DIS/ABILITY AND MATHEMATICS: THEORIZING THE RESEARCH DIVIDE BETWEEN SPECIAL EDUCATION AND MATHEMATICS

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Based on an analysis of 408 mathematics research articles published in 2013, this presentation theorizes the current divide between research in mathematics education and special education using Disability Studies in Mathematics Education. For those without disabilities, mathematical learning was understood primarily through constructivist, sociocultural, and sociopolitical perspectives, the research was both quantitative and qualitative, and almost 50% of the research was focused on the role of the teacher in learning. For those with disabilities, mathematical learning was understood primarily from medical and behavioral perspectives. This research was predominantly quantitative, and rarely focused on the teacher. We contend that this divide constructs and reifies the notion that there are two categories of mathematics learners who need different kinds of mathematics.

Keywords: Equity and Diversity, Learning Theory, Research Methods

Introduction

Students with disabilities are offered fewer opportunities to engage in meaningful mathematics, as special education classrooms and curriculum are focused on procedural rather than conceptual instruction (Jackson & Neel, 2006). Based on a content analysis of current research in both mathematics education and special education mathematics, we contend that disparities in access are influenced by a research divide between these two fields, which differ in the epistemologies, methodologies, and pedagogies used to understand learners. The research divide constructs and reifies what many consider to be a "common sense" assumption: children with and without disabilities are different, and should be educated differently in mathematics.

While this paper/presentation will describe that research divide using data from a research content analysis, our focus is to theorize that divide. Theory matters, because for some, including perhaps many at this conference, this divide may seem unremarkable. After all, disability is a medical condition, and mathematics education researchers are not experts in disability. Even in the rhetoric of equity in mathematics education research for marginalized student groups, students with disabilities are often not part of such conversations (Tan, 2014). We believe that Disability Studies can illuminate the historical reasons for this divide and challenge such borders moving forward. The conference theme of Questioning Borders is a generative location for our analysis, as we seek to deepen our understanding not only of the borders between these two academic fields, but the areas of intersection as well.

Conceptual Framework

Disability Studies in Education

Activists with disabilities pioneered the academic field of Disability Studies, advocating replacement of the medical model of disability with the social model (Union of Physically Impaired Against Segregation [UPIAS], 1975). While individuals may have cognitive or physical differences, disability is created through society's response to these differences. As Siebers (2008) writes, "the medical model defines disability as an individual defect lodged in the person, a defect that must be cured or eliminated if the person is to achieve full capacity as a human being" (p. 3). In contrast, Disability Studies "defines disability not as an individual defect but as the product of social injustice, one that requires not the cure or elimination of the defective person but significant changes in the

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social and built environment" (p. 4). The response to difference is not to seek to cure it in the affected individual, but to understand how unjust social systems create or exacerbate differences. Applied to schools, Disability Studies in Education (DSE) examines disability in schools as a social construction that results in social exclusion and oppression (Gabel, 2002).

Disability Studies in Mathematics Education (DSME) (Tan, 2014) reimagines the structures and processes of teaching and learning mathematics. Students with disabilities (and all students) are representative of the diversity of human experiences for which all educational environments should be designed. DSME also draws from critical mathematics education (CME) perspectives. CME is concerned with the social and political aspects of the learning of mathematics and how students and teachers operate in a social system rife with hegemonic power (Gutiérrez, 2002). CME aims to broadly (1) develop within individuals a political awareness of individual's position in a system (e.g., classroom, school, or community), and (2) motivate individuals to enact change toward advancing social justice (Powell & Brantlinger, 2008). DSME troubles conventional mathematics research by involving students with disabilities and by surfacing and questioning power differentials. This process includes challenging "hegemonic narratives about who can do mathematics and to reconstruct the role of mathematics in the struggle to empower learners whose mathematical powers have been underdeveloped" (Powell & Brantlinger, 2008, p. 425). In utilizing DSME, action towards more just practices is led first and foremost by students with disabilities where their lived experiences and voices are privileged in the conversation. Additionally, we situate our analysis within Dis/Crit, which highlights how race and disability intersect (Annamma, Connor, & Ferri, 2013).

