158244015626766.

Danforth, S., & Naraian, S. (2015). This new field of inclusive education: beginning a dialogue on conceptual foundations. *Intellectual and Developmental Disabilities, 53*(1), 70–85.

Davis, L. J. (2010). Constructing normalcy. In L. J. Davis (Ed.), *The disability studies reader* (3rd ed., pp. 3–16). London: Routledge.

Davis, L. J. (2014). *The end of normal: identity in a biocultural era*. Ann Arbor: University of Michigan Press.

Emdin, C. (2010). Affiliation and alienation: hip-hop, rap, and urban science education. *Journal of Curriculum Studies, 42*(1), 1–25.

Erevelles, N. (2000). Educating unruly bodies: critical pedagogy, disability studies, and thepolitics of schooling. *Educational Theory, 50*(1), 25–47.

Erevelles, N. (2011). *Disability and difference in global contexts: enabling a transformative body politic*. Springer.

Farnen, R. F., & Sunker, H. (Eds.). (2016). *The politics, sociology and economics of education: interdisciplinary and comparative perspectives*. Springer.

Feng, L., & Sass, T. R. (2013). What makes special-education teachers special? Teacher training and achievement of students with disabilities. *Economics of Education Review, 36*, 122–134.

Ferri, B., & Connor, D. (2005). Tools of exclusion: race, disability, and (re) segregated education. *Teachers College Record, 107*, 453–474.

Freeman, M. (2014). The hermeneutical aesthetics of thick description. *Qualitative Inquiry, 20*, 827–833.

Fram, S. M. (2013). The constant comparative analysis method outside of grounded theory. *Qualitative Report, 18*, 1–25.

Gomes, C. V., & Mensah, F. M. (2015). Sounding out science: using assistive technology for students with learning differences in middle school science classes. In M. J. Urban & D. A. Falvo (Eds.), Improving K-12 STEM education outcomes through technological integration (pp. 44–67). Hershey, PA: IGI Global.

Goodley, D., & Runswick-Cole, K. (2015). Big society? Disabled people with the label of learning disabilities and the queer (y) ing of civil society. *Scandinavian Journal of Disability Research, 17*(1), 1–13.

Herndon, A. (2011). Disparate, but disabled: fat embodiment and disability studies. In K. Q. Hall (Ed.), *Feminist disability studies* (pp. 245–262). Bloomington, IN: Indiana University Press.

Heshusius, L. (1989). The Newtonian mechanistic paradigm, special education, and contours of alternatives: an overview. *Journal of Learning Disabilities, 22*, 403–415.

Hollingsworth Koomen, M. H., Kahn, S., Atchison, C. L., & Wild, T. A. (Eds.). (2018). *Towards inclusion of all learners through science teacher education*. Leiden: Brill.

Kahn, S., & Lewis, A. R. (2014). Survey on teaching science to K-12 students with disabilities: teacher preparedness and attitudes. *Journal of Science Teacher Education, 25*, 885–910.

King-Sears, M. E., Brawand, A. E., Jenkins, M. C., & Preston-Smith, S. (2014). Co-teaching perspectives from secondary science co-teachers and their students with disabilities. *Journal of Science Teacher Education, 25*, 651–680.

Kirch, S. A., Bargerhuff, M. E., Cowan, H., & Wheatly, M. (2007). Reflections of educators in pursuit of inclusive science classrooms. *Journal of Science Teacher Education, 18*, 663–692.

Ladson-Billings, G., & Tate, W. F. (1995). Toward a critical race theory of education. *Teachers College Record, 97*(1), 47–68.

LaScotte, D. K. (2016). Singular they: an empirical study of generic pronoun use. *American Speech, 91*(1), 62–80.

Lee, H., Chang, H., Choi, K., Kim, S. W., & Zeidler, D. L. (2012). Developing character and values for global citizens: analysis of pre-service science teachers' moral reasoning on socioscientific issues. *International Journal of Science Education, 34*, 925–953.

Leonardo, Z., & Broderick, A. (2011). Smartness as property: a critical exploration of intersections between whiteness and disability studies. *Teachers College Record, 113*, 2206–2232.

Linton, S. (1998). *Claiming disability: knowledge and identity*. New York: NYU Press.

Marton, F. (1981). Phenomenography—describing conceptions of the world around us. *Instructional Science, 10*(2), 177–200.

Marton, F., & Pang, M. F. (2008). The idea of phenomenography and the pedagogy of conceptual change. In S. Vosniadou (Ed.), *International handbook of research on conceptual change* (pp. 533–559). New York: Routledge.

Mastropieri, M. A., Scruggs, T. E., Norland, J. J., Berkeley, S., McDuffie, K., Tornquist, E. H., & Connors, N. (2006). Differentiated curriculum enhancement in inclusive middle school science effects on classroom and high-stakes tests. *The Journal of Special Education, 40*, 130–137.

McDaniel, P., Devi, B., Crockett, D., & Atwater, M. M. (1995). Secondary preservice science teachers ideas about culture, ethnicity, and learning of marginalized students. ED 417950.

McDermott, R., & Varenne, H. (1995). Culture as disability. *Anthropology & Education Quarterly, 26*, 324–348.

