Haunted by Math: The Impact of Policy and Practice on Students with Math Learning Disabilities in the Transition to Post-Secondary Education in Mumbai, India

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Abstract

Only six states in India currently identify learning disabilities as a category of disability. This article highlights the challenges students with math learning disabilities face in their transition from secondary school to higher secondary education and Bachelor of Commerce degree programs in the state of Maharashtra. While the current educational policy aims to help students with learning disabilities participate in the general education curriculum and pass the 10th standard secondary exam, the implementation of curricular modifications has repercussions in post-secondary settings when students lack the math content knowledge for a required math course in their Bachelor's degree program. This qualitative study highlights the transitional experiences of secondary and post-secondary individuals with math learning disabilities in Mumbai through interviews with students, college administrators, and lecturers; and a document review of Maharashtra's special education policies. The results suggest that current special education policies and college practices in Mumbai do not prepare students with math learning disabilities with the math knowledge that they need to succeed in post-secondary mathematics courses. Current higher secondary and post-secondary interventions in Mumbai are reviewed and implications for policy and practice for all levels of education are discussed.

Keywords

Math learning disability; dyscalculia; intervention; higher secondary; post-secondary; transition; primary math; elementary education; policy; India

Introduction

From a young age, Vinod (pseudonym) was interested in pursuing a career in business. Before taking his 10th standard exam to complete secondary school, he underwent an educational assessment and was diagnosed with learning disabilities (LD). He majored in commerce at a junior college which did not require a mathematics course (11th and 12th standard) in Mumbai. After completing junior college, Vinod enrolled for a bachelor's degree in commerce at a Mumbai degree college. In the first year, he had to take the mandatory mathematical and statistical techniques course. Vinod recounts his transitional experience:

> *It was a shock for me to take math again. I was weak in math to begin with, and then it was like I wasn't practicing hard enough or something. People said that*

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 Citation: Eichhorn, Melinda Sue (2016). Haunted by math: The impact of policy and practice on students with math learning disabilities in the transition to post-secondary education in Mumbai, India.. *Global Education Review, 3*(3). 75-93

I wasn't studying and I was not paying attention. But I was. It was frustrating. I started not to care. I left it (math); I was like "screw it." You are stressed when you are behind. No one wants to be behind everyone else.

(Vinod, personal communication, April 25, 2013)

Vinod failed the mathematical and statistical techniques course and eventually moved to another degree college (which does not require a math course) to pursue a Bachelor of Arts degree because his previous college only offered commerce and science degrees. Once he finished his Bachelor of Arts degree, he went to London to study media. He currently lives in Mumbai and is a general manager of products and marketing for a multi-channel entertainment network on YouTube (Vinod, personal communication, April 25, 2013).

Vinod's case is similar that of other students with learning disabilities in post-secondary education in Mumbai. Students with math learning disabilities (MLD) reported having to study harder and longer than their peers, just to scrape by, or as in Vinod's case, taking another path in order to reach their goal.

If students with MLD have fallen behind in mathematics in primary school, and then discover they have a learning disability when they enter secondary school, what are the repercussions they face in mathematics as they transition to post-secondary education and into a career? Students with MLD eventually do learn basic math procedures in primary school, but are one to several years behind their typically achieving peers (Geary, Hoard, Nugent, & Bailey, 2012). If this gap widens during secondary school, what are the implications for students who opt out of math courses for 2-4 years, who must take required math courses in post-secondary education?

This exploratory study is a first step in beginning to understand the way special education policy, and the current education system in India, impacts students' math abilities and their post-secondary education options due to their math proficiency in secondary school. This qualitative study used interviews, observations, and a document analysis to examine the Indian education system's lack of options for students who may want to pursue a degree in commerce, but are unable to do so because of counsel from secondary counselors or college requirements. Because only one type math course is offered as a part of the degree program, students lack options and may have to take extra private classes to keep up with their peers.

This study originated from a desire of the Maharashtra Dyslexia Association (MDA) to correct the discrepancy between students with MLD and their typically achieving peers in post-secondary education, because many students in their network were experiencing severe difficulties in mathematics during their post-secondary transition, especially in Bachelor of Commerce degree programs. To this end, this study addresses two main questions:

- What accommodations and supports do students with MLD use during their secondary and post-secondary education?
- How do college math policies and procedures affect students with MLD?

Overall, very little is known about students with MLD in India. Only one peer-reviewed article has examined the identification and classification of MLD in India, and it focused on primary students in the city of Mysore (Ramaa & Gowramma, 2002). There are a few other studies on learning disabilities in India, but these have focused on three types of learning disabilities (reading, writing, and math) together (Mogasale et al., 2012; Kulkarni et al., 2006; Karande et al., 2007, 2009). Although, in general, awareness of learning disabilities has increased in India over the past decade, there is still a general lack of awareness in schools (Karande, Sholapurwala, & Kulkarni, 2011; Karande, Mahajan, & Kulkarni, 2009). Some studies have recommended increased training for primary school teachers, early screening

tools, and more remedial education and special educators in primary and secondary schools (Karande, Sholapurwala, & Kulkarni, 2011; Karande, Doshi, Thadhani & Sholapurwala, 2013; Unni, 2012). Other studies have examined the lack of uniformity for learning disability diagnosis, and attempted to create alternative, simplified procedures, especially for students in vernacular-medium schools (Mogasale et al., 2012, Ramaa & Gowramma, 2002). However, most researchers do not take an in-depth look at math learning disabilities and none have examined the impact of policy and transitional issues in post-secondary education. Overall, the peer-reviewed literature on students with math learning disabilities in India is sparse.