Historical Roots of Mathematics Education

Mathematics education has been influenced by (and has influenced) larger epistemological stances about learning and learners such as behaviorism, information processing, constructivism, and sociocultural theory (Woodward, 2004). Gutiérrez (2013) has called for mathematics education to address learning from a sociopolitical perspective as well, to better understand how larger social forces, power and positioning affect not only learning, but access to learning. We found that constructivist and sociocultural approaches to learning currently dominated research in mathematics education. In general, constructivist theories of learning understand individual learners as active participants in constructing knowledge through experience and reflection (Draper, 2002); sociocultural theory expands analysis of learning to the product of interactions between two or more people (Lerman, 2000). Learning is situated in contexts, and mediated by tools that include mathematical discourse.

Historical Roots of Special Education

Special education philosophy and research have historical roots in psychology and medicine guided by behaviorism and positivism orientations to develop and test interventions for students with disabilities (Paul, French, & Cranston-Gingras, 2002). Paul and colleagues noted that despite advancements and evolution in social science perspectives, special education researchers have maintained a strong commitment to a positivist epistemology. Mathematics research in special education continues to be heavily influenced by behaviorist theories of learning such as direct instruction (Woodward, 2004).

In the field of special education, evidence-based practices must include experimental control (Cook, Tankersley, Cook, & Landrum, 2015), significantly reducing the kinds of possible research that could influence teaching practice. Subscribing to such standards of what constitutes research evidence-based practices means only quantitative methods are valid. Research designs involving students with disabilities tend to focus on evaluating instructional practices on children's learning with limited focus on teachers' pedagogical understanding and curriculum design (e.g. Griffin, League, Griffin, & Bae, 2013) and limited focus on how students construct mathematical learning.

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Direct instruction in mathematics is widely endorsed and qualify as being evidence-based (Gersten et. al, 2009). Hence, researchers grounded in conventional special education epistemologies who desire to advance knowledge in their field are strongly pulled in the direction of the "evidence." Teacher directed and explicit instruction represents mathematical knowledge that must be transmitted from "knowers" and reifies acquiescence to societal power structures (Charlton, 1998). Thus, the prevalent and long-standing stance of who benefits and who does not benefit from certain mathematics pedagogies establishes and is established by omnipresent borders across societal structures that influence research and practice restricting what is possible for students with disabilities.

Methods

In order to understand the present state of this research divide, we conducted a content analysis of research articles published in 2013 that focused on mathematics and PK-12 education (Lambert 2015a; Lambert & Tan, 2016). Our research question asked how research on mathematical learning of children with and without disabilities differed in terms of academic fields, methodologies, mathematics content, and participants. Additional information on methodologies and findings can be found in previous publications.

We limited the sample to mathematics education research articles published in peer-reviewed journals in English in 2013. We excluded research that focused exclusively on mathematics at the undergraduate level, unless the participants were pre-service teachers. We found articles through searches of educational databases (ERIC, JSTOR, & PsychINFO) looking for descriptors and keywords of mathematics, math, and numeracy. We did a hand search through all journals mentioned in an analysis of equity in research published by Lubienski and Bowen (2000). The resulting data set was 408 articles. In the first stage of research, we coded based on the title, abstract and keywords for each article. We coded for academic field of the journal, methodology of article, participant focus, equity groups mentioned (such as race or disability), mathematical content focus, and pedagogy. Some articles did not present enough information in the title, abstract or keywords for us to code, particularly in methodology and pedagogy. In some categories, it was possible to combine more than one content area or pedagogy. Inter-rater reliability of coding was 97.3%. In the second stage of research, we looked more closely at two subsets of the data: (a) the articles that included disability (n=42) and (b) the articles that focused on problem solving (n=45). We read these articles in their entirety, coding again if necessary. Our study has several limitations. We only included research published in English. While this iteration only included one year, we are beginning a second round of coding that will include 2013-2015. We were not always able to determine coding from the title, abstract or keywords.

Findings

Of the entire set of articles (408), 42 included disability, or 10.3% of the sample. Much of the following data compares the set of articles that included disability (42) to the set of articles that did not include disability (366). We do not report on all aspects of our findings, focusing here on academic field, methodology, participant focus and pedagogy.