McGinnis, J. R. (2013). Teaching science to learners with special needs. *Theory Into Practice, 52*, 43–50.

Mensah, F. M. (2011). A case for culturally relevant teaching in science education and lessons learned for teacher education. *The Journal of Negro Education, 80*, 296–309.

Miller, P. (2016). 'White sanction', institutional, group and individual interaction in the promotion and progression of black and minority ethnic academics and teachers in England. *Power and Education, 8*, 205–221.

Moin, L. J., Magiera, K., & Zigmond, N. (2009). Instructional activities and group work in the US inclusive high school co-taught science class. *International Journal of Science and Mathematics Education, 7*, 677–697.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

NGSS Lead States. (2013). *Next generation science standards: for states, by states*. Washington, DC: The National Academies Press.

Nielsen, K. E. (2012). A disability history of the United States (Vol. 2). Boston: Beacon Press.

Nunes, T. (1995). Cultural practices and the conception of individual differences: theoretical and empirical considerations. *New Directions for Child and Adolescent Development, 1995*, 91–103.

Patton, J. M. (1998). The disproportionate representation of African Americans in special education: looking behind the curtain for understanding and solutions. *The Journal of Special Education, 32*(1), 25–31.

Preston-Smith, S. (2015). A comparison of perceptions from high school students with and without disabilities about their science co-teaching experiences (Doctoral dissertation, George Mason University). Retrieved from ProQuest Dissertations and Theses database. (UMI No. 10031794).

Pringle, R. M., & McLaughlin, C. A. (2014). Preparing science teachers for diversity: integrating the contributions of scientists from underrepresented groups in the middle school science curriculum. In M. Atwater, M. Russell, & M. B. Butler (Eds.), *Multicultural science education* (pp. 193–208). Amsterdam: Springer.

Reid, D. K., & Knight, M. G. (2006). Disability justifies exclusion of minority students: a critical history grounded in disability studies. *Educational Researcher, 35*(6), 18–23.

Rieser, R. (2012a). The struggle for disability equality. In M. Cole (Ed.), *Education, equality and human rights: issues of gender, 'race,' sexuality, disability and social class* (pp. 159–189). New York: Routledge.

Rieser, R. (2012b). Inclusive education: a human right. In M. Cole (Ed.), *Education, equality and human rights: issues of gender, 'race,' sexuality, disability and social class* (pp. 190–216). New York: Routledge.

Rivera Maulucci, M. S. (2013). Emotions and positional identity in becoming a social justice science teacher: Nicole's story. *Journal of Research in Science Teaching, 50*, 453–478.

Rivera Maulucci, M. S., & Mensah, F. M. (2015). Naming ourselves and others. *Journal of Research in Science Teaching, 52*, 1–5.

Rudolph, J. L. (2014). Dewey's "science as method" a century later: reviving science education for civic ends. *American Educational Research Journal, 51*, 1056–1083.

Seiler, G. (2013). New metaphors about culture: implications for research in science teacher preparation. *Journal of Research in Science Teaching, 50*, 104–121.

Shakespeare, T. (2013). *Disability rights and wrongs revisited*. New York: Routledge.

Slee, R. (2010). *The irregular school: exclusion, schooling and inclusive education*. London: Taylor & Francis.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: procedures and techniques for developing grounded theory*. Thousand Oaks, CA: Sage.

Suriel, R. L., & Atwater, M. M. (2012). From the contribution to the action approach: white teachers' experiences influencing the development of multicultural science curricula. *Journal of Research in Science Teaching, 49*, 1271–1295.

Therrien, W. J., Taylor, J. C., Hosp, J. L., Kaldenberg, E. R., & Gorsh, J. (2011). Science instruction for students with learning disabilities: a meta-analysis. *Learning Disabilities Research & Practice, 26*, 188–203.

Tight, M. (2016). Phenomenography: The development and application of an innovative research design in higher education research. *International Journal of Social Research Methodology, 19*, 319–338.

Tight, M. (2018). Higher education research: The developing field. Bloomsbury Publishing

Titchkosky, T. (2011). *The question of access: disability, space, meaning*. Toronto: University of Toronto Press.

Waitoller, F. R., & Artiles, A. J. (2013). A decade of professional development research for inclusive education: a critical review and notes for a research program. *Review of Educational Research, 83*, 319–356.

Waitoller, F. R., & King Thorius, K. A. (2016). Cross-pollinating culturally sustaining pedagogy and universal design for learning: toward an inclusive pedagogy that accounts for dis/ability. *Harvard Educational Review, 86*, 366–389.

Wan, Z. H., Wong, S. L., & Zhan, Y. (2013). Teaching nature of science to preservice science teachers: a phenomenographic study of Chinese teacher educators' conceptions. *Science & Education, 22*, 2593–2619.

Woodcock, S., & Hardy, I. (2017). Probing and problematizing teacher professional development for inclusion. *International Journal of Educational Research, 83*, 43–54.

World Health Organization. (2011). World report on disability. Retrieved from: http://library.bsl .org. au/jspui/handle/1/2587.

Zeidler, D. L., Sadler, T. D., Simmons, M. L., & Howes, E. V. (2005). Beyond STS: a research- based framework for socioscientific issues education. *Science Education, 89*, 357–377.