Background

Defining Math Learning Disabilities

Students and adults with mathematics learning disability (MLD) are individuals that perform at a level substantially below their peers in mathematics, whose poor performance cannot be explained by any deficit in vision, speech, hearing, or intelligence. It is, in a sense, "unexpected underachievement" (Fletcher, Lyon, Fuchs, & Barnes, 2007, p. 27; American Psychiatric Association, 2013a, 2013b). Learning disabilities, which can occur in the areas of reading, mathematics, and/or written expression, contribute to students experiencing low self-esteem due to their poor academic performance and negative school reports (Fletcher et al., 2007; Gibson & Kendall, 2010; Lahane et al., 2013).

Currently, there is no universal definition of math learning disability (MLD) (Mazzocco & Myers, 2003). Although there has been almost a century of efforts, problems with the definition of math "learning disability" still exist. There is still a lack of understanding as to which criteria classify MLD so that it is reliable and valid (Fletcher et al., 2007). According to the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), the definition of math learning disability was a severe discrepancy (in some cases, more than two standard deviations) between a student's achievement in math and his/her age, schooling, and level of intelligence (IQ), and significant impairment in real-life activities that require math (APA, 2004; Geary, 2011; Sparks & Lovett, 2009; Allsopp, 2008). In the DSM-5, the IQ-achievement discrepancy requirement was eliminated and now the criteria for MLD involves evidence of symptom persistence for at least six months, despite extra help or targeted instruction (Tannock, 2014).

The DSM-5 acknowledges that learning deficits in mathematics are sometimes referred to as "dyscalculia" internationally (American Psychiatric Association, 2013a). Although the term, "dyscalculia," is used extensively in India, the term "math learning disability" will be used throughout this paper in order to better reflect a wide range of difficulties in mathematics, rather than focusing on calculation and arithmetic. In the literature, these terms are occasionally used synonymously (Butterworth, 2002; Williams, 2012).

In the field of MLD, there is disagreement as to whether MLD is caused solely by a core deficit in number sense/numerosity, as Butterworth (2005) posits, or due to a more general deficit in working memory or spatial cognition, which is the view of Geary et al. (2004) (as cited by Pennington, 2009). These two theoretical perspectives or orientations are still under debate, which make it difficult to define MLD (Fletcher et al., 2007).

Overall, children with MLD typically have a low start point on math achievement tests and show slow growth as compared to typically achieving peers (Geary, Hoard, Nugent, & Bailey, 2012). Lewis (2014) posits that students with MLD process or manipulate numbers in an atypical way due to differences in cognitive abilities. If these early math deficits, or differences, are remediated immediately, then students may not fall further behind their peers in math skills (Desoete et al., 2009). Addressing slow growth usually requires several

simultaneous types of remedial and instructional interventions (Geary, Hoard, Nugent, & Bailey, 2012). Interventions may be particularly effective if they are early (Dowker, 2005; Nelson & Sheridan, 2011).

Math Learning Disabilities in India

The national government of India does not currently recognize "learning disability" or any type of mathematics learning disorder, so there are no uniform guidelines for assessment, diagnosis, or certification. There is also extreme lack of awareness of learning disabilities among teachers (Unni, 2012). The educational boards in only six states consider learning disability (LD) as a category of disability (Goa, Gujarat, Karnataka, Kerala, Maharashtra, and Tamil Nadu) (Al-Yagon et al., 2013). Currently, students in Mumbai, Maharashtra receive a learning disability certificate from one of three government hospitals (Nair, Sion, and King Edward Memorial), or a recognized testing center, such as the Maharashtra Dyslexia Association (MDA). Students are typically diagnosed as having a learning disability based on the IQ-achievement discrepancy model (DSM-IV), but organizations in India are moving towards the DSM-5 criteria (M. Khan, personal communication, September 30, 2014). The terms "dyslexia," "dysgraphia," and "dyscalculia" are used synonymously for reading, writing, and math learning disabilities on the LD certificates in Maharashtra.

The occurrence of MLD in India is believed to be 5.5% to 6% among primary school children (Ramaa & Gowramma, 2002; Karande & Kulkarni, 2005). Due to the lack of uniformity in diagnosing learning disabilities, it is difficult to present an accurate picture of the number of students with MLD in the country. There are no standardized measures available for students who study in vernacular-medium schools (where the language of instruction is not English) (Al-Yagon, et al., 2013). Also, there is a debate as to whether standardized tests used in Western countries, such as the Woodcock-Johnson Tests of Cognitive Abilities or the Wechsler Intelligence Scale for Children (WISC) are culturally appropriate for Indian students who are studying in English-medium schools (Al-Yagon et al., 2013). The WISC does have an Indian adaptation test available for IQ, yet there are no standardized measures for academic achievement (M. Khan, personal communication, March 6, 2014). At this point, centers like the Maharashtra Dyslexia Association (MDA) use the academic achievement battery standardized on the U.S. and U.K. populations, but place emphasis on "error analysis and give a qualitative report with rationales for diagnosis and accommodations" (M. Khan, personal communication, March 6, 2014). The LD clinics at Nair and Sion hospitals also use tests that are not standardized for the Indian population, while KEM hospital uses curriculum-based tests for students in English-medium schools (Al-Yagon et al., 2013). More research needs to be done in order to develop curriculum-based tests for diagnosis of learning disabilities in India, especially in the 21 official Indian languages, apart from English (Al-Yagon et al., 2013).

India, as a nation, is incredibly diverse. With 28 states and 7 union territories, there are 30 languages spoken by more than one million people. There are additional languages and dialects as well. Overall, it is very difficult to standardize a uniform assessment of learning, let alone of learning disabilities in India (Unni, 2012).