Academic Field. We found that mathematics research on students with disabilities was overwhelmingly published in special education or psychology journals, with very little included in mathematics education journals. Articles that did not include disability were primarily published in mathematics education journals (68.3%). Only 8.5% of those articles were published in special education or psychology journals. 90.5% of articles that included disability were published in special education or psychology journals. Mathematics education journals only published 2 articles that included disability in 2013.

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Methodology and Participants. Research on the mathematical learning of students with disabilities was predominantly quantitative (83.3%), with only 9.5% qualitative. In contrast, research on the mathematical learning of students without disabilities was more evenly distributed: 32.8% was quantitative and 40.2% was qualitative.

For each article, we determined whether the unit of analysis was learners in preschool, elementary school, middle school, high school or teachers. Research on the learning of students with disabilities was focused on younger learners, with over half of the research on elementary-aged students, while research on learning of students without disabilities was more evenly spaced across ages. For articles that did not focus on disability, the most frequently researched participant category was teachers (48.6%). In contrast, only 11.9% of articles that focused on learners with disabilities focused on teachers.

Disability is a highly diverse category, not only racially and culturally, but in wide variety of differences that fall under the umbrella of disability. Research on mathematics learning did not reflect that diversity, as most articles about disability and mathematics focused on one category: students with mathematical learning disabilities (71.3%). Of those articles, 40% focused not on learning, but on diagnosis. A very limited sample of people with disabilities was included in mathematical research at all.

Pedagogy. Coding the articles for pedagogy was a critical part of our investigation since we were interested in whether or not students with disabilities were understood differently in the research literature. However, coding for pedagogy was complex. Following Woodward (2004), we first identified Behaviorist, Information Processing, Constructivist and Sociocultural as theories of pedagogy that have influenced mathematics and special education, using his description of the differences between these categories as coding indicators. We added two additional categories: (a) Sociopolitical/Critical (Gutiérrez, 2013) to capture an emerging focus in mathematics education on analysis of wider contexts and processes that affect classrooms and learning, and (b) Medical. We added the category of medical because we found a significant number of research articles that understood learning as mediated or controlled by psychometrics alone. Articles could be coded for more than one pedagogical perspective. Additional information on how we coded for these categories will be available at the session.

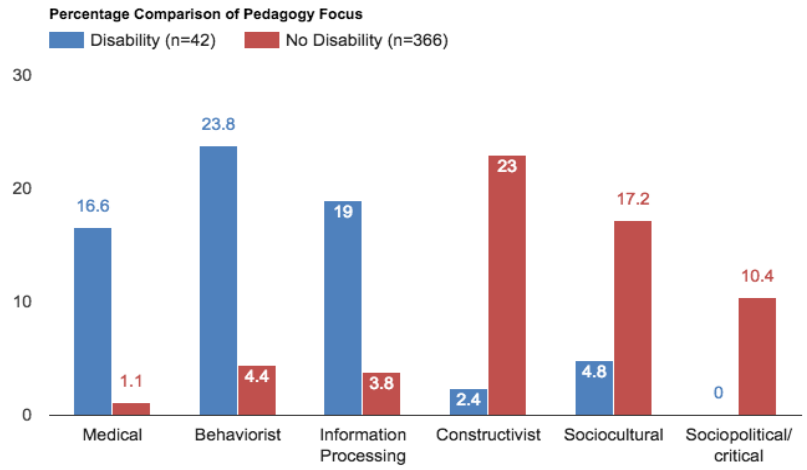

Figure 1. Percentage of Articles by Pedagogical Focus.

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Figure 1 suggests that learners with disabilities and those without are conceptualized differently in mathematical research. We recognize the limitations of this particular analysis, particularly that we determined pedagogy through the title, abstract, and keywords alone, which meant that we did not assign a code to all articles. However, we found similar percentages in this analysis of all articles, and a follow up analysis of the full-texts of all articles that focused on problem-solving for both learners with and without disabilities.

Discussion

Based on this analysis of research published in 2013, there was significant differences between mathematics educational research focused on learners with disabilities, and that which was focused on those without disabilities. For those with disabilities, mathematical learning was understood primarily from medical, behavioral and information processing perspectives, the research was predominantly quantitative, and rarely focused on the teacher. For those without disabilities, mathematical learning was understood primarily through constructivist, sociocultural, and sociopolitical perspectives, the research was both quantitative and qualitative, and almost 50% of the research was focused on the role of the teacher in learning.