In India, education is a responsibility of both the national and state governments. The national government performs an advisory role, but allows states the freedom to adapt or adopt policy and curricula, since the context varies considerably from state to state (M. Jain & K. Sharma, personal communication, July 5, 2013). Elementary education in India is defined by the Ministry of Human Resource Development (MHRD) as schooling up to 8th standard, or ages 6–14 (MHRD Department of School Education and Literacy, 2015a). Secondary education is for

students between the ages of 14 and 18, which corresponds to 9th–12th standard (MHRD Department of School Education and Literacy, 2015b). In the state of Maharashtra, however, elementary education is further divided into primary (1st–5th standards) and upper primary (6th– 8th standard). Secondary education includes 9th and 10th standards, while 11th and 12th standards are known as higher secondary or senior secondary school (Maharashtra Prathamik Shikshan Parishad, 2015). Higher secondary schools are often called junior colleges in Mumbai. Since this study took place in Maharashtra, I will refer to higher secondary education as coursework following 10th standard and post-secondary education as all education following the 12th standard.

Each school and college in India is associated with a Board, or curriculum, such as the Indian Certificate of Secondary Education (ICSE) Board, the Central Board of Secondary Education (CBSE) Board, or a state Board. In Maharashtra, the state Board is the Secondary School Certificate (SSC) Board for primary and secondary schools, while the higher secondary Board is the Higher Secondary Certificate (HSC) Board. Depending on the Board, students with MLD in Mumbai are eligible for "provisions," or accommodations, ranging from extra time to dropping math after 8th standard (Karande, 2008; Karande & Gogtay, 2010; Kulkarni, et al., 2006; MDA, 2014). These provisions were originally intended to function as a "corrective lens" to help students with LD continue in regular education (Karande, n.d., slide 28; Karande, Sholapurwala, & Kulkarni, 2011, p. 516). Although these provisions, or accommodations, were envisioned to "level the play(ing) field" in secondary school, they can actually lead to gaps in math content knowledge and set students up for failure when these students transition to junior college (11th and 12th standard) and degree college (Karande, 2008, p. 75). Additionally, there is low awareness among teachers and parents, and many students in Mumbai are not diagnosed with MLD or other learning disabilities until 8th standard or later (Karande & Gogtay, 2010). By this time, it is difficult to remediate the many misconceptions that students have formed about mathematical ideas.

In higher secondary education (11th and 12th standard) math is an elective subject. Students in both Higher Secondary Certificate (HSC – Maharashtra state board) and Indian School Certificate (ISC) junior colleges can opt out of mathematics. However, once students finish junior college (12th standard) and they pursue a Bachelor's degree in post-secondary educational institutions (degree colleges), students may need to take a required math course, depending on their degree program. So although there is a (non-math) course substitution, such as Secretarial Practice in HSC-affiliated junior colleges, which serves as a program accommodation, students may still have to take a math course later on in their academic career (Madaus, 2010). For instance, if a student pursues a Bachelor's degree in Commerce, a math course is required in the first year.

Students with MLD in India may enter secondary school without the foundation required for higher-level mathematics, including conceptual understanding of math, mastery and automaticity of basic math facts and skills, and problem-solving strategies. Yet, math lecturers in higher secondary education assume and expect that students have already acquired the needed foundational knowledge and skills in previous classes.

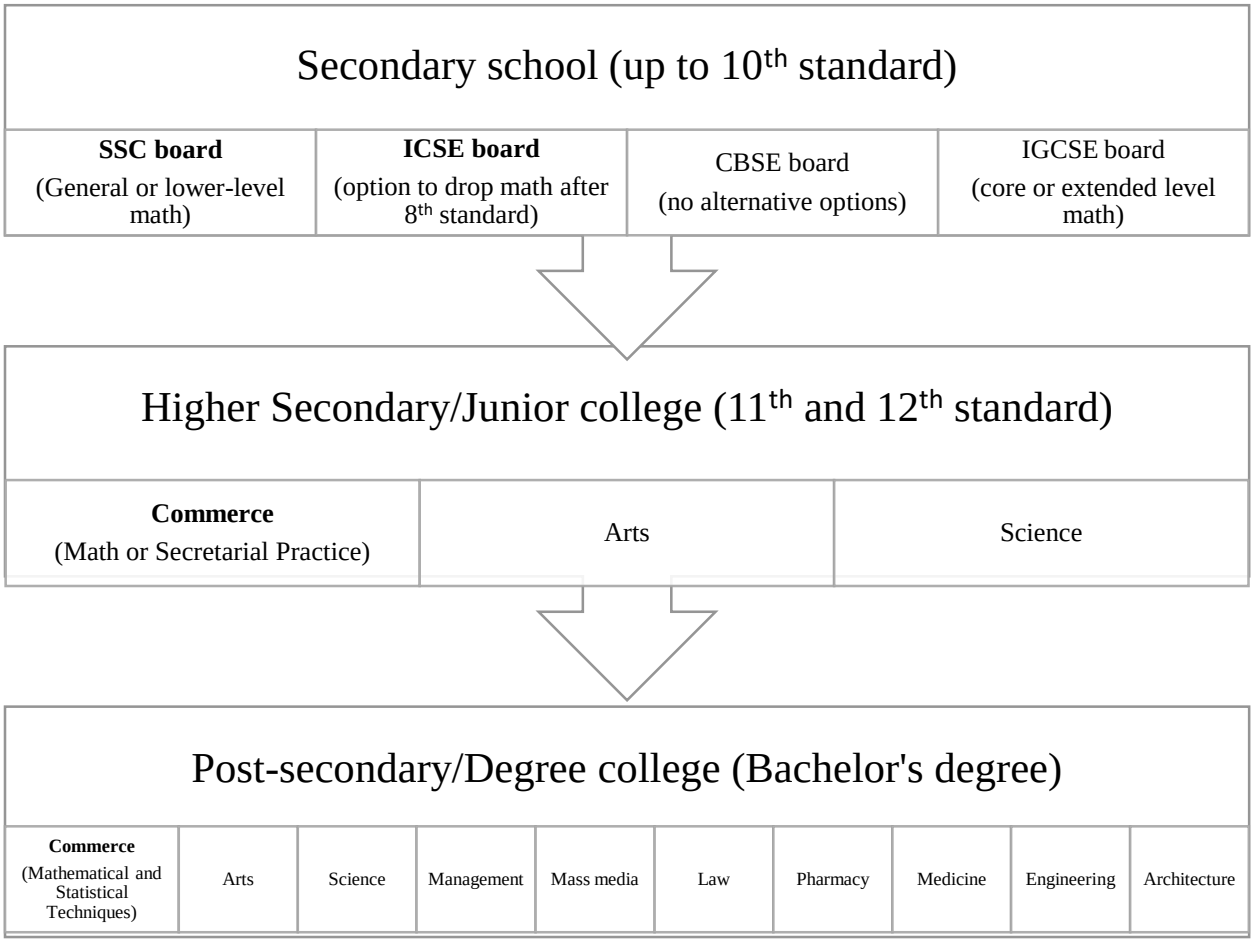

Figure 1. Pathway to post-secondary education for students in Mumbai, Maharashtra. The students in this sample studied in SSC board and ICSE board schools in secondary school. This study focused on students with learning disabilities that had entered or completed the Commerce stream and their math course options.

Mathematics and the Transition to Post-Secondary Education

Pursuing higher education improves a student's chances of a higher income, opportunities for career advancement, achieving status, and becoming part of a life-long professional network (Wehman & Yasuda, 2005). However, students with MLD are at a great disadvantage in pursuing post-secondary education and job options since they typically lag behind their peers in conceptual and procedural understanding of math knowledge, skills, and problem solving. According to Ramaa & Gowramma (2002), nearly half of the Indian students with MLD also have a learning disability in reading and writing. Although students with math learning disabilities in India have a complex profile of strengths and challenges, their difficulties in math may limit their options and opportunities within postsecondary education (Pennini, 2006). On the whole, very little is known about the transitional experience of post-secondary

students with MLD in India. This study begins to address this knowledge gap.

Theoretical/Conceptual Framework

The theoretical framework of critical theory in education was used to reflect on the way policies and practice affect students with MLD, and can actually disempower them, as well contributing to marginalization and exclusion (Arnesen, Mietola, Lahelma, 2007; Erevelles, 2005; Peters, 2005). Specifically, this article used insights from the intersection of critical pedagogy and disability studies in education to analyze the ways Indian educational policies and practices deny access to math content for people of various abilities (Gabel, 2002). For instance, if education is viewed as a "practice of access," then all students should have access to the curriculum and learning opportunities (Baglieri, Valle, Connor, & Gallagher, 2011, p. 272). However, pulling students out of the regular classroom, tracking, and offering certain accommodations, will continue to separate them, mark them as different or disabled, and can limit their access to the curriculum and opportunities to learn (Baglieri, Valle, Connor, & Gallagher, 2011). This pattern of distinctions creates systems and norms that include or exclude students, based on their ability (Popkewitz, 2001).

Additionally, current methods of identifying students as having a learning "disability" are problematic. The eligibility criteria make judgements between what is "normal" and what is a learning "disability," and often categorizes students - attaching a stigma to their identity (Baglieri, Valle, Connor, & Gallagher, 2011; Goffman, 1963). Because learning disabilities are an invisible disability, students may reject accommodations to conceal their label and avoid the stigma, which Goffman (1963) calls "information control" (p. 91). Students may or may not be willing to embrace this aspect of their identity, based on how they imagine others will perceive them (Schifter, 2015). However, all human differences and diversity is normal, including the continuum of math abilities (Baglieri, Valle, Connor, & Gallagher, 2011). Yet, general educational systems, especially those in India, are inflexible (Hehir, 2015b). Instead of questioning the norms of educational systems, students' disabilities, or differences, are seen as the problem. So often, the "'problem' of disability" is seen as being the student's fault, instead of questioning why institutional norms and classroom practices have not been changed (Hehir, 2015a, p. 181).

In this article, therefore, the Indian education policy and college practices toward students with learning disabilities are viewed as inflexible systems which do not allow for diversity of mathematical abilities. Each finding is examined in light of this critical theory framework, emphasizing the ways students with MLD are denied access to mathematical content through current policy and practice.

Methodology

Setting and Participants

This study took place in Mumbai (formerly Bombay), India's most populous city between April 2012 and November 2013. Mumbai is located in the state of Maharashtra. The approximate population of the Mumbai Metropolitan Region (comprising Mumbai, Navi Mumbai, Thane, Vasai-Virar, Bhiwandi and Panvel) is nearly 21 million, according to the 2011 census (Press Information Bureau, Government of India, 2011). The students in this study are from predominately middle and upper-middle class areas of Mumbai.

Five secondary students were selected for in-depth case studies (one male in 8th standard, two females and one male in 9th standard, and one 10th standard female). All of these students had been tested for LD at MDA, so they were

familiar with the organization. These students were chosen based on their ability to express themselves verbally and the parents' willingness to be involved in this research.