How might this matter? One way to understand the impact was to look closer at one content focus. In the articles focused on problem solving, most research articles including students with disabilities focused on "word problems," while for those without disabilities, "problem solving" was more common. Much of the research in word problem solving for students with disabilities used a schema-based approach, which builds at least partially on constructivist research on how children approach different problem types (Carpenter et al., 1999). Articles in our sample, however, reformulated that research to better fit a behaviorist model of both learning and research. Children in these studies were given "explicit instruction" on the problem types in a scripted intervention. Jitendra et al. (2013) made a clear distinction between the two pedagogies, "Standards-based instruction is characterized by an inquiry-based, student-directed approach, whereas SBI [Schema Based Instruction] incorporates an explicit, teacher-mediated approach" (p. 257). We do not intend to devalue particular research methodologies or pedagogies, rather we seek to question why certain methodologies are used for certain groups almost exclusively.

Analyzing the research published on problem solving for learners without disabilities, we found eight studies of problem posing, which was defined as a process in which students used their experiences to "construct personal interpretations of concrete situations and from these situations formulate meaningful (i.e., non-trivial) mathematical problems" (Harpen, & Presmeg, 2013, p. 119). This article, along with two others in a special issue on problem posing in our sample, made explicit claims about the connection between problem posing, creativity, and mathematical giftedness. Do articles that seek to understand the relationship between problem posing and mathematical ability further deny access to those who are not currently seen as mathematically able to make sense of their worlds using mathematics.

We argue that this research divide in methodologies and pedagogy continually reinscribes an assumption that students with disabilities are a completely different kind of learner. Learners with disabilities are understood through a medical model that seeks to identify psychometric deficits that can inform remediation. These remediations are typically designed through a behaviorist lens, focusing on simplifying mathematics by breaking mathematics into tasks, teaching students procedures to solve word problems. Policy initiatives such as Response to Intervention (RTI) ask that interventions be evidence-based, yet the definition of evidence privileges particular quantitative methodologies.

In these 2013 articles, however, we have two examples of research that challenge these borders. One article from a constructivist perspective focused on using artifacts such as grocery store flyers to develop students' problem posing (Bonnoto, 2013). This article did not create a distinction between

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ability and mathematical creativity, and found that children with histories as underachievers were able to engage deeply in problem posing when artifacts were relevant to their lives. All children were expected to make mathematical meaning as long as they could connect their own lived experience. Bonnoto (2013) rejects understanding mathematical creativity as incommensurate with disability. In another article from the sample, Heyd-Metzuyanim (2013) analyzed the co-construction of learning disabilities in mathematics through interaction between a mathematics teacher and a student. As in Lambert (2015b), disability was contextual, produced through interaction. These studies suggest connections between sociocultural analysis and disability studies that should be further explored.

Implications

As mathematics education researchers, we must honor our long-standing commitment to equity for marginalized groups of students. Both activists and academics who identify with the disability rights movement increasingly demand that diversity include disability (e.g. Siebers, 2008). DSME and Dis/Crit provide mathematics education researchers theoretical frameworks that shift perception of disability as a deficit toward viewing disability as a difference. We seek a deeper analysis of disability in mathematics through these lenses, including analysis of how disability intersects with race and genders (Annamma, Connor, & Ferri, 2013).

We call for including disability, not only to improve the lives of those with disability, but to improve mathematics education. As de Freitas and Sinclair (2014) suggest, mathematics education could benefit from more deeply considering the perspective of learners with disabilities, as exploring the mathematical world through these diverse learners can help us better understanding the relationship between embodiment and knowing in mathematics.

We believe that shifting mathematics research towards learners with disabilities will allow our field to rethink assumptions that privilege the mythical "normal" mathematical learner. The borders between these academic fields police a distinction between students without disabilities and those with disabilities, who are not recognized as competent and able mathematics learners. These learners are separated from inquiry and problem-solving pedagogy and curriculum, which can affect not only learning, but identity development, or who students with disabilities are learning to become in mathematics (Lambert, 2015b). Non-disabled peers also stand to academically and socially benefit as classrooms shift to recognize and develop a wider range of mathematical competencies.

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