Six adults (five male and one female) with learning disabilities with a Bachelor's degree were also interviewed. They had received remedial or testing services at MDA or responded to our requests for participants through the Indian Psychological Association list-serv. Pseudonyms have been used for all participants with learning disabilities.

Permission was obtained to interview college math lecturers and administrators where MDA had some prior affiliation or personal connection. Other prominent colleges in south Mumbai and in the suburbs that offered degrees in Commerce were contacted. All college names and lecturer names are pseudonyms.

Semi-structured interviews were conducted with college lecturers and administrators (n = 18) in seven colleges. Additional lecturers (n = 28) in four of the seven colleges were also asked to complete a survey (appended). The surveys gathered descriptive information about the lecturers and their views of the transition experience. Six observations were conducted with an in math courses in two of the colleges using an observation protocol. A document review was completed of government resolution circulars in Maharashtra, which outline the exam accommodations and quotas that are required for students with learning disabilities, as well as college and university math syllabi from Maharashtra State Board of Secondary and Higher Secondary Education (MSBSHSE, Pune) and Mumbai University.

Results

Accommodations and Supports for Students with MLD in Secondary and Post-Secondary Education

Secondary school counselors have advised students with MLD to drop math or take lower-level math as early as possible (sometimes after 7th standard) (A. Kumar, personal communication, November 27, 2012). Yet, college lecturers (both at the junior college and degree college level) recommend that all students take math throughout their academic career (K. Kapoor, personal communication, January 21, 2013). Students who have been counseled to drop math or take a lower level math by secondary school counselors may not know all of the ramifications of their choice according to Mr. Kumar: "Since we cannot change the syllabus, we can change the way we counsel students about math courses, especially secondary school counselors" (A. Kumar, personal communication, November 27, 2012). In other words, educational professionals can advise students to make informed choices about dropping math or continuing their study of mathematics, based on their desired educational and career path, but don't.

Once students complete secondary school (10th standard), they can enter higher secondary studies by attending a junior college. The choice of stream (Arts, Commerce, or Science) is very important to students in junior college, and can limit their future education and career options. For example, students who enter the Arts stream in junior college may only complete a Bachelor of Arts (B.A.) or a Bachelor's in Mass media degree in degree college (M. Bose, personal communication, February 18, 2013).

Most junior colleges in Maharashtra are affiliated with the Higher Secondary Certification Board (HSC). When secondary students with MLD transition to a HSC junior college, they receive an accommodation of half an hour extra time on each exam (two hours in duration) and do not have to draw figures. If the student fails the exam, he/she gets "20 grace marks to pass the exam" (Government of Maharashtra Higher & Technical Educational Department, 2004, p. 1). Grace marks are extra points given to students who meet a certain criteria to help equalize their opportunity for

success, as opposed to grading on a curve for all students. Student with MLD can apply these grace marks to one subject, or spread them across subjects. Students identified as having a MLD are not penalized for number reversals (Government of Maharashtra Higher & Technical Educational Department, 2004). Degree colleges (for Bachelor's and Master's degrees) are affiliated with the University of Mumbai. The same accommodations listed for the junior colleges above are available at the degree college level (MDA, 2014).

If students apply for the LD accommodations in higher secondary and post-secondary education, they have to take their exams in a separate room to receive extra time. Vinod did not want to seem different from his peers, so he did not ask for accommodations in college for his learning disabilities:

> *It is not always so easy to ask for help. If you get provisions, then you have to take your exam in a different room. You will be seated in the roll number order during the exam. People will notice you aren't there and they will ask you, "Why didn't you give your exam?" "Where were you?" No one was aware that I had a learning disability in college.*
>
> (Vinod, personal communication, April 25, 2013)

If students have difficulty understanding the math concepts in junior college and degree college, most lecturers will offer extra classes. However, these are open to all students and are not remedial classes. The lecturer might be able to give more attention to students, but he/she does not use alternative teaching methods to explain the concepts. Only a few colleges in south Mumbai offer special "dyslexia cells." These "cells," or programs, are primarily for support services for students with learning disabilities (A. Kumar, personal communication, November 27, 2012; R. Archarya, personal communication, February 11, 2013; Getzel & Thoma, 2008). Some students chose not to self-disclose their learning disability to postsecondary faculty and do not avail the provisions (Getzel, 2008).

Post-college adults remarked that they felt scared to ask lecturers for help during college. Some of these overcame their fears during degree college due to strong self-determination skills, yet others reported feelings of being judged by lecturers and were afraid of what their peers might think if they found out they had learning disabilities. One lecturer mentioned that students in his college were afraid to meet him for extra help during school hours:

> *Most students with LD do not disclose their diagnosis. They get bullied. Other students are very strong and harsh towards students with LD. In fact, many students do not want to meet me during school hours, for fear that their peers might see them getting extra help.*
>
> (A. Kumar, personal communication, November 27, 2012)

Participants with MLD are also impacted by the level of support in their home and school environment. Students with MLD in this sample, such as Vaibhav and Kunal, had access to remedial education and private tutoring. Kunal reported how he passed the Mathematical and Statistical Techniques course:

> *I took Secretarial Practice (S.P.) in junior college, so I had a gap of 2 years with no mathematics. Plus, I wasn't really comfortable with math in the first place. During my first year of B. Com., I had a private tutor. He came to my house three days a week and taught me for two hours. Then, he gave me homework and practice problems. For six days a week, I studied math. I had to work really hard at math. . . . . if you dedicate your time, and study for three hours a day, you can easily get 18*

> *marks on a 50 mark paper (which is 36%, just enough for the passing rate of 35%).*
> (Kunal, personal communication, March 13, 2013)

Kunal was solely focused on passing the class. Certain colleges, like Shri Ram, offer special programs for students with learning disabilities. Thus, students with MLD can be further supported for post-secondary success and their math abilities, depending on their environment.

However, many students with MLD have difficulty meeting post-secondary mathematics demands. Students with MLD may have conceptual gaps in understanding, visual-spatial deficits and/or difficulties with word problems. Due to the hierarchical nature of mathematics, students with MLD are not prepared for post-secondary math demands if they have fallen behind their peers in primary and secondary school (Strawser & Miller, 2001). The government of Maharashtra and the Higher Secondary Certificate Board have attempted to put some supports in place for students with MLD in the post-secondary setting, such as curricular accommodations and exam concessions. If the current accommodations are viewed through the lens of critical theory, they are performing an exclusionary role. In other words, students with MLD are excluded from math content and pre-requisite skills in secondary school, such as algebra, which are required for a degree college math course. The current policies for students with MLD are a quick fix, but ignore the root of the problem - gaps in math content and foundational skills.

College Policies and Procedures in Mathematics and the Effect on Students with MLD

In junior colleges, there is a 3% quota (or reservation) for admission to 11th standard for physically handicapped students, which includes visually impaired students, speech and hearing impaired students, and students with orthopedic disorders and learning disabilities (dyslexia, dysgraphia, and dyscalculia) (Maharashtra Secondary and Higher Secondary State Education Department, 2001). The 3% quota is based on merit, irrespective of the disability (M. Khan, personal communication, April 19, 2016). According to the syllabus for Standards 11 and 12, college students only have three compulsory subjects: English, Environment Education, and Health and Physical Education. Students can then choose four other electives (42 electives are listed in the syllabus) to complete the required coursework each year (Maharashtra State Board of Secondary and Higher Secondary Education, 2012).

However, at all of the colleges in this sample, students must choose, as one of their electives, either mathematics or Secretarial Practice (S.P.). S.P. requires no mathematical skill. The students need only to understand English (S.P. college lecturer, personal communication, December 19, 2012). S.P. does not serve as a mathematical subject option. It is an entirely unrelated subject. In some colleges, students have an open choice between Math and S.P.; yet other colleges have a cut-off score requirement in order to have access to math courses and all other students must take S.P.

At Ambedkar College, only students who have scored 87-88% on their 10th standard exam are eligible to enroll in 11th and 12th standard math classes. All other students take Secretarial Practice (S.P.) at Ambedkar (L. Ghose, personal communication, February 6, 2013). The case is the same at Singh College, except the acceptable passing percentage on the 10th standard exam is a little lower at 83% (or 125 out of 150). Only students who qualify for math based on their 10th standard exam score in math are eligible to enroll in math in 11th standard (V. Jha, personal communication, February 6, 2013). At St. Joseph Junior College, if a student took general math or lower-level math for their 10th standard

exam (an accommodation for students with MLD in the SSC Board), they are ineligible to enroll in 11th standard math (U. Jain, personal communication, January 21, 2013).

The degree college math lecturers reported that they expect students to have the prerequisite skills and knowledge from having taken math continuously through 12th standard (K. Kapoor, personal communication, January 21, 2013). A degree college math lecturer adamantly reported that students who take Secretarial Practice, then enroll in the Mathematical and Statistical Techniques course are not prepared for it: "These students have a lot of difficulty, especially with word problems. They have difficulty figuring out what is given, what is asked, applying formulas, like with profit percentage" (M. Bose, personal communication, February 18, 2013). A lecturer from Shri Ram College, as well as another lecturer from Ambedkar College, also reported that any secondary student that drops math is not prepared to take math at the college level (survey, February 18, 2013).

According to a review of the Mathematical and Statistical Techniques course syllabus and textbooks, students must have pre-requisite understanding of algebraic concepts, such as linear equations and functions (Welling, Saraph, and Diwanji, 2013; Joshi et al., 2011). Students must complete all of the math by hand in this course. Calculators are permitted for all students in degree college, but statistical software is not available in the colleges in this sample (Shri Ram College, observation, February 11, 2013). College math lecturers reported through surveys that the most important skills that students need for their classes are reasoning skills, problem solving skills, and algebraic concepts.

Considering the current practices of junior colleges through the lens of critical theory, students who take Secretarial Practice are denied access to pre-requisite math content required for a Bachelor's degree in Commerce based on their math abilities as measured by their 10th standard exam results. The seemingly simple choice between Secretarial Practice and mathematics in junior college may not be a choice at all, and may further reinforce systems of exclusion based on mathematical ability.

Discussion

Math learning disabilities do not disappear with time, and students with MLD will continue to face difficulties as they enter secondary school and higher secondary education (Mazzocco, Devlin, & McKinney, 2008; Vogel, Fresko, & Wertheim, 2007; Shalev, Manor, & Gross-Tsur, 2005). Students with MLD also need continued practice and review of foundational math skills (Fuchs et al., 2013). This suggests the need for continued instruction of critical component skills and math content in secondary and post-secondary education.

For students with MLD, the gap in math knowledge and skills may have started in primary school, due to their atypical understanding of math concepts and possible deficits in number sense, working memory, processing, and attention. Yet, these difficulties can be exacerbated for secondary students with MLD in Maharashtra due to current special education policies, including dropping mathematics (ICSE Board), taking a lower-level math exam (SSC Board), or applying 20 grace marks to a student's failed exam to enable them to pass (SSC Board). These policies are focused on helping students pass the 10th standard exams, but do not prepare them for post-secondary education. Instead, the current policies allow students to have gaps in critical component skills and math content. Students, parents, and secondary school counselors must understand the gap of necessary mathematical knowledge, skills, and strategies that will continue to widen if students take lower level math or drop math, and later on, take Secretarial Practice instead of math. Viewing this gap from

the lens of critical theory in education, when junior colleges force students into S.P., they are performing a gate-keeping role by excluding certain students from the opportunity to continue math instruction. Also, by offering a non-math substitute, like S.P., the junior colleges are continuing to marginalize students with MLD in the transition. If enrolled in S.P., students with MLD receive no re-teaching in critical mathematical skills during the two years of junior college. This limits their access to the mathematical curriculum, as well as restricts their opportunities to learn important math concepts required for a bachelor's degree in Commerce.

Lecturers in this sample reported that students who take Secretarial Practice instead of math during 11th and 12th standard are not prepared for the required math course for the first year of a Bachelor's degree in Commerce. Students with MLD that took Secretarial Practice in junior college, then opted for a bachelor's degree in commerce reported that they felt shocked and had to work extremely hard during the Mathematical and Statistical Techniques class in their first year (Vinod, personal communication, April 25, 2013; Kunal, personal communication, March 13, 2013). Some students are able to scrape by and pass, but others fail the math course and have to repeat the entire year. Lecturers for the degree college math course assume that students have taken math throughout their academic career and have the pre-requisite skills through 12th standard mathematics. Kunal reflected on his transition: "Math keeps coming back. I might have a gap of 2-3 years of no math, but then I have to take another course" (personal communication, March 13, 2013). It is as if math is haunting him throughout his educational experience.

These findings are consistent with current research on the hierarchical nature of mathematics and access to post-secondary education. According to Strawser & Miller (2001), students with MLD will not be prepared for post-secondary math demands, if they have fallen behind their peers in primary and secondary school. Also, students must have access to the general education curriculum and national standards to ensure positive academic outcomes and to prepare them for future steps (Maccini & Gagnon, 2002).

Lack of preparation for the Mathematical and Statistical Techniques course (required for a bachelor's degree in Commerce) may be due to the fact that students with MLD have not had access to or success in algebra, which has been referred to as an academic passport or a "gateway to expanded opportunities" (Impecoven-Lind & Foegen, 2010, p. 31; Fennel, 2008; Lacampagne, Blair, & Kaput, 1995; Maccini, McNaughton, & Ruhl, 1999). But, in order to succeed in algebra, students need a strong foundation in the prerequisite skills needed for algebra, such as fractions, decimals, percentages, ratio and proportion, problem solving, and even basic multiplication (Fennell, 2008). It is imperative that students with MLD in India have access to algebra so that they are not held back by the "gatekeeper" to educational and economic success (Impecoven-Lind & Foegen, 2010, p. 32).

Another reason for lack of preparation is that junior colleges are performing a gatekeeping role and excluding students, by enforcing an eligibility score for mathematics courses in junior college, based on students' performance on the 10th standard exam. When students are excluded from math in junior college, they lose additional pre-requisite skills that are required for the Mathematical and Statistical Techniques course in B.Com. If students fail this math course, they have to repeat the entire year of first-year B.Com., and many of them experience similar difficulties in accounts and economics later in the coursework (S. Parikh, personal communication, August 23,

2013). Considering the current practices of junior colleges through the lens of critical theory, students who take Secretarial Practice are denied access to pre-requisite math content required for a Bachelor's degree in Commerce based on their math abilities as measured by their 10th standard exam results.

These findings were consistent with other international research on students with MLD and transition to post-secondary education. Therefore, the findings may have practical implications for special education policy at the secondary and post-secondary level, as outlined below.

Conclusions and Recommendations

It is very difficult to repair foundational deficits in math understanding once the student reaches post-secondary education. Interventions are most effective when they are conducted early in a student's academic career (Dowker, 2005; Nelson & Sheridan, 2011; VanDerHeyden, 2008). Also, in the Indian educational system, students are not rewarded for understanding the math content or for increasing their mathematical literacy. Instead, the goal is to simply pass the exam or pass the course (usually by memorizing).

These findings suggest that current special education policy and junior college practices in Maharashtra do not prepare students with MLD for the math knowledge that they need to succeed in post-secondary mathematics. Although the current policy may enable students with MLD to pass the 10th standard exam, they, on average, lack critical component skills and math content required for post-secondary math courses. Also, students with MLD can be "forced" into taking Secretarial Practice for two years of junior college, excluding them from two additional years of math content and review of pre-requisite skills needed for the Mathematical and Statistical Techniques course in the Bachelor of Commerce degree program. Through the lens of critical theory, current policy and practice is segregating students with MLD and denying them of essential math content needed for certain degree college programs. The current system is very rigid and does not cater to individual students' needs, perhaps an artifact of an education system that must educate, uniformly, such a huge population.

In order to help MLD students be better prepared for secondary and post-secondary mathematics, there are three major systemic changes that can be instituted in the Indian education system. These systemic changes should include: professional development for primary teachers, multiple math course options in secondary and post-secondary education, and awareness training for teachers and lecturers at the secondary and post-secondary level.

First, primary school teachers should be provided with continued professional development that prepares them to identify students who are struggling with math early on and to use varied teaching methods to help students understand math concepts. Since the gap between students with MLD and typically achieving students emerges before they leave secondary school, primary teachers should identify students with math learning disabilities and difficulties in mathematics in the early stages of learning. The current practice of identifying students in 8th standard or later is difficult for intervention and the gap between these two groups of students will only widen in later years. For early intervention, teachers need math screening tools, multiple strategies to teach conceptual and procedural math skills, and knowledge and experience in math remediation. The Maharashtra Secondary School Certificate (SSC) Board and Maharashtra State Department of Education can be involved in facilitating early math screening in primary

schools (English-medium as well as vernacular-medium). Since the national government does not yet recognize learning disabilities, this information is not included in the Bachelor's degree in Education syllabus at this time. Therefore, teachers need additional pre-service and in-service training on identifying math difficulties and strategies for teaching students so they better understand math concepts early on and throughout primary and secondary school. Teacher educators and teachers need access to teacher guides that accompany the textbook and outline specific strategies for teaching students with misconceptions and atypical understandings in mathematics, keeping in large class sizes in mind. Professional development should include video examples of math remediation (since there are few experts in this area in India) in one-to-one, small group, and large group settings – so that teachers can observe methods of math remediation and snapshots of engagement with students with MLD. The National Council for Educational Research and Training (NCERT) has the capability to offer math remedial training through satellite and video conferencing to regional education institutes. The videos can also be uploaded on their website so that private school teachers can also view them.

Second, students with MLD need multiple math course options throughout their secondary and post-secondary education. Current curriculum Board policies allow students with MLD to drop math in secondary school (ICSE) or take a lower-level math exam without targeted instruction (SSC). However, secondary students with MLD need continued practice and review of foundational math skills, as well as access to the grade-level curriculum, to be prepared for post-secondary math demands (Strawser & Miller, 2001). Only one math class per standard, or year, is presently offered. Yet, the data suggests that students with MLD need more flexibility in math course options, including more time to complete all math tasks. Course options continue to be an issue for students with MLD in junior college. Students with MLD are not prepared for degree college mathematics because junior colleges are performing a gatekeeping role and excluding students, by enforcing an eligibility score for mathematics courses in junior college, based on students' performance on the 10th standard exam. When students are excluded from math in junior college, they lose additional pre-requisite skills that are required for the Mathematical and Statistical Techniques course in B.Com. The Higher Secondary Certificate (HSC) Board can examine the exclusive practices of Mumbai junior colleges in mathematics courses, as well as consider offering additional math courses to include students with various math abilities.

Third, secondary school teachers and college lecturers should be aware of learning disabilities as well, since the difficulties students with MLD have in math will not disappear as they transition from primary to secondary and on to post-secondary education. During the data collection, there were only a few lone lecturers that were aware of MLD and really wanted to advocate for these students, such as Professor Kumar at Ambedkar College. College administrators questioned the authenticity of learning disability certificates and thought parents were taking advantage of the system of concessions, or accommodations. Lecturers were unsure as to what MLD was and how it impacted students' learning. Post-college adults remarked that they felt scared to ask lecturers for help. One lecturer even mentioned that current students in his college are scared to meet him for extra help during school hours, for fear that their peers might see them and later bully them. The Maharashtra State Board of Secondary and Higher Secondary and Mumbai University need to take an active role in leading an awareness campaign. When teachers gain knowledge of learning disabilities and the students' need for

accommodations, they may form more positive attitudes towards these students (Karande, Sholapurwala, & Kulkarni, 2011; Saravanabhavan & Saravanabhavan, 2001). In turn, students may find the lecturers more approachable for help. Students with math learning disabilities need allies in learning – people who do not limit their achievement, but believe in intellectual growth and the talent of all students (Dweck, 2006). Additionally, teachers and lecturers can help typically achieving students to be more aware of the rationale behind the provisions and accommodations for students with learning disabilities, which may reduce bullying (Karande, Mahajan, & Kulkarni, 2009).

Implications for Policy Makers

These findings will be useful for inclusive education advocacy groups in India as they work with policy makers and enforcers at the national and state level, as they revise policy and procedures for students with learning disabilities in Maharashtra and India.

Future researchers can build upon the present work by investigating students with MLD from various socio-economic backgrounds in Maharashtrian government (vernacular-medium) schools, as well as considering degree programs in professional (Architecture, Engineering, etc.) and vocational (Management and Mass Media) streams. Additionally, educational researchers might explore special education policies in other Indian states.

Author Note

The author wishes to thank the Maharashtra Dyslexia Association in Mumbai for their support of this study.

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About the Author

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Appendix
Survey for College Lecturers

1. Which classes do you teach (include level)?
2. For how long have you been teaching at the college level?
3. Do you feel that secondary students are prepared to enter college?
   ☐ Yes ☐ No
4. Why or why not?
5. Overall, what skills do students have?
6. What skills do students need to improve on?
7. How many students are enrolled in your class?
8. On a typical day, how many students come to class?
9. What are the minimum criteria to pass in your college (actual test score, etc.)?
10. What methods of math instruction do you use in your class on a weekly basis (please tick all that apply)?
    ☐ Lecture ☐ Group work ☐ Solving sums during class
    ☐ Other, list here: _____
11. Do you give homework following your class?
    ☐ Yes ☐ No
12. If so, how much do you give per week?
13. What is your opinion about students' success:
    ☐ The student is responsible for his/her own success
    ☐ The college supports students in their academic success
14. Explain your choice above
15. Please rank the following math skills as low (L), medium (M), or high (H) – depending on which skills are most important in your field of study:
    - Algebra L M H
    - Geometry L M H
    - Statistics L M H
    - Trigonometry L M H
    - Calculus L M H
16. Please rank the following cognitive skills as low (L), medium (M), or high (H) – depending on which skills are most important in your field of study:
    - analytical skills L M H
    - interpretation L M H
    - precision and accuracy L M H
    - problem solving L M H
    - reasoning L M H
    - time management L M H
    - strategic study skills L M H
    - persistence L M H
    - ability to use study groups L M H
17. Do you allow students to use calculators in your class?
    ☐ Yes ☐ No
18. Why or why not?